

# **ANTIBACTERIAL THERAPY**

***Dr N.nahanmoghaddam  
MD,MPH,Pediatrics infectiousman***



***Specific antibiotic therapy*** is optimally driven by a ***microbiologic diagnosis***, predicated on isolation of the pathogenic organism from a sterile body site, and supported by clinical diagnosis .

***empirical use*** of antibacterial agents, administered before or even without eventual identification of the specific pathogen.



*the age-appropriate differential diagnosis with  
respect to likely pathogens.*

*the child's immunologic status*

*antimicrobial resistance*

*vaccination*

*History of The presence of foreign bodies*



# Classification of antibacterial agents

## Bactericidal

β-lactam agents  
Aminoglycosides  
Co-trimoxazole  
Vancomycin

## Bacteriostatic

Erythromycin  
Tetracyclines  
Chloramphenicol  
Sulfonamides

# PROTECTED ANTIBIOTICS IN PAEDIATRICS

Antibacterial drug classification	Antibacterial drug	Comment
Beta-lactam antibiotics	Meropenem Ertapenem Piperacillin / Tazobactam	
Aminoglycosides	Tobramycin injection Tobramycin nebulas	For paediatric patients with cystic fibrosis only
Macrolides	Azithromycin syrup and capsules	Can be used for paediatrics third line where compliance is an issue

<b>Quinolones</b>	<p>Ciprofloxacin tablets, suspension and infusion</p> <p>Levofloxacin tablets and injection</p>	<p>For CF patients</p>
<b>Other antibiotics</b>	<p>Chloramphenicol injection</p> <p>Colistin injection for nebulised use</p> <p>Co-trimoxazole</p> <p>Fosfomycin inj</p> <p>Daptomycin Inj Linezolid injection, tablets and suspension</p>	<p>For use in penicillin allergic patients only in CNS infections</p> <p>For CF patients only</p> <p>For use in feverish illness in children for children &gt; 3 months in penicillin allergy (IV), in intra-abdominal sepsis and post-operative intra-abdominal infections in penicillin allergy (PO),</p> <p>For use in CNS infections in penicillin allergic patients</p>





# Antibiotics: Penicillins

## Natural penicillins

- penicillin G, penicillin V potassium

## Penicillinase-resistant penicillins

- cloxacillin, dicloxacillin, methicillin, nafcillin, oxacillin



# Penicillins: Mechanism of Action

- Penicillins enter the bacteria via the cell wall.
- Inside the cell, they bind to penicillin-binding protein.
- Once bound, normal cell wall synthesis is disrupted.
- Result: **bacteria cells die from cell lysis.**
- Penicillins do not kill other cells in the body.

# Antibiotics: Penicillins

- Bacteria produce enzymes capable of destroying penicillins.
- These enzymes are known as **beta-lactamases**.
- As a result, the medication is not effective.

# Antibiotics: Penicillins

- Chemicals have been developed to inhibit these enzymes:
  - clavulanic acid
  - tazobactam
  - sulbactam
- These chemicals bind with beta-lactamase and prevent the enzyme from breaking down the penicillin



# Antibiotics: Penicillins

## Aminopenicillins

- amoxicillin, ampicillin, bacampicillin

## Extended-spectrum penicillins

- piperacillin, ticarcillin, carbenicillin, mezlocillin

# Penicillins: Therapeutic Uses

- Prevention and treatment of infections caused by susceptible bacteria, such as:
  - gram-positive bacteria
  - Streptococcus, Enterococcus, Staphylococcus species



# PENICILLINS

*the drugs of choice :*

***group A and group B Streptococcus, Treponema pallidum (syphilis), L. monocytogenes, and N. meningitides***

***The semisynthetic penicillins (nafcillin, cloxacillin, dicloxacillin) susceptible staphylococcal infections, although the increasing incidence of MRSA has limited the usefulness of these drugs.***

**aminopenicillins (ampicillin, amoxicillin)**

**broad-spectrum activity against *Gram-negative organisms*, including *E. coli* and *H. influenzae*, but the emergence of resistance has limited their utility in many clinical settings.**

**The carboxypenicillins (carbenicillin, ticarcillin) and ureidopenicillins (piperacillin, mezlocillin, azlocillin) also have bactericidal activity against most strains of *P. aeruginosa*.**

# Antibiotics: Cephalosporins

- First Generation
- Second Generation
- Third Generation
- Fourth Generation

# Antibiotics: Cephalosporins

- Semisynthetic derivatives from a fungus
- Structurally and pharmacologically related to penicillins
- Bactericidal action
- Broad spectrum
- Divided into groups according to their antimicrobial activity



# Cephalosporins: First Generation

cefazolin

(Ancef and Kefzol)

IV and PO

cephalexin

(Keflex and Keftab)

PO

used for surgical prophylaxis, URIs, otitis media



# Cephalosporins: First Generation

- cefadroxil
- cephalexin
- cephradine
- cefazolin
- cephalothin
- cephapirin
  - Good gram-positive coverage
  - Poor gram-negative coverage

# Cephalosporins: Second Generation

- cefaclor
  - cefprozil
  - cefamandole
  - cefoxitin
  - cefuroxime
  - cefonicid
  - ceforanide
  - cefmetazole
  - cefotetan
- Good gram-positive coverage
  - Better gram-negative coverage than first generation

# Cephalosporins: Second Generation

Cefoxitin

(Mefoxin)

IV and IM

Used prophylactically for  
abdominal or colorectal  
surgeries  
Also kills anaerobes

cefuroxime

(Kefurox and Ceftriaxone)

PO

Surgical prophylaxis  
Does not kill  
anaerobes



# Cephalosporins: Third Generation

## cefixime (Suprax)

- Only oral third-generation agent
- Best of available oral cephalosporins against gram-negative
- Tablet and suspension

## ceftriaxone (Rocephin)

- IV and IM, long half-life, once-a-day dosing
- Easily passes meninges and diffused into CSF to treat CNS infections

# Cephalosporins: Fourth Generation

cefepime (Maxipime)

- Newest cephalosporin agents.
- Broader spectrum of antibacterial activity than third generation, especially against gram-positive bacteria.



**Table 180-5**      **Classification of Parenteral and Oral Cephalosporins**

<b>CEPHALOSPORINS</b>	<b>FIRST GENERATION</b>	<b>SECOND GENERATION</b>	<b>CEPHAMYCINS</b>	<b>THIRD GENERATION</b>	<b>FOURTH GENERATION</b>	<b>FIFTH GENERATION</b>
Parenteral	Cefazolin (Ancef, Kefzol) Cephalothin (Keflin, Seffin) Cephapirin (Cefadyl) Cephradine (Velosef)	Cefamandole (Mandol) Cefonicid (Monocid) Cefuroxime (Kefurox, Zinacef)	Cefmetazole (Zefazone) Cefotetan (Cefotan) Cefoxitin (Mefoxin)	Cefoperazone (Cefobid) Cefotaxime (Claforan) Ceftazidime (Fortaz) Ceftizoxime (Cefizox) Ceftriaxone (Rocephin)	Cefepime (Maxipime) Cefpirome (Cefrom) Ceftolozane (combined with tazobactam; CXA-101)	Ceftaroline (Teflaro) Ceftobiprole (Zeftera)
Oral	Cefadroxil (Duricef, Ultracef) Cephalexin (Keflex, Biocef, Keftab) Cephradine (Velosef)	Cefaclor (Ceclor) Cefprozil (Cefzil) Cefuroxime-axetil (Ceftin) Loracarbef (Lorabid)		Cefdinir (Omnicef) Cefditoren (Spectracef) Cefixime (Suprax) Cefpodoxime (Vantin) Ceftibuten (Cedax)		

*Adapted from Mandell GL, Bennett JE, Dolin R, editors: Principles and practice of infectious diseases, ed 7. Philadelphia, 2010, Elsevier, Table 22-1.*

# CEPHALOSPORINS

*The first-generation cephalosporins (e.g., **cefazolin**, a parenteral formulation, and **cephalexin**, an oral equivalent) are commonly used for management of skin and soft-tissue infections caused by **susceptible strains of S. aureus and group A Streptococcus.***

*The second-generation :*

*cephalosporins (e.g., **cefuroxime, cefoxitin**)*

*are used to treat **respiratory tract infections,  
urinary tract infections, and skin and soft-tissue  
infection***

***sinopulmonary infections and otitis media***

# CARBAPENEMS

***Gram-positive, Gram-negative, and anaerobic organisms.***

***MRSA and E. faecium are not susceptible to carbapenems.***

***poorly active against Stenotrophomonas maltophilia***

# GLYCOPEPTIDES

**vancomycin** bactericidal and act via inhibition of cell wall biosynthesis

Gram-positive organisms, including *S. aureus*,  
coagulase-negative staphylococci,  
*pneumococcus*, enterococci, *Bacillus*, and  
*Corynebacterium*



value for serious infections, including meningitis, caused by fever and neutropenia in oncology patients, MRSA and penicillin- and cephalosporin-resistant *S. pneumoniae*

infections associated with indwelling medical devices

*Clostridium difficile* infections

**Telavancin** has been approved by FDA for the treatment of skin and soft-tissue infections by MRSA for situations where other alternatives are not suitable.

# Antibiotics: Aminoglycosides

- gentamicin (Garamycin)
- kanamycin
- neomycin
- streptomycin
- tobramycin
- amikacin (Amikin)
- netilmicin

# Aminoglycosides

- Natural and semi-synthetic
- Produced from Streptomyces
- Poor oral absorption; no PO forms
- Very potent antibiotics with serious toxicity
- Bactericidal
- Kill mostly gram-negative; some gram-positive also



# Aminoglycosides

- Used to kill gram-negative bacteria such as *Pseudomonas* spp., *E. coli*, *Proteus* spp., *Klebsiella* spp., *Serratia* spp.
- Often used in combination with other antibiotics for synergistic effect.



# Aminoglycosides

- Three most common (systemic): gentamicin, tobramycin, amikacin
- Cause serious toxicities:
  - Nephrotoxicity (renal failure)
  - Ototoxicity (auditory impairment and vestibular [eighth cranial nerve])
- Must monitor drug levels to prevent toxicity

# Aminoglycosides: Side Effects

Ototoxicity and nephrotoxicity are the most significant

- Headache
- Paresthesia
- Neuromuscular blockade
- Dizziness
- Vertigo
- Skin rash
- Fever
- Superinfections

# AMINOGLYCOSIDES

*mechanism of action via inhibition of bacterial protein synthesis*

**Gram-negative** infections ,broad-spectrum agents: activity against ***S. aureus*** and provide synergistic activity against **group B streptococcus, *L. monocytogenes*, viridans streptococci, corynebacteria, Pseudomonas, Staphylococcus epidermidis, and Enterococcus** when coadministered with a  $\beta$ -lactam agent.



*neonatal sepsis, urinary tract infections, Gram negative sepsis, and complicated intraabdominal infections; infections in cystic fibrosis patients (including both parenteral and aerosolized forms of therapy); and in oncology patients with fever and neutropenia.*

*Aminoglycosides, in particular streptomycin, are also important in the management of Francisella tularensis, Mycobacterium tuberculosis, and atypical mycobacterial infections.*



# Antibiotics: Quinolones

- ciprofloxacin (Cipro)
- enoxacin (Penetrex)
- lomefloxacin (Maxaquin)
- norfloxacin (Noroxin)
- ofloxacin (Floxin)

# Quinolones

- Excellent oral absorption
- Absorption reduced by antacids
- First oral antibiotics effective against gram-negative bacteria

# Quinolones: Mechanism of Action

- Bactericidal
- Effective against gram-negative organisms and some gram-positive organisms
- Alter DNA of bacteria, causing death
- Do not affect human DNA



# Quinolones: Therapeutic Uses

- Lower respiratory tract infections
- Bone and joint infections
- Infectious diarrhea
- Urinary tract infections
- Skin infections
- Sexually transmitted diseases



# Quinolones: Side Effects

## Body System

## Effects

CNS

headache, dizziness, fatigue,  
depression, restlessness

GI

nausea, vomiting, diarrhea,  
constipation, thrush,  
increased liver function tests

# TETRACYCLINES

*bacteriostatic antibiotics that exhibit their antimicrobial effect by binding to the bacterial 30S ribosomal subunit, inhibiting protein translation.*

*broad spectrum of antimicrobial activity against Gram-positive and Gram-negative bacteria, rickettsia, and some parasites.*

*Rocky Mountain spotted fever, ehrlichiosis, Lyme disease, and malaria.*

# **TIGECYCLINE**

## **SEMISYNTHETIC DERIVATIVE OF MINOCYCLINE**

*Tigecycline is active against tetracycline-resistant  
**Gram-positive and Gram-negative** pathogens,  
including **MRSA**, and possibly **VRE**, but not  
*Pseudomonas*.*

# SULFONAMIDES

*trimethoprim-sulfamethoxazole (TMP-SMZ),*

*Commonly used for treatment of urinary tract infections.*

*. TMP-SMZ also plays a unique role in immunocompromised patients, as a prophylactic and therapeutic agent for *Pneumocystis jiroveci* infection.*

*Other commonly used sulfonamides include sulfisoxazole, which is useful in the management of urinary tract infections, sulfadiazine, which is a drug of choice in the treatment of toxoplasmosis.*



## MACROLIDES

*The spectrum of antibiotic activity includes many **Gram-positive bacteria**.*

*resistance to these agents among *S. aureus* and group A *Streptococcus* is fairly widespread, limiting the usefulness of macrolides for many skin and soft-tissue infections and for streptococcal pharyngitis.*

***Azithromycin and clarithromycin have demonstrated efficacy for otitis Media***

*All of the members of this class have an important role in the management of **pediatric respiratory infections**, including **atypical pneumonia** caused by *M. pneumoniae*, *Chlamydia pneumoniae*, and *Legionella pneumophila*, as well as infections caused by *Bordetella pertussis*.*

***Crossresistance may develop between a macrolide and the subsequent use of clindamycin.***

# **LINCOSAMIDES(CLINDAMYCIN)**

*Protein synthesis inhibitor*

*active against most **Gram positive aerobic and anaerobic cocci***

*except*

*Enterococcus*

*therapy of serious infections caused by **MRSA**.*

*Clindamycin is also useful in the management of **invasive group A Streptococcus infections** and in the management of many **anaerobic infections**,*

*Clindamycin also plays an important role in the treatment of malaria and babesiosis (when coadministered with quinine), P. jiroveci pneumonia (when coadministered with primaquine), and toxoplasmosis.*



# DALFOPRISTIN-QUINUPRISTIN

***MRSA,***

***coagulase negative staphylococci,***

***penicillin-susceptible and penicillin-resistant***

***S. pneumoniae,***

***and vancomycin-resistant E. faecium***

***but not E. faecalis.***

# LINEZOLID

**MRSA,**

**VRE,**

***coagulase-negative staphylococci,***

***penicillin-resistant S. pneumoniae.***

# DAPTOMYCIN

*all Gram-positive organisms, including *E. faecalis* and *E. faecium*  
(including **VRE**) and  
*S.aureus* (including **MRSA**)*

***Daptomycin is inactivated by surfactant and should not be used  
to treat pneumonia.***

# METRONIDAZOLE

*a unique role as an **antianaerobic** agent and also possesses **antiparasitic** and **anthelmintic** activity.*



# RIFAMPIN

*major role in the manage of **tuberculosis**  
usually used as a second (synergistic) agent in the  
treatment of **S. aureus** infections or to eliminate  
nasopharyngeal colonization of **H. influenzae** type b or  
**N. meningitidis.***

***Rifaximin*** is a nonabsorbed rifamycin that has been •  
used as an adjunct agent to treat patients with  
multiple recurrences of ***C. difficile*** infection.

**COLISTIN**  
**THIS AGENT IS A MEMBER OF**  
**THE POLYMYXIN FAMILY OF ANTIBIOTICS (POLYMYXIN E).**

**Colistin is broadly active against the •**

***Enterobacteriaceae* family, including *P. aeruginosa*. It is also •**  
**active against extended-spectrum  $\beta$ -lactamase– and**  
**carbapenemase producing strain**





# FEVERISH ILLNESS IN CHILDREN

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Feverish Illness in children<sup>1</sup></b>			Give parenteral antibiotics to:
Children < 3 months	IV Cefotaxime + IV Amoxicillin		<ul style="list-style-type: none"> <li>- infants younger than 1 month with fever</li> <li>- all infants aged 1-3 months with fever who appear unwell</li> <li>- infants aged 1-3 months with WBC &lt; 5 or &gt; 15 x 10<sup>9</sup>/L</li> <li>- Amoxicillin added to cover for Listeria</li> </ul>
Children > 3 months	IV Ceftriaxone	If history of immediate hypersensitivity to penicillin or cephalosporin IV Co-trimoxazole	Give immediate parenteral antibiotics to children with fever if they are: <ul style="list-style-type: none"> <li>- shocked</li> <li>- unrousable /showing signs of meningococcal disease</li> </ul>

# GASTROINTESTINAL INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Diarrhoea and Vomiting</b>  Likely to be viral  Adenovirus Enterovirus Rotavirus Noravirus (SRSV – small round structured virus)	Antibiotics are not indicated		<b>Likely viral</b>  Faecal adenovirus can cause nasal symptoms as well as diarrhoea Send faecal specimen  <b>No need unless septicaemic, blood/mucus in stool or immunocompromised</b>
<b>Campylobacter / Salmonella / Shigella enteritis</b>	Must be based on culture results Usually self-limiting		Treat Campylobacter symptomatically, only consider antibiotics if immunocompromised or severe disease.
<b>E coli 0157</b>	<b>Conservative management : antibiotic therapy is not recommended</b>		

Cryptosporodium	Self-limiting, treatment not recommended		If symptoms are repetitive or persistent contact consultant microbiologist for advice
Intra-abdominal sepsis and post- operative intra- abdominal infections (eg gangrenous appendix)	IV Amoxicillin + IV Metronidazole Oral step down PO Co-amoxiclav	IV Vancomycin + IV Aztreonam + IV Metronidazole Oral step down PO co-trimoxazole + Metronidazole	
	Total Duration 5 days		
coliforms enterococcus anaerobes			

<p>Wounds at gastrostomy sites</p> <p>Staphylococci</p> <p>Streptococci</p>	<p>PO Flucloxacillin</p>	<p>PO Clindamycin</p>	
<p>Perianal abscess</p> <p>Staphylococci</p> <p>Group A strep</p> <p>Anaerobes</p>	<p>IV Co-amoxiclav</p> <p>Post drainage up to 2 weeks</p>	<p>IV Clindamycin</p> <p>Post drainage up to 2 weeks</p>	<p>Switch to oral at clinical discretion. Aim for minimum of 5 days IV</p>



# RESPIRATORY TRACT INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Acute Otitis Media</b> <sup>1</sup> <sub>23</sub>  Usually viral  <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>M. catarrhalis</i> .	<b>Non- severe:</b> PO Amoxicillin  <b>Severe:</b> IV Cefuroxime or IV Co-amoxiclav or high dose IV Amoxicillin	<b>Non- severe:</b> PO Erythromycin or PO Clarithromycin  <b>Severe:</b> IV Ceftriaxone or IV Clarithromycin	Most uncomplicated cases resolve without antibiotics. Manage pain and fever.  Antibiotics indicated if: - <6 months of age - Bilateral and <2years of age - Unilateral with otorrhoea - Evidence of mastoiditis - Severe or no improvement after 48-72 hours - At risk of complications (e.g. immunosuppression, CF)
	<b>Duration</b> Non-severe and >5years: 5 days Severe or < 5years: 10 days		

<p><b>Mastoiditis</b></p> <p>Staph. aureus S. pneumoniae H. influenzae</p>	<p>IV Co-amoxiclav</p> <p><b>Severe:</b> IV Ceftriaxone</p> <p><b>Duration:</b> As clinically deemed appropriate ( will also depend on whether there is a mastoid abscess)</p>	<p>IV Clindamycin and IV Aztreonam</p>	<p>Switch to narrow spectrum agent based on cultures</p>
--	--	--	--

## Acute Sinusitis <sup>4</sup>

Likely viral.

*S. pneumoniae*,  
*H. influenzae*,  
*M. catarrhalis*

**Non- severe:**  
PO Co-amoxiclav

**Severe:**  
High dose IV  
Amoxicillin or IV  
Ceftriaxone

**Non- severe:**  
PO Erythromycin  
or PO  
Clarithromycin

**Severe:**  
IV Clarithromycin

Likely viral and do not require antibiotics.

Consider antibiotics if:

- Persistent or worsening symptoms (e.g. purulent nasal discharge, daytime cough, fever) for >7-10days
- Severe
- High risk for complications (e.g. immunosuppression, CF)

**Duration:**  
Non-severe: 7days  
Severe: 10-14 days

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<p><b>Tonsillitis</b> <sup>156</sup></p> <p>Usually viral</p> <p><i>Group A beta-haemolytic Strep</i></p>	<p><b>Non- severe:</b> PO Phenoxymethypenicillin (Penicillin V)</p> <p><b>Severe:</b> IV Benzylpenicillin</p> <p><b>Duration</b> Non- severe: 10 days Severe: 10 days</p>	<p><b>Non- severe:</b> PO Erythromycin or PO Clarithromycin</p> <p><b>Severe:</b> IV Clindamycin</p>	<p>Most sore throats are viral.</p> <p>Consider antibiotic treatment if 3 out of 4 Centor criteria:</p> <ol style="list-style-type: none"> <li>1) Tonsillar exudate</li> <li>2) Tender anterior cervical lymph nodes</li> <li>3) history of fever</li> <li>4) absence of cough</li> </ol> <p>Or</p> <p>If features of systemic upset, peritonsillar cellulitis or abscess, at increased risk from acute infection (e.g. immunocompromised, CF) or history of valvular heart disease.</p> <p>SEND THROAT SWAB</p> <p>Do not use amoxicillin or co-amoxiclav in case patient has infectious mononucleosis as causes rash.</p>



<p><b>Peritonsillar/ Retropharyngeal abscess</b></p> <p>Anaerobes Group A strep <i>S. aureus</i> +/- coliforms</p>	<p>Initially treat with IV antibiotics</p> <p>IV Co-amoxiclav then PO</p>	<p>Initially treat with IV antibiotics</p> <p>IV Clindamycin initially then PO</p>	<p>Drainage is essential part of treatment.</p> <p>Send pus for MC&amp;S.</p>
	<p><b>Duration:</b> depends on clinical outcome and culture sensitivities</p>		

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Acute Epiglottitis</b>  <i>H. influenzae</i>	Initially treat with IV antibiotics  IV Ceftriaxone	Initially treat with IV antibiotics  IV Aztreonam	<i>Secure airway first and call anaesthetist</i> <i>Avoid upsetting child.</i>
	Duration: 10-14 days		
<b>Pertussis</b>	<b>Non-severe:</b> PO Clarithromycin or PO Erythromycin  <b>Severe:</b> IV Clarithromycin		Ensure vaccination history obtained Inform PHE and obtain further guidance on vaccination
	Duration: 7 days		

<p><b>Tracheitis with secondary bacterial infection</b></p> <p>Mainly caused by respiratory viruses.</p>	<p>7 days</p> <p>High dose IV Amoxicillin</p>	<p>IV Clarithromycin</p>	<p>Ensure airway secure and avoid upsetting child.</p> <p>If not responding to initial treatment after 72hours send sputum for MC&amp;S and start antibiotics.</p>
<p><b>Cervical lymphadenitis</b></p> <p>Mixed bacteria, including anaerobes. Can be caused by mycobacterial species.</p>	<p><b>Initially treat with IV antibiotics</b></p> <p>IV Co-amoxiclav then PO (if child well PO initially)</p>	<p><b>Initially treat with IV antibiotics</b></p> <p>IV Clarithromycin then PO Erythromycin or PO Clarithromycin (if child well PO initially)</p>	<p>For chronic cases discuss with consultant microbiologist whether to send serology tests.</p> <p>Consider atypical mycobacterial/ TB infection.</p> <p>Consider referral to ENT</p>
	<p><b>Duration:</b> 5-7 days</p>		
	<p><b>Duration:</b> 7-10 days</p>		

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Bronchiolitis with secondary bacterial infection</b>  Viral, RSV.	<b>Non-severe:</b> PO Amoxicillin  <b>Severe:</b> IV Cefotaxime	<b>Non- severe:</b> PO Erythromycin or PO Clarithromycin  <b>Severe:</b> IV Clindamycin	Do not routinely prescribe antibiotics but consider if <6 weeks old or temp >39C  If <6 months of age treat as severe (see next page).
	<b>Duration:</b> 5-7 days		Difficult to distinguish viral from bacterial pneumonia, therefore if there is a clear clinical



<p><b>Uncomplicated Community Acquired Pneumonia</b> <sup>7 8</sup></p> <p>RSV, respiratory viruses, <b>Strep pneumoniae</b>. <i>H. influenza</i>, <i>S. aureus</i></p> <p>In school age also atypicals (<i>M. pneumonia</i>, <i>Chlamydia</i>)</p>	<p><b>≤ 5 years:</b> PO Amoxicillin. Add macrolide if no response.</p> <p><b>5-18 years:</b> PO Amoxicillin + PO Erythromycin or PO Clarithromycin if Mycoplasma or other atypicals likely or if no response</p> <p>If <i>S. aureus</i> suspected (e.g. bullae on CXR) add Flucloxacillin or Clindamycin</p> <p>In pneumonia associated with influenza use Co-amoxiclav</p>	<p><b>≤ 5 years:</b> PO Erythromycin or PO Clarithromycin</p> <p><b>5-18 years:</b> PO Erythromycin or PO Clarithromycin</p>	<p>diagnosis of pneumonia treat with antibiotics</p> <p><b>If &lt;2years presenting with mild symptoms of lower respiratory tract infection, pneumonia unlikely, so antibiotics unlikely to be needed especially if had pneumococcal vaccine.. Review if persists.</b></p> <p>Consider obtaining blood cultures in suspected pneumonia.</p> <p>Mycoplasma suggested by:</p> <ul style="list-style-type: none"> <li>- Age &gt;5 years</li> <li>- Subacute onset</li> <li>- Prominent cough</li> <li>- +/- headache</li> <li>- +/- sore throat</li> </ul>
	<p><b>Duration:</b> 7-10 days 14 days for <i>S. aureus</i> 2-3 weeks for mycoplasma, chlamydia</p>		

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Severe CAP</b> <sup>7 8</sup>  RSV, respiratory viruses, <b>Strep pneumoniae</b> . H. influenza, S. aureus  In school age also atypicals (M. pneumonia, Chlamydia)	IV Cefotaxime + IV Clarithromycin  If S.aureus suspected (e.g. bullae on CXR) add Flucloxacillin or Clindamycin (stop Clarithromycin)	IV Clarithromycin + IV Vancomycin  If S.aureus suspected (e.g. bullae on CXR) add Clindamycin (stop Clarithromycin)	Obtain blood cultures and send sputum for MC&S if able to obtain.  If child remains unwell or feverish after 48hrs treatment re-evaluate:  - Is the patient having appropriate treatment at adequate dose? - Is there a lung complication such as a collection of pleural fluid with development of an empyema or evidence of a lung abscess? - Is the patient not responding because of a complication such as immunosuppression or co-existent disease such as CF?
	<b>Duration:</b> 2-3 weeks		

<p><b>Hospital acquired pneumonia<sup>9</sup></b></p> <p>RSV, respiratory viruses, <b>Strep pneumoniae</b>. <i>H. influenza</i>, <i>S. aureus</i></p> <p>In school age also atypicals (<i>M. pneumonia</i>, <i>Chlamydia</i>)</p> <p><b>Tendency towards more resistant organisms such as Enterobacteriaceae and Pseudomonas aeruginosa.</b></p>	<p>IV Ceftazidime</p> <p>Consider adding IV Gentamicin for severe Pseudomonas infection.</p>	<p>IV Vancomycin + IV Aztreonam</p>	<p>Treat as Community Acquired Pneumonia if onset &lt;5 days after admission to hospital and no recent history of antibiotic treatment.</p> <p><b>Consider treating those with chronic illness such as severe neuro disability or frequent hospital admissions as HAP.</b></p>
	<p><b>Duration:</b></p> <p>7-10 days</p> <p>2 weeks for <i>S. aureus</i>/MRSA</p> <p>2-3 weeks for Pseudomonas</p>		

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Empyema</b> <sup>8 10</sup>  <i>S. aureus</i> , <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>S. pyogens</i> +/- coliforms, +/- anaerobes	<b>Acute, community acquired usually parapneumonic:</b> IV Amoxicillin + IV Clindamycin  <b>Sub-acute/ chronic, or Hospital acquired:</b> If < 3months IV Cefotaxime  If > 3months: IV Ceftriaxone	<b>Acute, community acquired usually parapneumonic:</b> IV Aztreonam + IV Clindamycin  <b>Sub-acute/ chronic, or Hospital acquired:</b> IV Aztreonam + IV Clindamycin	Advise US chest.  Consider discussion with Respiratory physician in immunocompromised, hospital acquired or TB suspected.  Send sample of pleural fluid for MC&S (+/- PCR and AAFB if TB suspected) and biochemistry.  Send blood cultures and sputum.  Consider need for chest drain especially if effusion enlarging or respiratory compromise. Reduces duration of illness/ length of hospital stay compared to abx use alone.  Broader cover required if hospital acquired or secondary to trauma, surgery or aspiration.
	If MRSA is suspected add IV Vancomycin to the above combinations  <b>Duration:</b> 2-4 weeks		



# CNS INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Bacterial meningitis and meningococcal disease</b>  <b>Empiric therapy</b> Children < 3 months	IV Cefotaxime + IV Amoxicillin	If history of immediate hypersensitivity to penicillin or cephalosporin : IV Chloramphenicol	Do not use corticosteroids in children < 3 months
Children > 3 months	IV Ceftriaxone IV +/- IV Dexamethasone (0.15mg/kg max 10mg qds for 4 days)	If history of immediate hypersensitivity to penicillin or cephalosporin :  IV Fosfomycin	<b>Add Dexamethasone</b> if lumbar puncture shows any of the following: - CSF is very purulent, - CSF WBC count > 1000/microlitre - raised CSF WBC count and protein greater than 1g/litre - bacteria on gram stain Give dexamethasone preferably before or with 1 <sup>st</sup> dose of antibiotics or within 4 hours, (if missed do not start 12 hours or later after starting antibiotics). <b>Avoid dexamethasone</b> in septic shock, meningococcal septicaemia, if immunocompromised, or in meningitis following surgery.

**For all ages:**

If recent multiple  
antibiotics exposure  
or overseas travel

Consider adding  
IV Vancomycin

If signs/symptoms  
suggestive of  
herpes simplex  
encephalitis

Add IV Aciclovir

At discretion of Consultant

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>For confirmed disease:</b> <b>Children &lt; 3 months</b> Neisseria meningitidis	IV Cefotaxime for 7 days in total		
Group B streptococci	IV Cefotaxime for at least 14 days		
Listeria monocytogenes	IV Amoxicillin for 21 days + IV Gentamicin for 1 <sup>st</sup> 7 days		
Gram negative bacilli	IV Cefotaxime for at least 21 days		Perform lumbar puncture on 20 <sup>th</sup> day of 3 week course, before decision is made to stop treatment

<b>For unconfirmed disease:</b> <b>Children &lt; 3 months</b>	IV Cefotaxime + IV Amoxicillin for at least 14 days		Stop treatment Failed lumbar puncture or negative blood/CSF culture and/or blood/CSF PCR
<b>For confirmed disease:</b> <b>Children &gt; 3 months</b> Neisseria meningitidis  Strep pneumoniae  H. influenzae type b	IV Ceftriaxone for 7 days in total  IV Ceftriaxone for 14 days  IV Ceftriaxone for 10 days	If history of immediate hypersensitivity to penicillin or cephalosporin : IV Fosfomycin  If history of immediate hypersensitivity to penicillin or cephalosporin :  IV Fosfomycin	Do not give Ceftriaxone with calcium containing fluids
<b>For unconfirmed disease:</b> <b>Children &gt; 3 months</b>	IV Ceftriaxone for at least 10 days	If history of immediate hypersensitivity to penicillin or cephalosporin : IV Fosfomycin	Failed lumbar puncture or negative blood/CSF culture and/or blood/CSF PCR Do not give ceftriaxone with calcium containing fluids





# MENINGOCOCCAL MENINGITIS PROPHYLAXIS

## ELIMINATION OF NASAL CARRIAGE OF ORGANISMS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
Prophylaxis of meningococcal meningitis			Must be given to any baby / child who has not received ceftriaxone
Neonate	<b>PO Ciprofloxacin:</b> 30mg/kg (max 125mg) as single dose		(Ciprofloxacin is not licensed for meningococcal prophylaxis).
Child 1 month – 5 years	30mg/kg (max 125mg) as single dose		
Child 5 – 12 years	250mg as single dose		
Child 12-18 years	500mg as a single dose <b>OR</b>		
Neonate	<b>PO Rifampicin:</b> 5mg/kg every 12 hours for 2 days		Stains body fluids orange including urine, saliva and tears
Child 1 month – 1 year	5mg/kg every 12 hours for 2 days		
Child 1-12 years	10mg/kg (max 600mg) every 12 hours for 2 days		
Child 12-18 years	600mg every 12 hours for 2 days		Can stain contact lenses. Reduces effectiveness of hormonal contraceptives, alternative measures must be used.

# URINARY TRACT INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Children &lt; 3 months with possible UTI<sup>1</sup></b>	<b>IV Cefotaxime + IV Amoxicillin</b>		Treat as per feverish illness in children (see <a href="#">page 12</a> )
<b>Acute pyelonephritis</b>  Infants and children > 3 months	IV Ceftriaxone for 72 hours then review. Step down to PO cefalexin or as per sensitivities  <b>Duration: 10 days</b>	IV Gentamicin for 72 hours then review. Step down to PO Trimethoprim if sensitive  <b>Duration: 10 days</b>	Ceftriaxone contra-indicated in G6PD deficiency, impaired renal function
<b>Cystitis/Lower UTI<sup>1</sup></b> Infants and children > 3 months	1st Line: PO Cefalexin 2 <sup>nd</sup> line: PO Trimethoprim  <b>Duration: 3 days</b>	PO Trimethoprim	Asymptomatic bacteriuria should not be treated with antibiotics
<b>UTI Prophylaxis</b> If prophylaxis warranted	PO Trimethoprim		

# BONE AND JOINT INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Osteomyelitis and Septic Arthritis</b> Organisms:  < 3 months Group B Strep. Staph aureus Coliforms	IV Cefotaxime + if sepsis or meningitis IV amoxicillin (stop amoxicillin when listeria meningitis excluded) Step down to PO Co-amoxiclav <b>Duration:</b> 14 – 21 days IV, treat for 6 weeks total		See also feverish illness in children ( <a href="#">page 12</a> )

<p>3 months to 5 years</p> <p>Staph. aureus</p> <p>Kingella kingae</p> <p>S pneumoniae</p> <p>Haemophilus sp.</p> <p>E coli</p>	<p>IV Ceftriaxone + PO Fusidic acid /Sodium fusidate</p> <p><b>Duration:</b> 4 weeks IV or depending on radiology or clinical decision</p>	<p>IV Clindamycin + PO Fusidic acid /Sodium fusidate</p> <p><b>Duration</b> 4 weeks IV or depending on radiology or clinical decision</p>	<p>Suspension = fusidic acid and dosing is higher than sodium fusidate tablets.</p> <p>If source identified and sensitive can step down to PO Flucloxacillin if appropriate</p>
<p>&gt; 5 years</p> <p>Staph. aureus</p>	<p>IV Flucloxacillin</p> <p><b>Duration:</b> 4 weeks IV or depending on radiology or clinical decision</p>	<p>IV Clindamycin</p> <p><b>Duration:</b> 4 weeks IV or depending on radiology or clinical decision</p>	



# SKIN AND SOFT TISSUE INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Erysipelas</b> Group A Strep (most common) Staph. aureus	PO Phenoxymethylpenicillin (Penicillin V)  If known Staph aureus PO Flucloxacillin  <b>Duration</b> 7-10 days based on clinical decision, further treatment if indicated clinically	PO Erythromycin Or PO Clarithromycin  <b>Duration</b> 7-10 days based on clinical decision, further treatment if indicated clinically	Increasing resistance of group A Strep against macrolides, review if no improvement
If severe	IV Benzylpenicillin Or if known Staph aureus IV Flucloxacillin  <b>Duration</b> 7-10 days based on clinical decision, further treatment if indicated clinically	IV Clindamycin  <b>Duration</b> 7-10 days based on clinical decision, further treatment if indicated clinically	

**Cellulitis**

Staph aureus  
Group A Strep or  
other Streptococci

Severe

IV Benzylpenicillin + IV  
Flucloxacillin

**Duration**

7-10 days based on  
clinical decision, further  
treatment if indicated  
clinically

Less severe or step  
down

PO Flucloxacillin

**Duration**

7-10 days based on  
clinical decision, further  
treatment if indicated  
clinically

IV Clindamycin

**Duration**

7-10 days based on  
clinical decision,  
further treatment if  
indicated clinically

PO Clindamycin

**Duration**

7-10 days based on  
clinical decision,  
further treatment if  
indicated clinically

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
<b>Infected Eczema</b> Staph aureus	1 <sup>st</sup> line: PO Flucloxacillin 2 <sup>nd</sup> line: PO Co-amoxiclav <b>Duration:</b> 10 days	PO Erythromycin or PO Clarithromycin  <b>Duration:</b> 10 days	As guided by skin swabs
<b>Preseptal (Periorbital) Cellulitis</b> Staph aureus Coagulase negative staph Streptococci Anaerobes Haemophilus influenzae	IV Co-amoxiclav  <b>Duration:</b> Ideally 2 weeks, however oral step down can be considered on clinical grounds	IV Clindamycin  <b>Duration:</b> Ideally 2 weeks however oral step down can be considered on clinical grounds	Risk of extension into the orbit in young children

<b>Orbital cellulitis</b> Strep pneumoniae Staph aureus Strep pyogenes H. influenzae Anaerobes  < 3 months  > 3 months	IV Cefotaxime  IV Ceftriaxone		<b>Ophthalmic Emergency</b> Infection of soft tissues behind orbital septum. <b>Refer urgently to Ophthalmology</b> Refer to ENT
	<b>Duration:</b> Minimum 2 weeks , longer if needed		If no improvement within 48 hours consider adding IV Metronidazole + IV Clindamycin
	<b>Dog bite / Human bite</b>  PO Co-amoxiclav <b>Duration:</b> 5 to 7 days	PO Metronidazole and PO Erythromycin or Clarithromycin <b>Duration:</b> 5 to 7 days	

# OPHTHALMIC INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
Conjunctivitis	Chloramphenicol eye drops 0.5% <b>Duration:</b> 5 days or based on clinical improvement		



# DENTAL INFECTIONS

Infection	Antibiotic Therapy	Penicillin Allergy	Comments
Dental Abscess	PO Metronidazole Duration: 7 to 14 days Review day 3, if no improvement add PO Amoxicillin	PO Metronidazole Duration: 7 to 14 days Review day 3, if no improvement add PO Clindamycin	

# SURGICAL PROPHYLAXIS

Procedure	Prophylactic Antibiotic	Penicillin Allergy	Comments
<b>Tonsillectomy</b>	Antibiotic prophylaxis not recommended		
<b>Adenoidectomy by curettage</b>	Antibiotic prophylaxis is not recommended		
<b>Grommet insertion</b>	Single topical dose Chloramphenicol ear drops		
<b>Appendicectomy</b>	At induction: IV Amoxicillin 50mg/kg (max 2g) + IV Metronidazole infusion Child if 17kg or more give 500mg (if less than 17 kg give 30mg/kg)	At induction: IV Gentamicin 2.5mg/kg + IV Metronidazole infusion if 17kg or more give 500mg (if less than 17 kg give 30mg/kg)	If gangrenous appendix then change to IV Amoxicillin + IV Metronidazole for 5 days

<b>Colorectal surgery</b>	At induction: IV Amoxicillin 50mg/kg (max 2g) + IV Metronidazole infusion if 17kg or more give 500mg (if less than 17 kg give 30mg/kg)	At induction: IV Gentamicin 2.5mg/kg + IV Metronidazole infusion if 17kg or more give 500mg (if less than 17 kg give 30mg/kg)	If further treatment is required post-op switch to IV Amoxicillin + IV Metronidazole
<b>Splenectomy</b>	Antibiotic prophylaxis is not recommended Consider in immunosuppression		
<b>Open surgery for closed fractures</b>	At induction: IV Co-Amoxiclav	At Induction: IV Clindamycin	



*Thanks for your attention*

