Clinical Pathways

Community Acquired Pneumonia (CAP)

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An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.

Why is Pathway Necessary?



- US (2018): CAP is among the most common causes for hospitalization with an annual incidence of 15.7-22.5 hospitalizations per 100,000 children (at 124,000 hospitalizations annually)
 - o 2 million outpatient visits annually
- Word-wide: responsible for deaths of >800,000 children annually
- Variability in management
- In 2011, the Infectious Diseases Society of America (IDSA) and Pediatric Infectious Diseases Society released guidelines for CAP management in pediatrics

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

John S. Bradley,^{1,a} Carrie L. Byington,^{2,a} Samir S. Shah,^{3,a} Brian Alverson,⁴ Edward R. Carter,⁵ Christopher Harrison,⁶ Sheldon L. Kaplan,⁷ Sharon E. Mace,⁸ George H. McCracken Jr,⁹ Matthew R. Moore,¹⁰ Shawn D. St Peter,¹¹ Jana A. Stockwell,¹² and Jack T. Swanson¹³

Objectives of Pathway



- Decrease variation in antibiotic usage for CAP
- Decrease unnecessary use of broad spectrum antibiotics
- Decrease unnecessary use of azithromycin
- Decrease antibiotic usage to shortest effective duration





<1 year olds:

- Viruses
- Chlamydia trachomatis

<5 years old:

- Viruses (RSV; parainfluenza, flu, adenovirus, etc.) most common
- Bacteria (*Strep pneumoniae* most common; Hib (for unvaccinated); *S. aureus*)

≥5 years old:

- *Strep pneumoniae* most common
- S. aureus
- Mycoplasma, C. pneumoniae

Background – Definitions



The pathway now divides management for CAP into uncomplicated CAP and complicated CAP.

• Uncomplicated CAP:

Includes CAP with trace/small and moderate effusions

• Complicated CAP:

○ Free flowing pleural effusion >1/2 hemithorax on CXR (aka "large effusion")

Any sized loculated/septated effusion

 \circ Empyema

- \circ Abscess
- Necrotic lung
- Pneumatocele

Background – Definitions



"Under-immunized": fewer than <u>2 doses of Hib</u> vaccination

3rd dose of Hib vaccine only slightly increases protection

 1 Hib dose = 59% efficacy; 2 Hib doses = 92% efficacy;
 3 Hib doses = 93% efficacy

Epidemior milece 2012/hdg, 140(0). 1040-1000.	1 1000.1 1000404400
Published online 2012 May 14. doi: 10.1017/S0950268812000957	PMID: 22583474
Dose-specific efficacy of <i>Haemophilus influenzae</i> type b conjugate systematic review and meta-analysis of controlled clinical trials	e vaccines: a
<u>U. K. GRIFFITHS</u> , ^{1,*} A. CLARK, ² B. GESSNER, ³ A. MINERS, ² C. SANDERSON, ² E. R. SE K. E. MULHOLLAND ⁵	DYANINGSIH, ⁴ and

he Journal of Infectious Diseases
SUPPLEMENT ARTICLE



Hib Vaccines: Their Impact on *Haemophilus influenzae* Type b Disease _{Janet R Gilsdor}

• If *Strep pneumo* is the most common cause of CAP, why aren't we considering *Strep pneumo* vaccination rates when prescribing antibiotics?

Local susceptibility data (2018 onwards) show *Strep pneumo* isolates as 98-100% susceptible to amoxicillin, with low MICs (Minimum Inhibitory Concentration) → no longer concerned about needing higher doses, more frequent doses, or penetration of antibiotic (for uncomplicated CAP) if *Strep pneumo* is likely etiology





"Failure of outpatient treatment": now "progression of CAP despite appropriate therapy"

- CAP can progress at different rates while on appropriate therapy
- Strep pneumo can cause prolonged fevers
- "Failure" could be due to:
 - Poor adherence
 - $_{\odot}$ Insufficient time on antibiotic
 - Poor antibiotic absorption
 - Drug was not penetrating well due to development of a complication of pneumonia



We will be reviewing each component in the following slides.

CLINICAL PATHWAY: Community Acquired Pneumonia (CAP)



CONTACTS: IAN MICHELOW, MD | GRACE HONG, APRN | JENNIFER GIROTTO, PHARMD | ILANA WAYNIK, MD

Inclusion Criteria: ≥2 month old with suspected community acquired pneumonia (CAP)

Exclusion Criteria: <2 months old (see Fever & Sepsis in Neonate 0-28 Days Clinical Pathway, Fever & Sepsis in Infant 29-60 Days Clinical Pathway), signs of sepsis (see Septic Shock Clinical Pathway), immunocompromised, Cystic Fibrosis, non-Cystic Fibrosis bronchiectasis, Primary Ciliary Dyskinesia/Immotile Cilia Syndrome, sickle cell, concern for tuberculosis, tracheostomy in place, hospital acquired PNA, ventilator associated PNA

Inclusion Criteria:

• There is no longer an upper age limit

Exclusion Criteria:

- <2 month olds should be evaluated by the neonatal and infant fever pathways
- Any sign of shock will take priority and patient should be treated per the septic shock pathway
- Other exclusions may have less typical (or more resistant) organisms causing their pneumonia and should be treated off pathway

	$\mathbf{\lambda}$
	Confirmed CAP? NO Exit pathway. Consider alternative diagnosis.
Ÿ	YES
Uncomplicated CAP	Complicated CAP
(including pneumonia with trace/small and moderate effusions)	(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatoce
Patient fully immunited (i.e., received at least 2 does of Hb vaccine) grogregers in CAP de spite appropriate the regy or • Ampetilin N 200 mg/kg/day dir q6hr (max 2 g/does) or ammetilin P0 30 mg/kg/day dir q6hr (max 2 g/does) or • Morpiellin P0 30 mg/kg/day dir 3 does (max 2 g/does) or Grogregers of the D3 mg/kg/day dir 3 does (max 2 g/does) or • If PON allergy: Celtriaxone N 50 mg/kg daily (max 2 g/does) or Grogregers does (max 600 mg/doe) Patient not fully immunized (i.e., did not receive at least 2 doeses of the vacine) or geriation pneumonia supected: • Ampetilin/aulbactam IV 200 mg of ampidiin/kg/day dir 4 does (max 60 mg/doe)	Proference: Certriazone IV 75 mg/kg daily (max 2 g/dose) and Clindamycin M/PO 40 mg/kg/d dk 3 dose (max 600 mg/dose) Alterrative: Amgdillin/subactani IV 300 mg of ampidillin/kg/day dky q6hr (max 3 g of Umayn/dose) if additional aternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis Additional Considerations: If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive): O Diain MRSA hasal probeif not done (note: this test has a high negative predictive value o Consider adding avancomycin N:
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day daily (max 2 g/dose)	substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
 If aspiration pneumonia: start only Clindamycin IV/PO 40 	If concern for atypical pneumonia, pertu si s, COVID-19 or influenza: see Appendix A
mg/kg/day div 3 doses (max 600 mg/dose)	Consultations:
Additional Considerations:	Consult Infectious Diseases (ID)
 If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A 	Consult Surgery if large effusion or empyema
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Note:

Those with congenital heart disease, BPD, and neuromuscular diseases should now be **included** on this pathway as their etiology for CAP should not differ

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-	YES
Uncomplicated CAP	Complicated CAP
(including pneumonia with trace/small and moderate effusions)	(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocel
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T<mark>HIS PATHWAY</mark> SERVES AS A G<mark>UIDE</mark>

Initial Evaluation:

- *If moderate-large effusion:* consider obtaining ultrasound to evaluate for size of effusion and loculated/septated effusion
- If under immunized for Hib (i.e., did not receive at least 2 doses of Hib vaccine), progression of CAP despite appropriate therapy, severely ill, or complicated CAP (i.e., large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele):
 - Obtain CBC w diff, lytes, blood culture (aerobic), procalcitonin
 - For complicated CAP: add anaerobic blood cultures
- Consider adding: MRSA nasal swab if concern for MRSA pneumonia (abscess, cavitation, empyema, or necrosis), viral testing if virus is circulating (influenza, Sars-CoV-2 PCR, RSV; BIO FIRE only if concerned for pertussis, atypical pneumonia, or if result would change antibiotic management; see Appendix A)
 Note: If signs of sepsis, exit pathway and follow Septic Shock Clinical Pathway.

<u>CXR</u>

- We recommended obtaining CXR for all children presenting to the ED with suspected CAP.
- But we recognize:

CXR

- CXR can have low sensitivity in diagnosing CAP (particularly if uncomplicated)
- IDSA recommends against routine CXR, particularly in outpatient settings.
- IDSA recommends CXR in those who require admission or are more sick.

Patient fully immunized (i.e., received at least 2 doese of Hb vaccine) or progression of CAP despite appropriate therapy: • Ampkillin V 200 mg/kg/day (vi q6hr (max 2 g/does) or Ampkillin PO 30 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Hib vac one) or any intrion pneumonia suspected: • Ampkillin/subbactam IV 200 mg of ampicillin/kg/day div 2 doese (max 1 g/does) Lagrentin XR is not receive at least 2 doese of Hib vac one) or any intrion pneumonia suspected: • Ampkillin/subbactam IV 200 mg of ampicillin/kg/day div 2 doese (max 1 g/does) Lagrentin XR is not recommended] • if PCV divrgy: consult Infectious Diseases (10) for allergy considerations • if not fully immunized start only Cefuriasone IV 75 mg/kg/ day dai (ymax 2 g/does) • if day daily (max 2 g/does) • if asyntation pneumonia, start only Clindamycin M/PO 40 mg/kg/day div doese (max 600 mg/doe) • if concern for atypical pneumonia, pertussis, COVID-19 or influenz: see Appendix A	Preference: Ceftriacone IV 75 mg/kg daiy (max 2 g/dose) and Clindamycin IV/PO 40 mg/kg/day dk3 3 doses (max 600 mg/dose) Alternative: Ampdilln/subactam IV 300 mg of ampicillin/kg/day div g6hr (max 3 g of Um aşn/dose) if additional atternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis Additional Considerations: if concern for MSN (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive): Obtain MRSA nasal probe if not done (note: this test has a high negative predictive volue) Consider adding Vancomyon IV: - <22 weeks PMA/ Jabout 32 months da - 11 years old: 70 mg/kg/day div g6hr; 212 yrs old: 50 mg/kg/day div g6hr (*PAA/POst-Menstrual Age) = gestational age + postnaial age) - (if secure nearthine higher than expected for age, or charge is 70.3 mg/kl. over 48 hrs: substatute vancomycin with lines diff (10 10 mg/kg/day div q6hr (*PAA/POst-Menstrual Age) = (if secure nearthine higher than expected for age, or charge is 70.3 mg/kl. over 48 hrs: substatute vancomycin with lines diff (10 10 mg/kg/day div q6hr (21 yrs old) for Consult for dar age effusion or emyrema Consult infectious Diseases (ID) Consult infectious Diseases (ID) Consult infectious Diseases (ID)
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CXR

Consider adding: MRSA nasal swab if concern for MRSA pneumonia (abscess, cavitation, empyema, or necrosis), viral testing if virus is circulating (influenza, Sars-CoV-2 PCR, RSV; BIO FIRE only if concerned for pertussis, atypical pneumonia, or if result would change antibiotic management; see Appendix A)
 Note: If signs of sepsis, exit pathway and follow Septic Shock Clinical Pathway.

Lung Ultrasound

- Lung ultrasounds have better sensitivity with similar specificity to CXR
- CT Children's processes support CXR first, then ultrasound if there is a moderate-large effusion seen on CXR
- Ultrasound will help evaluate effusion size and if presence of loculated/septated effusion

Patient fully immunic dd (i.e., received at laast 2 does of 1 His vacche) or progression of CAP depits perport at the therapy. Ampoillin V 200 mg/kg/day div 2 does imas 1 g/does) gr. Amork tillin V 200 mg/kg/day div 2 does imas 1 g/does) gr. Clindamycin IIV/PO 40 mg/kg/day div 3 does (imas 1 g/does) gr. Clindamycin IV/PO 40 mg/kg/day div 3 does (imas 600 mg/does) Patient not fully immuniced (i.e., did not receive at least 2 doese of His vaccine) gr agi ration p neuronia sup ected: Ampoillin (Jacobi (i.e., did not receive at least 2 doese of His vaccine) gr agi ration p neuronia sup ected: Ampoillin (Jacobi (Jacobi (i.e., did not receive at least 2 doese of His vaccine) gr agi ration p neuronia sup ected: Augmentin E SP 0 (000 mg/s) mil 90 mg amork/gd/day div 2 doese (mas 1 g/does) / Augment XR is not recommended] If POV diregy: consult infectious Diseases (10) for allergy consideration: If not fully immuniced, start only Clindamycin IV/P0 40 mg/gl/day div 3 does (max 000 mg/doe)	 Parference: Ceftrikanone IV 75 mg/kg dally (max 2 g/dose) and Clindamycin IV/PO 40 mg/kg/day di y doses (max 600 mg/kg/dose) Alternative: Amgdilln/subactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Umsayn/dose) if additional alternatives needed: Infectious Diseases (ID) will discuss on a case by case basis Additional Condensions: if cancern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive): Obtain MRSA nasal probe if not done (note: this test has a high negative predictive value) Consider adding Yancomycin M: < <22 weeks PMA/ Jabout <23 mond d.15 mg/kg q6hr or as determined by pharmacy based on estimated AUC; <22 weeks PMA/Jabout <23 months id = 11 wers dd: 70 mg/kg/day div q6hr; 212 wrs old: 70 mg/kg/day div q6hr; 212 wrs old: 8 hrs: substitute vancomycin with lines ddi 11 van gRg/sde g8hr (17MA (Post-Menstrual Age) e gestational age + postnail age); If seum creativine higher than expected for age, or charge is >0.3 mg/di. over 48 hrs: substitute vancomycin with lines did 11 van gRg/sde g8hr (121 kg 12 kg vs ol);
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Blood Work

- Blood work and cultures are not routinely indicated, even if the child is hospitalized
- Blood work and cultures are reserved for those who are at more risk for less common organisms, more resistant organisms, and those with complicated CAP

Be mindful of diagnostic stewardship!

Patient not fully immunized (i.e., ddi not receive at least 2 doces of Hib vacrie (v) ize piration pneumonia suspected: • Ampletilin/subactam IV 200 mg of amploilin/kg/day div q6hr (max 3 g of unasyn/doce) gz • Augmentin E SP0 (600 mg/s ml) 30 mg amox/kg/day div 2 doces (max 1 g/doce) [Augmentin X H is not recommended] • If OPX diregy: consult infectious Desase (10) for allergy considerations: • 0 if or diffy immunized start only Ceftriaxone IV 75 mg/kg/ day daily (max 2 g/doce) • If group direction of the safe (10) for allergy considerations: • 0 if or diffy immunized start only Ceftriaxone IV 75 mg/kg/ day daily (max 2 g/doce) • If group direction of the safe (10) conditional Considerations: • 1 (concern for axypical pneumonia, pertussis, COVID-19 or influenca: see Appendix A	dik 3 daese (max 600 mg/daee) • Merentive: Ampallinkysubactam IV 300 mg of ampaldlin/kg/day div q6hr (max 3 g of Urasyn/daee) If additional atternatives needed: Infectious Diseases (ID) will discuss on a case-by case basis Additional Considerations : • If concern for MSR (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive): • Obtain MRSA nasal probe if not done (note: this test has a high negative predictive value) • Consider adding Vancomycin W: • Consider adding Vancomycin W: • Case MRSA (hasta) probe if not done (note: this test has a high negative predictive value) • Consider adding Vancomycin W: • Case Veek SMA ⁷ (about <3 molds: 15 mg/kg/q3kh or as determined by pharmacy based on estimated AUC; ≥2 weeks MA ⁷ (about >3 months cid − 11 years old: 70 mg/kg/day dit of phir >21 xr sold: 16 mg/kg/day dit q8hr (PMA (Pose)-Kenstruial Age) = gestational age + postnasil age) • (f serum creatin he figher than expected for age, or change is >0.3 mg/kl over 48 hrs: substitute vancomycin with lines clid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yr sold) If concern for atypical pneumonia, pertu sis § COVID-19 or influenza: see Appendix A Consult functions Diseases (ID) • Consult functions Diseases (ID) • Consult function, obtain aerobic and anaerobic fluid cultures (send in capped syringe) • If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)
See discharge medications' below. No admiss Complete initial evaluation, if not already complete Continue antibiotics per discharge medication section Unation of antibiotics per discharge medication section Uncomplicated CAP: Consider stopping antibiotics for uncomplicated Complicated CAP: Consult infection solicates and surgery, if need Of Mobio Cores and Solicate and surgery, if need Of Mith Acoverage started, consider discontinuing	an below ² Progression of CAP despite appropriate CAP after 5 days of therapy, if clinically improved therapy Complicated
[Note: ensure patient is able to receive the antibiot	i days; moderate uncomplicated CAP; 5-7 days; mum (discusswith ID) listed above. to Cefurozime PO 30 mg/kg/day div 2 doses (max 500 mg/dcse) ic for home prior to discharge] w 3 doses (max 600 mg/dcse) <u>or</u> Cefdinir PO 14 mg/kg/day div 2 ill select appropriate artilibicits for discharge discharge

DNTACTS: IAN MICHELOW, MD | GRACE HONG, APRN | JENNIFER GIROTTO, PHARMD | ILANA WAYNIK, MD

HIS PATHWAY SERVES AS A GUI<mark>DE</mark>

Initial Evaluation:

• CXR

• If moderate-large effusion: consider obtaining ultrasound to evaluate for size of effusion and loculated/septated effusion

• If under immunized for Hib (i.e., did not receive at least 2 doses of Hib vaccine), progression of CAP despite appropriate therapy, severely ill, or complicated CAP (i.e., large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele):

- Obtain CBC w diff, lytes, blood culture (aerobic), procalcitonin
- *For complicated CAP*: add anaerobic blood cultures

Consider adding: MRSA nasal swab if concern for MRSA pneumonia (abscess, cavitation, empyema, or necrosis), viral testing if virus is circulating (influenza, Sars-CoV-2 PCR, RSV; BIO FIRE only if concerned for pertussis, atypical pneumonia, or if result would change antibiotic management; see Appendix A)

Note: If signs of sepsis, exit pathway and follow Septic Shock Clinical Pathway.

Blood Work

 If complicated CAP is present, anaerobic cultures should be added as patients are at more risk of having an anaerobic etiology

or progression of CAP despite appropriate therapy: Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) or Alternative: Ampicillin/sulbactam IV	
Ampicillin IV 200 mg/kg/dgg dig g6br (mgy 2 g/dose) or Alternative: Ampicillin /gullactore IV	
	300 mg of ampicillin/kg/day div q6hr (max 3 g of
Amoxicilin PO 90 mg/kg/day div 2 doses (max 1 g/dose) Una syn/dose)	
	s Diseases (ID) will discuss on a case-by-case basis
Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)	
Additional Considerations:	
	ed, recently colonized in last 6 months, nasal MRSA
lib vaccine) or aspiration pneumonia suspected: swab positive):	
	(note: this test has a high negative predictive value)
(max3g of unasyn/dose) or Consider adding Vancomycin IV:	
	old: 15 mg/kg q8hr or as determined by pharmacy
	reeks PMA ⁺ /about ≥3 months old – 11 years old: 70
	l: 60 mg/kg/day div q8hr [*PMA (Post-Menstrual Age}
considerations = gestational age + postnatal age	e]
	expected for age, or change is >0.3 mg/dL over 48 hrs:
	zolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
 If aspiration pneumonia: start only Clindamycin IV/PO 40 If concern for atypical pneumonia, pertus 	s, COVID-19 or influenza: see Appendix A
mg/kg/day div 3 doses (max 600 mg/dose)	
Consultations:	
Additional Considerations: Consult Infectious Diseases (ID)	
 If concern for atypical pneumonia, pertussis, COVID-19 or Consult Surgery if large effusion or empye 	na
influenza: see Appendix A o If drained, obtain aerobic and anaero	bic fluid cultures (send in capped syringe)
	/ ¹ Admission Criteria: /
Discharge home Meets	/ • Hypoxemia /
See discharge medications ² below.	/ <90% /
	Increased WOB/
Yes	respiratory
Ongoing Management	distress/
 Complete initial evaluation, if not already complete 	tachypnea
 Continue antibiotics and change to PO antibiotics, if clinically appropriate 	 Lethargy
 Duration of antibiotics per discharge medication section below² 	 Progression of
Uncomplicated CAP:	CAP despite
 If blood culture was obtained and positive, or there is no clinical improvement: consult infectious 	Diseases appropriate
 Consider stopping antibiotics for uncomplicated CAP after 5 days of therapy, if clinically improve 	therapy
Complicated CAP:	Complicated
 Consult Infectious Diseases (and surgery, if needed) if not already done 	CAP
 If MRSA coverage started, consider discontinuing if nasal MRSA screen, blood cultures and pleur 	
negative. If patient is unstable or MRSA is detected, discuss continuation of vancomycin with Inf	ctious Diseases. compliance
² Discharge Medications:	↓
Total duration of treatment: mild uncomplicated CAP: 5 days; moderate uncomplicated CAP: 5-7 days;	Discharge Criteria:
complicated CAP: 10 days minimum (discuss with ID)	O2 >90% on RA x12-24 hr
Uncomplicated CAP:	Decrea sed fevers for 24
 Continue (or change to) appropriate PO options as listed above. 	hours
Of IPAN alteray and placed on Ceftraixone IV: switch to Cefuroxime PO 30 mg/kg/day div 2 doses (max 500 mg/dose) Of Tolerating discharge	
[Note: ensure patient is able to receive the antibiotic for home prior to discharge]	antibiotics
 Alternatives: Clindamycin PO 40 mg/kg/day div 3 doses (max 600 mg/dose) or Cefdinir PO 14 	
docos (max 600 ms/dau)	
doses (max 600 mg/day)	
 If alternative antibiotics were selected with ID: ID will select appropriate antibiotics for discharge 	Compliance with treatment
If alternative antibiotics were selected with ID: ID will select appropriate antibiotics for discharge Complicate d CAP: ID will advise selection of antibiotics at discharge	Compliance with treatment Appropriate follow up in
 If alternative antibiotics were selected with ID: ID will select appropriate antibiotics for discharge 	Compliance with treatment

ONTACTS: IAN MICHELOW, MD | GRACE HONG, APRN | JENNIFER GIROTTO, PHARMD | ILANA WAYNIK, MD

- CXR
- If moderate-large effusion: consider obtaining ultrasound to evaluate for size of effusion and loculated/septated effusion
- If under immunized for Hib (i.e., did not receive at least 2 doses of Hib vaccine), progression of CAP despite appropriate therapy, severely ill, or complicated CAP (i.e., large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele):
 - Obtain CBC w diff, lytes, blood culture (aerobic), procalcitonin
 - For complicated CAP: add anaerobic blood cultures
- Consider adding: MRSA nasal swab if concern for MRSA pneumonia (abscess, cavitation, empyema, or necrosis), viral testing if virus is circulating (influenza, Sars-CoV-2 PCR, RSV; BIO FIRE only if concerned for pertussis, atypical pneumonia, or if result would change antibiotic management; see Appendix A)
 Note: If signs of sepsis, exit pathway and follow Septic Shock Clinical Pathway.

Blood Work: Procalcitonin (PCT)

- Procalcitonin rises faster, peaks sooner, decreases faster and is more specific for bacterial infections than CRP
- Procalcitonin has 30% sensitivity but 88% specificity for bacterial CAP (<u>high negative</u> <u>predictive value</u>)
 - If PCT is negative/low, there is a very low likelihood that there is a bacterial CAP
- A negative PCT is far more informative than a positive one!

→ do NOT start or broaden antibiotics just because of an elevated PCT!

og progresion of CAP despite appropriate therapy: • Ampicialin N 200 mg/kg/day div ghim ma'z g/dose) or Amoxicilin P 09 mg/kg/day div 2 doses (ma'z 1 g/dose) or · if PCV allergy: Ceftratione N 50 mg/kg/day div 2 doses (ma c600 mg/dose) Patient not tulk immunized (i.e., dit not receive at least 2 doses of Hib vac or b) or as printon pneumonia superted: • Ampicillin/subactam IV 200 mg of ampicillin/kg/day div 2 doses (mat 1 g/dose) largementia X is not recommended) • if PCV allergy: consult infectious Diseases (ID) for allergy considerations: • of addity immunized start only Ceftriaxone IV 75 mg/kg/ day daily (max 2 g/dose)) • of adjuir (max 2 g/dose) • of adjuir (max 2 g/dose) • dispiration pneumonia supert on Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose) Additional Considerations: • if concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A	dw 3 doese (max 60 mg/doe) • Meternative: Ampdillin/Subactam IV 300 mg of ampidilin/Kg/day div q6hr (max 3 g of Una syn/does) • If additional deternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis Additional Considen dons: • If concern for MSA (e.g., previoudly infected, recently colonized in last 6 months, nasal MRSA swab positive): • Obtain MRSA nasal probeil find to done (<i>note: this stex has a high negative predictive value</i>) • Consider adding Vancomyrin N: • . <22 weeks PMA ² /about: 4 mo ddt. 15 mg/fg q8hr or as determined by pharmacy based on estimated AUC; 52 weeks PMA ² /about: 5 mg/fs/gd/ad via q8hr (¹ PMA (Post-Menstrual Age) = gestational age + postnatial age) • . If serum creativise higher than expected for oge, or charge is 5 0.3 mg/dt over 48 frss: substitute vancemprion with linea (dd V U om g/kg/ddw e& q8hr (12 Let 22 vrs 60H) • If concern for atpixal gneumonia, per ta sis & COVD-19 or influenza: see Appendix A Consultations: • Consult Infectious Diseases (ID) • Consult surgery if large effusion or empyema • If drained, obtain aerobic and amarobic fuld cultures (send in capped syringe)
Complete initial evaluation, if not already complete Continue antibiotics and change to PO antibiotics, if Duration of antibiotics par discharge medication see Uncompleted CAP: Crastider stopping antibiotics for uncomplete Completed CAP: Cansider Stopping antibiotics for uncomplete (Entry of Cansider Stopping antibiotics for uncomplete Cansider Stopping antibiotics for uncomplete (Entry of Cansider Stopping antibiotics (Entry of Cansider Stopping) (Entry of Cansider Stopping	Meets Meets Sign criterag ¹¹
[Note: ensure patient is able to receive the antibie	 5 days; moderate uncomplicated CAP; 5-7 days; imrum (discuss with ID) bit dabove. to Ceturoatine PO 30 mg/kg/day div 2 doses (max 500 mg/dose) div 3 doses (max 600 mg/dose) or Cefdinir PO 14 mg/kg/day div 2 Increased a ctivity/appetite Baseline mentation Compliance with treatment Appropriate closer units

DNTACTS: IAN MICHELOW, MD | GRACE HONG, APRN | JENNIFER GIROTTO, PHARMD | ILANA WAYNIK, MD

• CXR

- If moderate-large effusion: consider obtaining ultrasound to evaluate for size of effusion and loculated/septated effusion
- If under immunized for Hib (i.e., did not receive at least 2 doses of Hib vaccine), progression of CAP despite appropriate therapy, severely ill, or complicated CAP (i.e., large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele):
 - Obtain CBC w diff, lytes, blood culture (aerobic), procalcitonin
 - For complicated CAP: add anaerobic blood cultures

Consider adding: MRSA nasal swab if concern for MRSA pneumonia (abscess, cavitation, empyema, or necrosis), viral testing if virus is circulating (influenza, Sars-CoV-2 PCR, RSV; BIOFIRE only if concerned for pertussis, atypical pneumonia, or if result would change antibiotic management; see Appendix A) Note: If signs of sepsis, exit pathway and follow Septic Shock Clinical Pathway.

Additional Testing: MRSA

- MRSA testing should only be sent if concern for MRSA pneumonia (e.g., abscess, cavitation, empyema, or necrosis)
 - Do not send for uncomplicated CAP
- MRSA nasal swabs have a poor positive predictive value but excellent negative predictive value
 - A negative swab means you can stop MRSA coverage (if started)

Patient fully immunited (i.e., received at least 2 does of tib vaccine) or progression of CAP despite appropriate therapy: • Ampkillin V 200 mg/kg/day (vi q6hr (max 2 g/does) or Ampkillin PO 30 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 2 g/does) or Clindamycin IV/PO 40 mg/kg/day (vi q6hr (max 3 g of mayor)/does) or (max 3 g of mayor)/does) or Amagentin 5 PO (cio mg/S ml) 30 mg amoc/kg/day (vi 2 does (max 1 g/does) [Augmentin X His not reconvended] • // POA viewy: consult infectious Diseases (D) for allergy considerations 0 mg/s mg/s mg/s mg/s mg/s mg/s mg/s mg/s	 Pardemone: Certritoxone IV/25 mg/kg dubly (max 2 g/dose) and Clindamycin V/PO 40 mg/kg/day div 3 dose; max 600 mg/dose) Alternative: mg/dlin/sublactam IV 300 mg of ampicilin/kg/day div q6hr (max 3 g of Umsyn/dose) if additional atternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis Additional Considersitions: if concernitor MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA svab positive); Obtain MRSA nasal probei f not done (note: this test has a high negative predictive value) Consider adding Vancomycin M; < < weak NMA¹/about: 3 mo dd. 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; S22 weeks MA¹/about: 23 months dd - 11 years dds 70 mg/kg/day div q6hr (7MAA (Post-Menstrual Age) e gestational age - postnaia age; if serum creatmine higher than expected for age, or chang ets >3.3 mg/ks over 8 hrs; substrue vancomycin with lines (dd 10 Umg/kg/dose q8hr (q12-3 mg/ks over 8 hrs; substrue vancomycin with lines (dd 10 Umg/kg/dose q8hr (q12-3 mg/ks over 8 hrs;
ng/kg/day div 3 doses (max 600 mg/dose) Additional Considerations: I if concern for atypical preumonia, pertussis, COVID-19 or influenca: see Appendix A Discharge home. See discharge medications' below. No Complete initial evaluation, if not already complete Continue and bricts and change to P0 antibilities, if it Duration antibicities per discharge medication set Uncompleted CAP: I if boda culture was obtained and positive, or th Consider stopping antibicits for uncompletate Completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicits for uncompletate I completed CAP: I consider stopping antibicity for uncompletate I completed CAP: I consider stopping antibicity for uncompletate I completed CAP: I consider stopping I	tion below ² Progression of CAP despite appropriate appropriate there is no clinical improvement: consult infectious Diseases appropriate therapy Complicated
[Note: ensure patient is able to receive the antibio	 5 days; moderate uncomplicated CAP: 5-7 days; imum (discuss with ID) 5 by: moderate uncomplicated CAP: 5-7 days; 0 2>90% on RA x12-24 hr Decrasa eff evens for 24 hours to Ceturoxine PO 30 mg/kg/day div 2 doses (max 500 mg/dose) to Ceturoxine PO 30 mg/kg/day div 2 doses (max 500 mg/dose) Tolerating discharge antibiotics div 3 doses (max 600 mg/dose) or Cefdinir PO 14 mg/kg/day div 2 Baseline mentation Compliance with treatment 4 discharge Compliance with treatment

DNTACTS: IAN MICHELOW, MD | GRACE HONG, APRN | JENNIFER GIROTTO, PHARMD | ILANA WAYNIK, MD



• CXR

- If moderate-large effusion: consider obtaining ultrasound to evaluate for size of effusion and loculated/septated effusion
- If under immunized for Hib (i.e., did not receive at least 2 doses of Hib vaccine), progression of CAP despite appropriate therapy, severely ill, or complicated CAP (i.e., large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele):
 - Obtain CBC w diff, lytes, blood culture (aerobic), procalcitonin
 - For complicated CAP: add anaerobic blood cultures

Consider adding: MRSA nasal swab if concern for MRSA pneumonia (abscess, cavitation, empyema, or necrosis), viral testing if virus is circulating (influenza, Sars-CoV-2 PCR, RSV; BIOFIRE only if concerned for pertussis, atypical pneumonia, or if result would change antibiotic management; see Appendix A) Note: If signs of sepsis, exit pathway and follow Septic Shock Clinical Pathway.

Additional Testing: Viral

- Viral testing for influenza, Sars-CoV-2, and RSV is indicated if the virus is circulating
- Respiratory BIOFIRE should **only** be sent if there is a specific concern for pertussis, atypical pneumonia, or if the result would alter management
- Do NOT send respiratory BIOFIRE to simply obtain more information

Patient fully immuniced (i.e., received at kast 2 does of Hb vaccine) or progression of CAP despite appropriate thereavy: • Ampiciliin N 200 mg/kg/day div 2 does (max 1 g/does) or Amoxičilin P0 300 mg/kg/day div 2 does (max 1 g/does) or Clindamycin U/PO 40 mg/kg/day div 3 does (max 1 g/does) or Clindamycin U/PO 40 mg/kg/day div 3 does (max 600 mg/does) Patient not fully immunized (i.e., ddi not receive at least 2 does of Hib vaccine) or aspiration p neumonia suspected: • Ampiciliin LS 200 mg/S mg/does) or (immax 3 g of unasyn/does) or (immax 1 g/does) (Jaugmentin X R is not recommended) • (JPON dinery: consult infectious Dbeases (D) for allergy	 Proference: Certriaxone IV 75 mg/kg dally (max 2 g/dsse) and Clindamycin V/PO 40 mg/kg/day div 3 does (max 600 mg/kg/day) Alternative: mapcillin/subactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Umas yn/dsse) if additional afternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis Additional Considem dons: If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swabp potitive): Obtain MRSA nasal probeil font done (nate: this test has a high negative predictive vake) Consider adding Vancomycin N: Cay Sueks PMA/shout <3 molds to did. Is mg/kg dBhr or as determined by pharmacy based on estimated AUC; 252 weeks PMA/shout <3 months of d-11 years dd. 70 mg/kg/dd yn ddhr [PMA (Poec Mexintual Age)
considerations of float cliff immunized: start only Ceftriaxone IV 75 mg/kg/ day daily (max 2 g/dose) of floagination pneumonia: start only Clindamydin IV/PO 40 mg/kg/day db/3 does (max 600 mg/dose) Additional Considerations: e If concern for atypical meumonia, pertussis, COVID-19 or influenza; see Appondix A	= gestational age + postnatal age] • Jf serum creatinate higher than expected for age, or charge (s >0.3 mg/dt, over 48 hrs: substitute vancomycin with linear did iV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old) • If Concern for abpical pneumonia, pertu sis § COVD-19 or influenza: see Appendix A Consultations: Consult Infectious Diseases (ID) Consult Infectious Diseases (ID) Consult Infectious Diseases (ID) Consult Infectious Disease (ID) Consult Infectious Disease (ID)
Complete initial evaluation, if not already complete Continue antibiotics and change to PO antibiotics, if Duration of antibiotics per discharge medication see Uncomplicated CAP: o If blood culture was obtained and positive, or t Consider stopping antibiotics for uncomplicate Complicated CAP: o Consist Infectious Disceases (and surgery, if nee Consister Infections)	tion below ² Progression of CAP despite appropriate there is no cfrical improvement: consult infectious Diseases d CAP after 5 days of the rapy, if clinically improved ded ji fnot al ready done (CAP infinand IMR5 storem, blood cultures and pleural cultures are concern for
² Discharge Mee Total duration of treatment: mid uncomplicated CAP complicated CAP: 10 days mi Uncomplicated CAP: Continue (or change to) appropriate PO options a of tPOV allergy and placed on Caffrixone VV: switch [Note: ensure patient is all to receive the antibility]	5 days; moderate uncomplicated CAP: 5-7 days; imum (discuss with ID) Sited above. 10 Ceturoxine PO 30 mg/kg/day div 2 doses (max 500 mg/dcse) div 3 doses (max 600 mg/dcse) <u>or</u> Cefdinir PO 14 mg/kg/day div 2 div 3 doses (max 600 mg/dcse) <u>or</u> Cefdinir PO 14 mg/kg/day div 2 will select appropriate antibiotics for discharge vill select appropriate antibiotics for discharge

DNTACTS: IAN MICHELOW, MD | GRACE HONG, APRN | JENNIFER GIROTTO, PHARMD | ILANA WAYNIK, MD

If CAP is confirmed, management will be divided by uncomplicated and complicated CAP.

 Etiology (and necessary antibiotics) depends on presence of complications of CAP rather than overall clinical severity

> → This means that a child in the PICU with an uncomplicated CAP can have their CAP managed with the same antibiotics as a child on Med/Surg floors with uncomplicated CAP.



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(including pneumonia with trace/small and moderate effusions)

Patient fully immunized (i.e., received at least 2 doses of Hib vaccine) or progression of CAP despite appropriate therapy:

- Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) or Amoxicillin PO 90 mg/kg/day div 2 doses (max 1 g/dose)
- If PCN allergy: Ceftriaxone IV 50 mg/kg daily (max 2 g/dose) <u>or</u> Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Patient not fully immunized (i.e., did not receive at least 2 doses of Hib vaccine) <u>or aspiration pneumonia suspected</u>:

- Ampicillin/sulbactam IV 200 mg of ampicillin/kg/day div q6hr (max 3 g of unasyn/dose) or
- Augmentin ES PO (600 mg/5 ml) 90 mg amox/kg/day div 2 doses (max 1 g/dose) [Augmentin XR is not recommended]
- If PCN allergy: consult Infectious Diseases (ID) for allergy considerations
 - If not fully immunized: start only Ceftria xone IV 75 mg/kg/ day daily (max 2 g/dose)
 - If aspiration pneumonia: start only Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Additional Considerations:

• If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Uncomplicated CAP

 Management is divided based on immunization status of Hib, progression of CAP, or if aspiration pneumonia is suspected



CLINICAL PATHWAY:

Uncomplicated CAP

Remember:

- If the patient received at least 2 doses of Hib vaccine, they are considered fully immunized.
- *Strep pneumo* strains are highly susceptible to amoxicillin with low MICs
- Those with progression of CAP on appropriate therapy (but still no complications of CAP present), may need more time to resolve while monitoring for complications
 - Assess fever curve (e.g., timing, how far they are spacing out) and presence of complications rather than simply broadening therapy

We can choose a lower IV ampicillin dose q6hr **or** high dose amoxicillin divided **BID** (rather than TID) (including pneumonia with trace/small and moderate effusions)

Patient fully immunized (i.e., received at least 2 doses of Hib vaccine) or progression of CAP despite appropriate therapy:

- Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) or Amoxicillin PO 90 mg/kg/day div 2 doses (max 1 g/dose)
- If PCN allergy: Ceftriaxone IV 50 mg/kg daily (max 2 g/dose) or Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Patient not fully immunized (i.e., did not receive at least 2 doses of Hib vaccine) <u>or</u> **aspiration pneumonia suspected:**

- Ampicillin/sulbactam IV 200 mg of ampicillin/kg/day div q6hr (max 3 g of unasyn/dose) or
- Augmentin ES PO (600 mg/5 ml) 90 mg amox/kg/day div 2 doses (max 1 g/dose) [Augmentin XR is not recommended]
- If PCN allergy: consult Infectious Diseases (ID) for allergy considerations
 - If not fully immunized: start only Ceftria xone IV 75 mg/kg/ day daily (max 2 g/dose)
 - If aspiration pneumonia: start only Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Additional Considerations:

PCN Allergies:

- Perform a thorough PCN allergy history!
 - Many patients have PCN allergy noted in chart but may only have mild delayed reactions
 - Often not true allergies
- Majority of patients with PCN allergy reported can tolerate a cephalosporin
 - Third generation cephalosporins are less cross-reactive with PCN
 - Or, can choose clindamycin
- Note: these alternatives are not preferred. Narrowest coverage with ampicillin or amoxicillin is ideal!

Uncomplicated CAP

(including pneumonia with trace/small and moderate effusions)

Patient fully immunized (i.e., received at least 2 doses of Hib vaccine) or progression of CAP despite appropriate therapy:

Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) <u>or</u>
 Amoxicillin PO 90 mg/kg/day div 2 doses (max 1 g/dose)
 If PCN allergy: Ceftriaxone IV 50 mg/kg daily (max 2 g/dose) <u>or</u>
 Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Patient not fully immunized (i.e., did not receive at least 2 doses of Hib vaccine) <u>or</u> **aspiration pneumonia suspected:**

- Ampicillin/sulbactam IV 200 mg of ampicillin/kg/day div q6hr (max 3 g of unasyn/dose) or
- Augmentin ES PO (600 mg/5 ml) 90 mg amox/kg/day div 2 doses (max 1 g/dose) [Augmentin XR is not recommended]
- If PCN allergy: consult Infectious Diseases (ID) for allergy considerations
 - If not fully immunized: start only Ceftria xone IV 75 mg/kg/ day daily (max 2 g/dose)
 - If aspiration pneumonia: start only Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Additional Considerations:

Not fully immunized for Hib:

- Need to cover Hib
- Hib produces beta lactamases → need beta lactamase inhibitors to target (e.g., clavulanate or sulbactam)
- Remember, we are no longer worried about Strep pneumo resistance. We don't automatically use ceftriaxone without a true PCN allergy!
- If there is a PCN allergy, consult ID to help assess if ceftriaxone is appropriate.

Uncomplicated CAP

(including pneumonia with trace/small and moderate effusions)

Patient fully immunized (i.e., received at least 2 doses of Hib vaccine) or progression of CAP despite appropriate therapy:

- Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) or Amoxicillin PO 90 mg/kg/day div 2 doses (max 1 g/dose)
- If PCN allergy: Ceftriaxone IV 50 mg/kg daily (max 2 g/dose) or Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Patient not fully immunized (i.e., did not receive at least 2 doses of Hib vaccine) or aspiration pneumonia suspected:

- Ampicillin/sulbactam IV 200 mg of ampicillin/kg/day div q6hr (max 3 g of unasyn/dose) or
- Augmentin ES PO (600 mg/5 ml) 90 mg amox/kg/day div 2 doses (max 1 g/dose) [Augmentin XR is not recommended]
- If PCN allergy: consult Infectious Diseases (ID) for allergy
 considerations



- *If not fully immunized*: start only Ceftria xone IV 75 mg/kg/ day daily (max 2 g/dose)
- If a spiration pneumonia: start only Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Additional Considerations:

(including pneumonia with trace/small and moderate effusions)

Patient fully immunized (i.e., received at least 2 doses of Hib vaccine) or progression of CAP despite appropriate therapy:

- Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) or Amoxicillin PO 90 mg/kg/day div 2 doses (max 1 g/dose)
- If PCN allergy: Ceftriaxone IV 50 mg/kg daily (max 2 g/dose) <u>or</u> Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Patient not fully immunized (i.e., did not receive at least 2 doses of Hib vaccine) or aspiration pneumonia suspected:

- Ampicillin/sulbactam IV 200 mg of ampicillin/kg/day div q6hr (max 3 g of unasyn/dose) or
- Augmentin ES PO (600 mg/5 ml) 90 mg amox/kg/day div 2 doses (max 1 g/dose) [Augmentin XR is not recommended]
- If PCN allergy: consult Infectious Diseases (ID) for allergy considerations
 - If not fully immunized: start only Ceftria xone IV 75 mg/kg/ day daily (max 2 g/dose)



If aspiration pneumonia: start only Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Additional Considerations:

 If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Uncomplicated CAP

Aspiration Pneumonia:

- Need to cover anaerobic oral flora
- If PCN allergy is present, consult ID
 - Ceftriaxone doesn't cover anaerobes
 - Clindamycin may be a good alternative but it does not have Hib coverage

Additional Considerations:

 If there is a concern for atypical pneumonia, pertussis, COVID-19 or influenza, Appendix A has more detailed information.

Uncomplicated CAP

(including pneumonia with trace/small and moderate effusions)

Patient fully immunized (i.e., received at least 2 doses of Hib vaccine) or progression of CAP despite appropriate therapy:

- Ampicillin IV 200 mg/kg/day div q6hr (max 2 g/dose) or Amoxicillin PO 90 mg/kg/day div 2 doses (max 1 g/dose)
- If PCN allergy: Ceftriaxone IV 50 mg/kg daily (max 2 g/dose) <u>or</u> Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Patient not fully immunized (i.e., did not receive at least 2 doses of Hib vaccine) or aspiration pneumonia suspected:

- Ampicillin/sulbactam IV 200 mg of ampicillin/kg/day div q6hr (max 3 g of unasyn/dose) or
- Augmentin ES PO (600 mg/5 ml) 90 mg amox/kg/day div 2 doses (max 1 g/dose) [Augmentin XR is not recommended]
- If PCN allergy: consult Infectious Diseases (ID) for allergy considerations
 - If not fully immunized: start only Ceftria xone IV 75 mg/kg/ day daily (max 2 g/dose)
 - If a spiration pneumonia: start only Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)

Additional Considerations:

Appendix A

<3 mo old with Chlamydia trachomatis

- Testing is difficult for *Chlamydia trachomatis* and ID will help navigate
- If it is proven, or strongly suspected, azithromycin therapy should be added

Special Considerations:

<3 month old with Chlamydia trachomatis:</p>

- Consult Infectious Diseases (ID)
- Send diagnostic tests as directed by ID
- If proven or strongly suspected: ADD azithromycin IV/PO 20 mg/kg x3 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Chlamydia pneumonia:

- ADD azithromycin IV/PO:
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Mycoplasma pneumoniae:

- Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall clinical course)
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

Documented Influenza:

- ADD oseltamavir PO:
 - Preterm neonates ≤40 weeks PMA: discuss dosing with pharmacy
 - Preterm neonates >40 weeks and term neonates up to 9 months: 3 mg/kg BID
 - ≥9 months up to 12 months: 3.5 mg/kg BID
- ≥12 months:
 - >15 kg 23 kg: 45 mg BID
 - >23 kg 40 kg: 60 mg BID
 - >40 kg: 75 mg BID

Suspect COVID-19

- Place on Special Precautions
 - ED/Inpatient COVID-19 Algorithm
 - Inpatient Therapies for COVID-19 Clinical Pathway



Special Considerations

Documented Pertussis at Any Age:

- Azithromycin IV/PO (monotherapy):
 - o <6 mo old: 10 mg/kg x5 days</p>
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

$_{\odot}$ 26 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Chlamydia pneumonia:

- ADD azithromycin IV/PO:
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Mycoplasma pneumoniae:

- Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall clinical course)
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

Documented Influenza:

- ADD oselta mavir PO:
 - Preterm neonates ≤40 weeks PMA: discuss dosing with pharmacy
 - Preterm neonates >40 weeks and term neonates up to 9 months: 3 mg/kg BID
 - ≥9 months up to 12 months: 3.5 mg/kg BID
- ≥12 months:
 - >15 kg 23 kg: 45 mg BID
 - >23 kg 40 kg: 60 mg BID
 - >40 kg: 75 mg BID

Suspect COVID-19:

- Place on Special Precautions
 - ED/Inpatient COVID-19 Algorithm
- Inpatient Therapies for COVID-19 Clinical Pathway

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Appendix A

Pertussis

 If pertussis is proven, azithromycin should be used as monotherapy (e.g., discontinue other antibiotics)

If respiratory BIOFIRE was sent due to significant concern for atypical pneumonia, and resulted with a positive Chlamydia

<u>pneumoniae:</u>

•

- ADD azithromycin IV/PO:
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days
 - Azithromycin IV/PO (monotherapy):
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Chlamydia pneumonia:

- ADD azithromycin IV/PO:
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Mycoplasma pneumoniae:

- Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall clinical course)
 - o <6 mo old: 10 mg/kg x5 days</p>
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

Documented Influenza

- ADD oselta mavir PO:
 - Preterm neonates ≤40 weeks PMA: discuss dosing with pharmacy
 - Preterm neonates >40 weeks and term neonates up to 9 months: 3 mg/kg BID
 - ≥9 months up to 12 months: 3.5 mg/kg BID
- ≥12 months:
 - >15 kg 23 kg: 45 mg BID
 - >23 kg 40 kg: 60 mg BID
 - >40 kg: 75 mg BID

Suspect COVID-19

- Place on Special Precautions
- ED/Inpatient COVID-19 Algorithm
- Inpatient Therapies for COVID-19 Clinical Pathway

Appendix A

Chlamydia pneumoniae

- If respiratory BIOFIRE was sent due to a significant concern for atypical pneumonia and it resulted with a positive *Chlamydia pneumonia, add* azithromycin
- Remember, respiratory BIOFIRE should not be routinely sent

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If respiratory BIOFIRE was sent due to significant concern for atypical pneumonia, and resulted with a positive

<u>Mycoplasma pneumoniae:</u>

- Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall clinical course)
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

Documented Pertussis at Any Age:

- Azithromycin IV/PO (monotherapy):
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Chlamydia pneumonia:

- ADD azithromycin IV/PO:
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Mycoplasma pneumoniae:

- Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall clinical course)
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

Documented Influenza:

- ADD oselta mavir PO:
 - Preterm neonates ≤40 weeks PMA: discuss dosing with pharmacy
 - Preterm neonates >40 weeks and term neonates up to 9 months: 3 mg/kg BID
 - ≥9 months up to 12 months: 3.5 mg/kg BID
- ≥12 months:
 - >15 kg 23 kg: 45 mg BID
 - >23 kg 40 kg: 60 mg BID
 - >40 kg: 75 mg BID

Suspect COVID-19

- Place on Special Precautions
- ED/Inpatient COVID-19 Algorithm
- Inpatient Therapies for COVID-19 Clinical Pathway

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Appendix A

Mycoplasma pneumoniae

- *Mycoplasma pneumoniae* is a common cause of CAP in older children
- Studies have shown that the addition of azithromycin has no significant clinical benefit for *mycoplasma*associated uncomplicated CAP
- If respiratory BIOFIRE was sent due to a significant concern for atypical pneumonia and it resulted with a positive *Mycoplasma pneumonia*, azithromycin does **not** have to automatically be added

Special Considerations:

<3 month old with Chlamydia trachomatis:

- Consult Infectious Diseases (ID)
- Send diagnostic tests as directed by ID
- If proven or strongly suspected: ADD azithromycin IV/PO 20 mg/kg x3 days

Documented Pertussis at Any Age:

- Azithromycin IV/PO (monotherapy):
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Chlamydia pneumonia:

- ADD azithromycin IV/PO:
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Mycoplasma pneumoniae:

- Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall clinical course)
 - <6 mo old: 10 mg/kg x5 days
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

Documented Influenza:

- ADD oselta mavir PO:
 - Preterm neonates ≤40 weeks PMA: discuss dosing with pharmacy
 - Preterm neonates >40 weeks and term neonates up to 9 months: 3 mg/kg BID
 - ≥9 months up to 12 months: 3.5 mg/kg BID
- ≥12 months:
 - >15 kg 23 kg: 45 mg BID
 - >23 kg 40 kg: 60 mg BID
 - >40 kg: 75 mg BID

Suspect COVID-19

- Place on Special Precautions
- ED/Inpatient COVID-19 Algorithm
- Inpatient Therapies for COVID-19 Clinical Pathway

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Appendix A

Azithromycin

- No significant benefit for *mycoplasma*-associated uncomplicated CAP
- Resistances are emerging for Strep pneumo.
 - Never use as monotherapy (unless documented pertussis)

Appendix A

Influenza

• If influenza is documented, add oseltamavir

COVID-19

• COVID screening and management are discussed on these linked pathways

CLINICAL PATHWAY: Community Acquired Pneumonia (CAP) Appendix A: Special Considerations

Documented Influenza:

- ADD oseltamavir PO:
 - Preterm neonates ≤40 weeks PMA: discuss dosing with pharmacy
 - Preterm neonates >40 weeks and term neonates up to 9 months: 3 mg/kg BID
 - ≥9 months up to 12 months: 3.5 mg/kg BID
 - ≥12 months:
 - >15 kg 23 kg: 45 mg BID
 - >23 kg 40 kg: 60 mg BID
 - >40 kg: 75 mg BID
 - o <6 mo old: 10 mg/kg x5 days</p>
 - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1 day, then 5 mg/kg (max 250 mg/dose) to complete 5 days

If respiratory BIOFIRE was sent due to significant concern for atypical PNA, and resulted with a positive Mycoplasma pneumoniae: Consider adding azithromycin (the addition of azithromycin to antibiotic regimen may have no added benefit to patient's overall

Suspect COVID-19:

- Place on Special Precautions
 - ED/Inpatient COVID-19 Algorithm
 - Inpatient Therapies for COVID-19 Clinical Pathway

>23 kg – 40 kg: 60 mg BID

>40 kg: 75 mg BID

Suspect COVID-19

- Place on Special Precautions
 - ED/Inpatient COVID-19 Algorithm
 - Inpatient Therapies for COVID-19 Clinical Pathway

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AND DOES NO

🚺 (large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

Complicated CAP

Complicated CAP is defined as the presence of the following:

- Large effusion
- Any size loculated/septated effusion
- Empyema
- Abscess
- Necrotic lung
- Pneumatocele

Note: it is no longer defined by the overall clinical status of the child.

- Preference: Ceftriaxone IV 75 mg/kg daily (max 2 g/dose) and Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)
 - *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
- If additional alternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (*note: this test has a high negative predictive value*)
 - Consider adding Vancomycin IV:
 - <52 weeks PMA[‡]/about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; ≥52 weeks PMA[‡]/about ≥3 months old 11 years old: 70 mg/kg/day div q6hr; ≥12 yrs old: 60 mg/kg/day div q8hr [[‡]PMA (Post-Menstrual Age) = gestational age + postnatal age]
 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if \geq 12 yrs old)
- If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
- Consult Surgery if large effusion or empyema
 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

Complicated CAP

Etiology of complicated CAP

 In addition to usual culprits, think of anaerobes (even without a clear hx of aspiration)

Coverage

- Important to cover for anaerobes even if they don't grow out in culture (they are difficult to grow!)
- American Association for Thoracic Surgery (2016) recommends anaerobic coverage for complicated CAP even if culture are negative

Preference: **Ceftriaxone IV** 75 mg/kg daily (max 2 g/dose) <u>and</u> **Clindamycin IV/PO** 40 mg/kg/day div 3 doses (max 600 mg/dose)

- *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
- If additional alternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (*note: this test has a high negative predictive value*)
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 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
- If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
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 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

- *Preference:* **Ceftriaxone IV** 75 mg/kg daily (max 2 g/dose) <u>and</u> **Clindamycin IV/PO** 40 mg/kg/day div 3 doses (max 600 mg/dose)
 - *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
- *If additional alternatives needed*: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (*note: this test has a high negative predictive value*)
 - Consider adding Vancomycin IV:
 - <52 weeks PMA[‡]/about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; ≥52 weeks PMA[‡]/about ≥3 months old 11 years old: 70 mg/kg/day div q6hr; ≥12 yrs old: 60 mg/kg/day div q8hr [[‡]PMA (Post-Menstrual Age) = gestational age + postnatal age]
 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
- If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
- Consult Surgery if large effusion or empyema
 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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Complicated CAP

Antimicrobial Coverage

- In line with American Association for Thoracic Surgery (2016)
 - In areas with lower resistance patterns, 3rd generation cephalosporin with clindamycin for anaerobic coverage; or an antibiotic with a beta lactamase inhibitor (e.g., sulbactam)
- Ceftriaxone and ampicillin/sulbactam should be dosed higher than they are for uncomplicated CAP. This allows for better penetration into affected lung spaces.

(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

- *Preference:* **Ceftriaxone IV** 75 mg/kg daily (max 2 g/dose) <u>and</u> **Clindamycin IV/PO** 40 mg/kg/day div 3 doses (max 600 mg/dose)
 - *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
- If additional alternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

Complicated CAP

If appropriate, consider using

NSAIDs for pain control and treat

Persistent pleural inflammation

may contribute to ongoing

production of pleural fluid

Clinical Pearl: Pain Control

pleuritis

•

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (*note: this test has a high negative predictive value*)
 - Consider adding Vancomycin IV:
 - <52 weeks PMA[‡]/about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; ≥52 weeks PMA[‡]/about ≥3 months old 11 years old: 70 mg/kg/day div q6hr; ≥12 yrs old: 60 mg/kg/day div q8hr [[‡]PMA (Post-Menstrual Age) = gestational age + postnatal age]
 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
- If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
- Consult Surgery if large effusion or empyema
 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

- Preference: Ceftriaxone IV 75 mg/kg daily (max 2 g/dose) and Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)
 - *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
- If additional alternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (*note: this test has a high negative predictive value*)
 - Consider adding Vancomycin IV:
 - <52 weeks PMA[‡]/about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; ≥52 weeks PMA[‡]/about ≥3 months old 11 years old: 70 mg/kg/day div q6hr; ≥12 yrs old: 60 mg/kg/day div q8hr [[‡]PMA (Post-Menstrual Age) = gestational age + postnatal age]
 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
- If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
- Consult Surgery if large effusion or empyema
 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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Complicated CAP

MRSA

- MRSA is a consideration for complicated CAP, particularly if the patient was previously infected, colonized in the last 6 months, or if the MRSA swab is positive
- Consider adding vancomycin coverage
- Remember that MRSA nasal swabs have a high negative predictive value. If it is negative, it is very unlikely that MRSA is a concern and vancomycin should be discontinued
Complicated CAP

(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

- Preference: Ceftriaxone IV 75 mg/kg daily (max 2 g/dose) and Clindamycin IV/PO 40 mg/kg/day div 3 doses (max 600 mg/dose)
 - *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
- *If additional alternatives needed*: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (*note: this test has a high negative predictive value*)
 - Consider adding Vancomycin IV:
 - <52 weeks PMA[‡]/about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; ≥52 weeks PMA[‡]/about ≥3 months old 11 years old: 70 mg/kg/day div q6hr; ≥12 yrs old: 60 mg/kg/day div q8hr [[‡]PMA (Post-Menstrual Age) = gestational age + postnatal age]
 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
 - If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
- Consult Surgery if large effusion or empyema
 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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Complicated CAP

Clinical Pearl: AKI

 Monitor closely for acute kidney injury, particularly if the patient is on vancomycin, NSAIDs, and if they received contrast

Complicated CAP

(large effusion, any size loculated/septated effusion, empyema, abscess, necrotic lung, pneumatocele)

- *Preference:* **Ceftriaxone IV** 75 mg/kg daily (max 2 g/dose) <u>and</u> **Clindamycin IV/PO** 40 mg/kg/day div 3 doses (max 600 mg/dose)
 - *Alternative:* Ampicillin/sulbactam IV 300 mg of ampicillin/kg/day div q6hr (max 3 g of Una syn/dose)
 - If additional alternatives needed: Infectious Diseases (ID) will discuss on a case-by-case basis

Additional Considerations:

- If concern for MRSA (e.g., previously infected, recently colonized in last 6 months, nasal MRSA swab positive):
 - Obtain MRSA nasal probe if not done (note: this test has a high negative predictive value)
 - Consider adding Vancomycin IV:
 - <52 weeks PMA[‡]/about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC; ≥52 weeks PMA[‡]/about ≥3 months old 11 years old: 70 mg/kg/day div q6hr; ≥12 yrs old: 60 mg/kg/day div q8hr [[‡]PMA (Post-Menstrual Age) = gestational age + postnatal age]
 - If serum creatinine higher than expected for age, or change is >0.3 mg/dL over 48 hrs: substitute vancomycin with linezolid IV 10 mg/kg/dose q8hr (q12hr if ≥12 yrs old)
- If concern for atypical pneumonia, pertussis, COVID-19 or influenza: see Appendix A

Consultations:

- Consult Infectious Diseases (ID)
- Consult Surgery if large effusion or empyema
 - If drained, obtain aerobic and anaerobic fluid cultures (send in capped syringe)

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Complicated CAP

Consultations

- All cases of complicated CAP should have ID involvement.
- If there is a large effusion or empyema, consult surgery.
 - Remember to send aerobic and anaerobic fluid cultures to lab in a capped syringe if anything is drained!

CLINICAL PATHWAY: Community Acquired Pneumonia (CAP)



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Admission Criteria

Note

 All patients with progression of CAP despite appropriate therapy should be admitted so that they can be monitored for complications of CAP

ementin ESPO (600 mg/5 ml) 90 mg amox/kg/day diy 2 do

(max 1 g/dose) [Augmentin XR is not recommended

mg/kg/day div 3 doses (max 600 mg/

day daily (max 2 g/dose)

considerations

al Considerations concern for atypical pneumonia

uenza: see Appendix A

Discharge home harge medicatio

If PCN alleray: consult infectious Diseases (ID) for allere

If not fully immunized: start only Ceftriaxone IV 75

REPLACE CLINIC

Ongoing Management

- Complete initial evaluation, if not already complete
- Continue antibiotics and change to PO antibiotics, if clinically appropriate
 - Duration of antibiotics per discharge medication section below²

Uncomplicated CAP:

- If blood culture was obtained and positive, or there is no clinical improvement: consult Infectious Diseases Ο
- Consider stopping antibiotics for uncomplicated CAP after 5 days of therapy, if clinically improved Ο
- Complicated CAP:
 - Consult Infectious Diseases (and surgery, if needed) if not already done Ο
 - If MRSA coverage started, consider discontinuing if nasal MRSA screen, blood cultures and pleural cultures are Ο negative. If patient is unstable or MRSA is detected, discuss continuation of vancomycin with Infectious Diseases.

Ongoing Management

Uncomplicated CAP

- If blood cultures were obtained and were positive, or if there is no clinical improvement despite appropriate therapy, ID should be consulted to help tailor antimicrobial coverage
- However, if the patient is clinically improved, consider stopping antibiotics after 5 days of therapy (duration is discussed further in discharge slides)

If aspiration pneumonia: start only Clindam Remember that blood cultures are not routinely indicated, even for hospitalized patients.

<52 weeks PMA[‡]/about <3 mo old: 15 mg/kg g8br or as determined by

based on estimated AUC; ≥52 weeks PMA[†]/about ≥3 months old - 11 years old: 70

60 mg/kg/day diy g8hr [*PMA (Post-Menstrual Ag

una is >0.3 ma/di. over A8 h

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Blood cultures are reserved for those who are at more risk for less common organisms, more resistant organisms, and those with complicated CAP

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if alt

Complicated If atypical pneur

If influenza: osel

ICHELOW, MD | GRACE

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Ongoing Management

- Complete initial evaluation, if not already complete
- Continue antibiotics and change to PO antibiotics, if clinically appropriate
- Duration of antibiotics per discharge medication section below²
- Uncomplicated CAP:
 - If blood culture was obtained and positive, or there is no clinical improvement: consult Infectious Diseases
 - Consider stopping antibiotics for uncomplicated CAP after 5 days of therapy, if clinically improved

Complicated CAP:

- Consult Infectious Diseases (and surgery, if needed) if not already done
- If MRSA coverage started, consider discontinuing if nasal MRSA screen, blood cultures and pleural cultures are negative. If patient is unstable or MRSA is detected, discuss continuation of vancomycin with Infectious Diseases.

Ongoing Management

Complicated CAP

- Remember to consider stopping MRSA coverage if the nasal screen is negative (high negative predictive value!), particularly if blood and pleural cultures are also negative.
- If the patient is clinically unstable, or MRSA is detected, discuss MRSA coverage with ID.



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THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Ongoing Management

- Complete initial evaluation, if not already complete
- Continue antibiotics and change to PO antibiotics, if clinically appropriate
- Duration of antibiotics per discharge medication section below²

• Uncomplicated CAP:

- If blood culture was obtained and positive, or there is no clinical improvement: consult Infectious Diseases
- Consider stopping antibiotics for uncomplicated CAP after 5 days of therapy, if clinically improved

Complicated CAP:

- Consult Infectious Diseases (and surgery, if needed) if not already done
- If MRSA coverage started, consider discontinuing if nasal MRSA screen, blood cultures and pleural cultures are negative. If patient is unstable or MRSA is detected, discuss continuation of vancomycin with Infectious Diseases.

Ongoing Management

Note

- When trending inflammatory markers (PCT or CRP), pay close attention to units.
 - Need to only follow one inflammatory marker. Following both is redundant and considered low value care.
- Trends of CRP may be useful when assessing the rate of decrease (rather than the absolute value)
- It may help determine when PO antibiotics may be indicated



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CLINICAL PATHWAY: Community Acquired Pneumonia (CAP)



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Discharge criteria are listed

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²Discharge Medications:

Total duration of treatment: mild uncomplicated CAP: 5 days; moderate uncomplicated CAP: 5-7 days; complicated CAP: 10 days minimum (discuss with ID)

Uncomplicated CAP:

- Continue (or change to) appropriate PO options as listed above.
- If PCN allergy and placed on Ceftriaxone IV: switch to Cefuroxime PO 30 mg/kg/day div 2 doses (max 500 mg/dose)
 [Note: ensure patient is able to receive the antibiotic for home prior to discharge]
 - Alternatives: Clindamycin PO 40 mg/kg/day div 3 doses (max 600 mg/dose) or Cefdinir PO 14 mg/kg/day div 2 doses (max 600 mg/day)
- o If alternative antibiotics were selected with ID: ID will select appropriate antibiotics for discharge
- **Complicated CAP:** ID will advise selection of antibiotics at discharge
- If atypical pneumonia: azithromycin (see Appendix A) x5 days total
- If influenza: oseltamivir (see Appendix A) x5 days total

Discharge Instructions

Uncomplicated CAP antibiotics

- Amoxicillin is the best and optimal coverage for Strep pneumo
 - Per IDSA: no oral cephalosporins provided activity at the site of infection that equaled high dose amoxicillin
 - Most 2nd and 3rd generation cephalosporins only provide adequate activity against 60-70% of the currently isolated strains of pneumococcus
- If the patient had a true PCN allergy and was improving on ceftriaxone, can be placed on cefuroxime (or clindamycin or cefdinir)
 - Ceforuxime suspension must be compounded and is difficult to find. Make sure they can pick it up!

mission Criteria: Hypoxemia <90% Increased WOB/ respiratory distress/ tachypnea Lethargy Progression of CAP despite appropriate therapy Complicated CAP Concem for compliance

charge Criteria: 30% on RA x12-24 vased fevers for 24

> ed activity/appeti ementation Ince with treatm

), signs of sepsis (see Se yndrome, sidde cell,

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enza, Sars-CoV-2

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shr (a12hr if ≥12 yrs old

AUC; ≥52 weeks PMA[†]/about ≥3 months old – 11 years old: >12 yrs old: 50 mg/kg/day diy g8hr ([†]PMA (Post-Menstrual)







Review of Key Points



- Strep pneumo is very susceptible to amoxicillin

 Ampicillin/amoxicillin is the drug of choice
 Immunization status evaluation should focus on Hib doses
- PCN allergy should be further evaluated
- Azithromycin has no proven benefit for mycoplasma-associated uncomplicated CAP
- MRSA nasal probe and procalcitonin \rightarrow high negative predictive values
- Treatment should depend on complications of CAP rather than severity of clinical illness alone
- Complicated CAP should have additional anaerobic coverage
- Courses of antibiotics should be shorter

Quality Metrics



- % of patients with CAP pathway order set
- % of patients with appropriate inpatient antibiotic selection per pathway
- % of patients with appropriate inpatient antibiotic dosage per pathway
- % of patients who receive amoxicillin/ampicillin while in the Emergency Department
- % of appropriate discharge antibiotic selection per pathway
- Average number of days (duration) of antibiotic coverage
- % of patients with nasal MRSA PCR negative and vancomycin or linezolid discontinued within 24 hours of negative PCR
- ALOS (days)

Pathway Contacts



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About Connecticut Children's Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children's, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings. These pathways serve as a guide for providers and do not replace clinical judgment.