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Handbook of PEDIATRIC Drug Therapy and Immunization

RK Suneja

3rd Edition

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4 CHAPTER

Preferred Antimicrobial Agents against Selected Bacteria

Table 4.1 lists drugs of choice and alternatives for empirical use against selected commonly encountered bacteria. It is based on generally observed sensitivity pattern of different bacteria to various antibiotics. Clinicians must, however, take into due consideration the locally prevalent antibiotic sensitivity/resistance pattern of organisms in their region, community and institution to arrive at the appropriate choice of antimicrobial agents in their clinical practice. The choice of appropriate antibiotic in an individual case would also be influenced by the site and severity of infection, presence of any coexisting morbid conditions and patient's immunologic status. As far as possible, first-line simple antibiotic, which would suffice in the particular case, should be chosen for treatment instead of the strong second-line one.

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Table 4.1: Drugs of choice and alternatives for empirical use against selected commonly encountered organisms.

Organism and the common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
Bacteroides fragilis *Peritonitis, sepsis, abscesses, appendicitis*	Metronidazole Clindamycin	Piperacillin-tazobactam Ticarcillin/clavulanate	Meropenem, imipenem
Bordetella pertussis *Pertussis*	(for age >1 month Erythromycin Clarithromycin	For <1 month azithromycin	For children aged >2 months TMP–SMX
***Brucella* spp.** *Brucellosis*	Doxy + genta	Doxy + RIF or TMP-SMX + genta	Doxy + RIF + genta
Campylobacter jejuni *Diarrhea*	Erythromycin, azithromycin	Ciprofloxacin	TMP-SMX
Chlamydia trachomatis *Urethritis, vaginitis (in adolescents)*	Erythro, azithro	Ofloxacin, levofloxacin	

Contd…

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Organism and the common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
Clostridium difficile *Antibiotic associated colitis*	Mild illness: Metronidazole (PO)	Moderate, severe illness vancomycin (PO)	Bacitracin (PO)
Clostridium tetani *Tetanus*	Penicillin G, metronidazole	Erythromycin, tetracycline, doxy	
Corynebacterium diphtheriae *Diphtheria*	Erythromycin (+ antitoxin)	Penicillin G/Procaine Penicillin	
Eikenella corrodens *Human bite wounds, abscesses, meningitis*	AM-CL, ampicillin	TMP-SMX, FQ, Penicillin G	(Resistant to: cephalexin, clindamycin, erythromycin, metronidazole)
Escherichia coli (E. coli) *UTI; not hospital acquired*	2nd/3rd gen. cephalosporin	Amp/Amox/TMP-SMX	
Sepsis, pneumonia, hospital-acquired UTI	Ceftriaxone/cefotaxime + aminoglycoside		

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Organism and the common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
E. coli – Meningitis	Ceftazidime/cefepime + aminoglycoside	Meropenem + ciprofloxacin	
E. coli – Diarrhea	See under 'Gastrointestinal Infections' in Chapter 1 (Guidelines for Antimicrobial Therapy)		
***Enterococcus* spp.** *Endocarditis, UTI*	Ampicillin + aminoglycoside	Vancomycin + aminoglycoside	For vancomycin resistant: Linezolid, daptomycin, tigecycline
Haemophilus ducreyi *Chancroid*	Azithro/ceftriaxone	Erythro, ciprofloxacin	
Haemophilus influenzae *URI, non-life-threatening*	AM-CL, Ceph 2/3	Ampicillin, Amoxycillin	
Meningitis, epiglottitis, pneumonia, arthritis	Ceftriaxone, cefotaxime	Amoxy-clavulanate	
Helicobacter pylori	See under treatment of *H. pylori* infection		

Contd…

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Organism and the common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
***Klebsiella* spp.** *UTI*	Fosfomycin	Nitrofurantoin	
Sepsis, pneumonia, meningitis	Imipenem, meropenem	Cefepime Fluoroquinolone	(Use most narrow spectrum effective agent as per culture) Colistin
Listeria monocytogenes *Sepsis, meningitis*	Ampicillin + gentamicin	TMP-SMX, erythromycin	Aminoglycoside + vancomycin
Moraxella catarrhalis *Sinusitis, otitis, bronchitis*	AM-CL, 2nd/3rd ceph, TMP-SMX	Azithro, clarithro	Erythro and quinolones
Mycoplasma pneumoniae *Pneumonia*	Erythro, azithro, clarithro	Doxycycline	
Neisseria gonorrhoeae *Gonorrhea*	Ceftriaxone/ cefotaxime + doxycycline or azithromycin	Cefixime + azithro/ doxycycline	

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Organism and the common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
Neisseria meningitidis *Meningitis, sepsis*	Penicillin G, ampicillin	Ceftriaxone, cefotaxime,	If β-lactam allergy, ciprofloxacin, chloramphenicol
Pasteurella multocida *Sepsis, abscesses, animal bite wound*	Penicillin G, AMP, amox, cefuroxime	Doxy, levo, moxi, TMP-SMX	Ceftriaxone, cefpodoxime
Proteus mirabilis *UTI, sepsis, meningitis*	Ampicillin, amoxy	Carbapenems, cephalosporins	Fluoroquinolones
Pseudomonas aeruginosa (i) *Urinary infection*	An antipseudomonal penicillin,* ceftazidime, cefepime imipenem, meropenem, tobramycin, ciprofloxacin, aztreonam	Piperacillin-tazobactam + aminoglycoside	
(ii) *Serious infections: sepsis, meningitis*	**Antipseudomonal penicillin–β-lactam combination + tobramycin or ciprofloxacin ** Ticarcillin-clavulanate/ Piperacillin-tazobactam	Meropenem, Aztreonam	

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Organism the Common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
Salmonella typhi[#a] *Typhoid fever, sepsis*	(Severe typhoid) Ceftriaxone, cefotaxime, FQ	Cefixime, azithro, TMP-SMX (for outpatient treatment)	Chloramphenicol, amox
Shigella sp.[#b] *Dysentery*	Cefixime Ceftriaxone, ciprofloxacin	Azithromycin	
Staphylococcus aureus (*Methicillin-sensitive*)	Cloxacillin/nafcillin	Clinda, vanco	
(Methicillin-resistant)	Vancomycin + gentamicin (for severe infection)	(For mild infection: Clinda, trimethoprim-sulfamethoxazole) (for very severe infection: linezolid, daptomycin)	
Staphylococcus epidermidis	Vancomycin	FQ	
Staphylococcus saprophyticus	Ceph oral; AM-CL	FQ, TMP-SMX	

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Organism the common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
Strep. (Group A, B, C, G, F) (*Streptococcus pyogenes*) Penicillin-sensitive			
(i) Pharyngitis, impetigo, adenitis	Penicillin V or amoxicillin, or benzathine penicillin	Macrolide, ceph 1, clindamycin	
(ii) Pneumonia, sepsis, meningitis	Penicillin G, ampicillin	A first-generation ceph, vancomycin	
(For serious group B infection)	Penicillin G ± gentamicin	Ampicillin + gentamicin	
(For serious group A infection)	Penicillin G ± clindamycin		
Streptococcus pneumoniae (i) Penicillin-sensitive	Amoxicillin Penicillin G	Ceftriaxone/cefotaxime A macrolide, clinda, cefpodoxime, cefdinir, TMP-SMX	
(ii) Penicillin-resistant	Vancomycin, rifampicin in meningitis cases, cefotaxime/ ceftriaxone	For non-meningeal infection: Cefotaxime, ceftriaxone, high dose AMP	Linezolid
Vibrio cholerae	Doxy or tetracycline	Erythromycin, azithromycin, ciprofloxacin	Quinolones effective for *V. cholerae* 01 and 0139 strains

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Organism the Common clinical illness	*Drug of choice*	*Alternative*	*#Other effective agents*
Yersinia enterocolitica *mild cases*	Ciprofloxacin; or TMP-SMX	Fluoroquinolones	
for systemic infection and very young:	Ceftriaxone (other parenteral 3rd gen ceph) + aminoglycoside		

*Antipseudomonal penicillins: Piperacillin, ticarcillin, mezlocillin, azlocillin

** Antipseudomonal penicillins-β-lactam combination: Ticarcillin clavulanate, Piperacillin-tazobactam.

#The list of other effective agents is not complete, only some of them have been listed.

(Amox: amoxicillin; clinda: clindamycin; AM-CL: amoxicillin clavulanate; AM-SB: ampicillin-sulbactam; AMP: ampicillin; azithro: azithromycin; CARB: carbapenem; clarithro: clarithromycin; ceph 1, 2, 3: first, second, third generation cephalosporin; CIP: ciprofloxacin; doxy: doxycycline; erythro: erythromycin; FQ: fluoroquinolones; gati: getifloxacin; IMP: imipenem; levo: levofloxacin; MER: meropenem; moxi: moxifloxacin; genta: gentamicin; Pip-Tz: piperacillin-tazobactam; RIF: rifampicin; teico: teicoplanin; TMP-SMX: trimethoprim-sulfamethoxazole; UTI: urinary tract infection; vanco: vancomycin)

#a & #bFor details see under diseases in Chapter 1.

RESERVE ANTIMICROBIALS

These drugs are held in reserve to maintain their effectiveness in treating certain difficult situations by reducing the spread of microbial resistance.

Carbapenems (Imipenem-cilastatin, Meropenem, Ertapenem)

Special indications:

- Severe sepsis (more than one organ failure of recent onset and/or elevated serum lactate level)
- Clinical failure of other antibiotics over 48 hours (worsening inflammatory markers, unresolving fever, new/worsening hemodynamic instability)
- Underlying severe immune suppression, e.g. neutropenia, immunosuppressive therapy, diabetic ketoacidosis
- Infections (e.g. bacteremia, intra-abdominal infections, nosocomial pneumonia, etc.) caused by gram-negative bacteria (*E. coli*, *Klebsiella*, *Enterobacter* spp., *Pseudomonas aeruginosa*) resistant to other classes of antibiotics and susceptible only to carbapenems on culture and sensitivity studies.

Linezolid (Intravenous and Oral)

For restricted use only:

- Glycopeptide-insensitive *Staphylococcus aureus*
- Vancomycin-resistant Enterococcus
- For IV/oral switch from IV vancomycin [used for methicillin-resistant *Staphylococcus* (MRS) or methicillin-resistant *Staphylococcus epidermidis* (MRSE)] to oral linezolid on discharge when rifampicin-trimethoprim combination is inappropriate.
- As home/outpatient parenteral antibiotic therapy for skin and soft tissue infections as an alternative to IV teicoplanin.

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Colistin

Indications:

- Pan-resistant organisms as per culture report with evidence of invasive disease—fever/leukocytosis/elevated procalcitonin (PCT) or culture from a sterile site.
- Clinical failure of all other classes of antibiotics over 75 hours.

Rifampicin

Indications:

- For treatment of tuberculosis as a part of 4-drug regimen
- Treatment of mycobacteria
- Chemoprophylaxis of meningococcal meningitis.

Note: Rifampicin not to be used alone as an antibacterial.

Aminoglycosides

Criteria for use:

- Only as a part of initial empiric regimen of a combination therapy to step down to single drug after culture report
- Other safer drug option not available on culture report
- Not to be used if focus of infection in lung or anaerobic abscess.

Vancomycin

Drug of choice for inpatient treatment of following infections:

- Serious (e.g. bacteremia, osteomyelitis) coagulase negative Staphylococcus and methicillin-resistant *Staphylococcus aureus* (MRSA) infections and penicillin-resistant enterococcal infections
- Empiric therapy in febrile neutropenia patients not responding to first-line therapy
- Continuous ambulatory peritoneal dialysis (CAPD) associated peritonitis
- Prosthetic value endocarditis.

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Teicoplanin

It is a suitable alternative to vancomycin for all indications for vancomycin, except meningitis.

- Patients on outpatient parenteral therapy with glycopeptide loading doses
- Inability to tolerate vancomycin
- Oncology/hematology patients
- Rare cases of vancomycin resistant and teicoplanin sensitive.

TREATMENT OF MULTIDRUG-RESISTANT BACTERIAL PATHOGENS

- MRSA
- Vancomycin-resistant *Enterococcus*
- Extended-spectrum β-lactamases (ESBL) producing Enterobacteriaceae
- Carbapenem-resistant Enterobacteriaceae.

Treatment of Methicillin-resistant *Staphylococcus aureus*

- Resistant to all penicillins, cephalosporins, and macrolides
- May be sensitive in vitro but do not use: Fluoroquinolones, aminoglycosides, CM, doxycycline
- Avoid rifampicin (except for tuberculosis, other mycobacterial diseases).
- Drugs of choice:
  - Vancomycin, teicoplanin (glycopeptides)
  - Linezolid: for skin and soft tissue infections
  - Mupirocin local intranasal application—for eradicating nasal carriage
  - Daptomycin: For complicated skin infection; for *S. aureus* bacteremia. NOT FOR treatment of pneumonia as it gets inactivated by pulmonary surfactant and has poor lung penetration.

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Treatment of Vancomycin-resistant *Enterococcus*

Linezolid: Only drug specifically approved for vancomycin-resistant Enterococcus-bloodstream infection

Other approved drugs for specific situations:

- Nitrofurantoin: for uncomplicated urinary tract infection
- Fosfomycin: Urinary tract infection susceptible isolates
- Streptomycin + Ampicillin: for enterococcal endocarditis by susceptible organisms
- Ampicillin (high dose)—for susceptible strain isolates.

Treatment of ESBL-producing *Enterobacteriaceae*

Drugs of choice for serious infections caused by these agents:

- Carbapenems (Ertapenem, meropenem, imipenem)
- For mild infections when ESBL susceptible in vitro—piperacillin-tazobactam, cefoperazone-sulbactam—use group 1 carbapenems.

Note: These organisms resistant to most broad-spectrum antibiotics. Do not use even if in vitro sensitive to all penicillins, cephalosporins (including cefepime, cefpirome), aztreonam.

Treatment of Carbapenem-resistant Enterobacteriaceae (Extremely Drug Resistant)

- **Tigecycline:** Active in vitro
  Licensed for use in complicated skin and first-time infection and complicated intra-abdominal infection
- **Colistin**—successful in some cases
  Some strains may be susceptible to CM, ciprofloxacin, cotrimoxazole.

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Handbook of PEDIATRIC Drug Therapy and Immunization

Salient Features

- The book is a concise, wide-ranging, and up-to-date ready reference companion guide for pediatricians, residents, postgraduate (PG) and undergraduate (UG) students, and general practitioners.
- It provides standard guidelines for the management of a wide-range of pediatric disorders encountered in one's day-to-day practice in outdoor, indoor, as well as intensive care settings.
- The spectrum of effectiveness of various antibiotics and their rational use in management of different types of infections have been described.
- Current guidelines for immunization and pre- and postexposure prophylaxis in children have been discussed.
- The indications, dosage, precautions, contraindications, and side effects of various drugs used in neonates, infants, and children alongside names of some proprietary products have been detailed.
- An excellent index provides instant retrieval of the conditions being searched for, which enables prompt institution of appropriate therapy.

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