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Infections: session 1

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Learning Objectives

Analyse patient information to support the appropriate diagnosis and management of infections

Clinically evaluate the appropriateness of prescribed anti-infective agents

Apply the principles of antimicrobial stewardship, to ensure optimal care of patients


Day 1 pharmacist
Believe
You
Doing (Learning in Practice)
Revision and preparation …and rest

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Recognise an infection

REVIEW the patient information and make an appropriate diagnosis.

A 46-year old male has a past medical history of renal transplant. He is normally prescribed aspirin 75mg every morning, atorvastatin 20mg at night, prednisolone 20mg in the morning, tacrolimus (Adoport) 6mg twice a day, mycophenolate (Myfenax) 1g twice a day and cimetidine 400mg twice a day. He visits a late-night pharmacy to request a suitable moisturiser for his left leg. He thinks it might be sunburn as he has been feeling warm all over and tired. The leg is dark red/burgundy and appears swollen, making the skin appear smooth and shiny. When touched, the patient says the leg is tender.

Answer: cellulitis

REVIEW the patient information and make an appropriate diagnosis.

A 11-year old female appears unwell, prompting the parent to contact the urgent care services. The patient is normally fit and well and has no significant medical history. The parent states that the child has a severe headache, and has vomited several times. The child appears drowsy and is complaining that the light is hurting her eyes. On examination the child appears warm to touch and there appears to be some bruising of the skin, which is purple in colour.

Answer: meningitis

Bacterial

- Pain
- Swelling
- Redness*
- Heat
- Loss of function
- Discharge
- Temperature at extremities
- WCC, CRP, neutrophils – out of range
- Heart rate and BP

Fungal

- Itching
- Soreness
- Flaky skin

- Systemic infection – similar to bacterial

Viral

- Dehydration
- Diarrhoea
- Fever and aches
- Nausea and vomiting
- Rashes*
- Rhinorrhoea
- Sore throat

- Systemic infection – similar to bacterial

***Be mindful of skin tone**

Principles of good Antimicrobial Stewardship

You need to be apply these principles in practice (and theoretical/simulated situations):

Assess patient and try to **identify source/likely causative organism** (NB antibiotics will not be effective against viral infections)

Samples should be taken for culture and sensitivities (ideally before starting antimicrobials)

Narrow spectrum antimicrobials are preferred

Duration of therapy **depends on the nature** of the infection **and the response** to treatment

Prolonged courses can lead to **antimicrobial resistance**, as well as increased risk of side effects and increased cost

Decide whether each of the statements below are TRUE or FALSE

STATEMENT 1: Antibiotic therapy should always be initiated prior to taking a sample for bacteriological testing

STATEMENT 2: The choice of antibiotics for empirical therapy should be based on knowledge of prevalent organisms and their sensitivities.

Decide whether each of the statements below are TRUE or FALSE

STATEMENT 1: Antibiotic therapy should always be initiated prior to taking a sample for bacteriological testing - **FALSE**

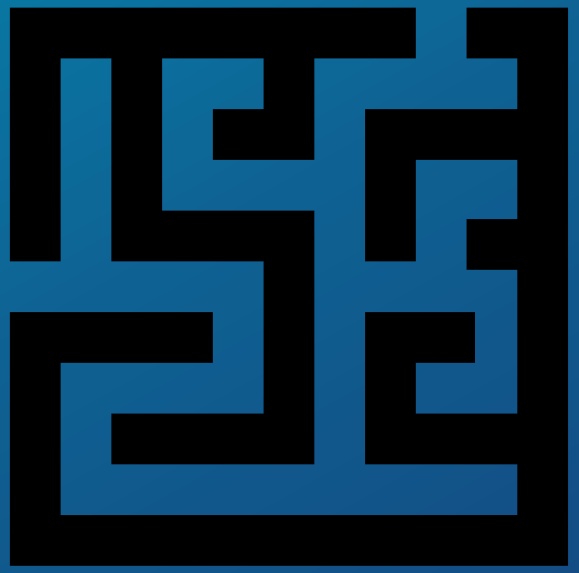
STATEMENT 2: The choice of antibiotics for empirical therapy should be based on knowledge of prevalent organisms and their sensitivities - **TRUE**

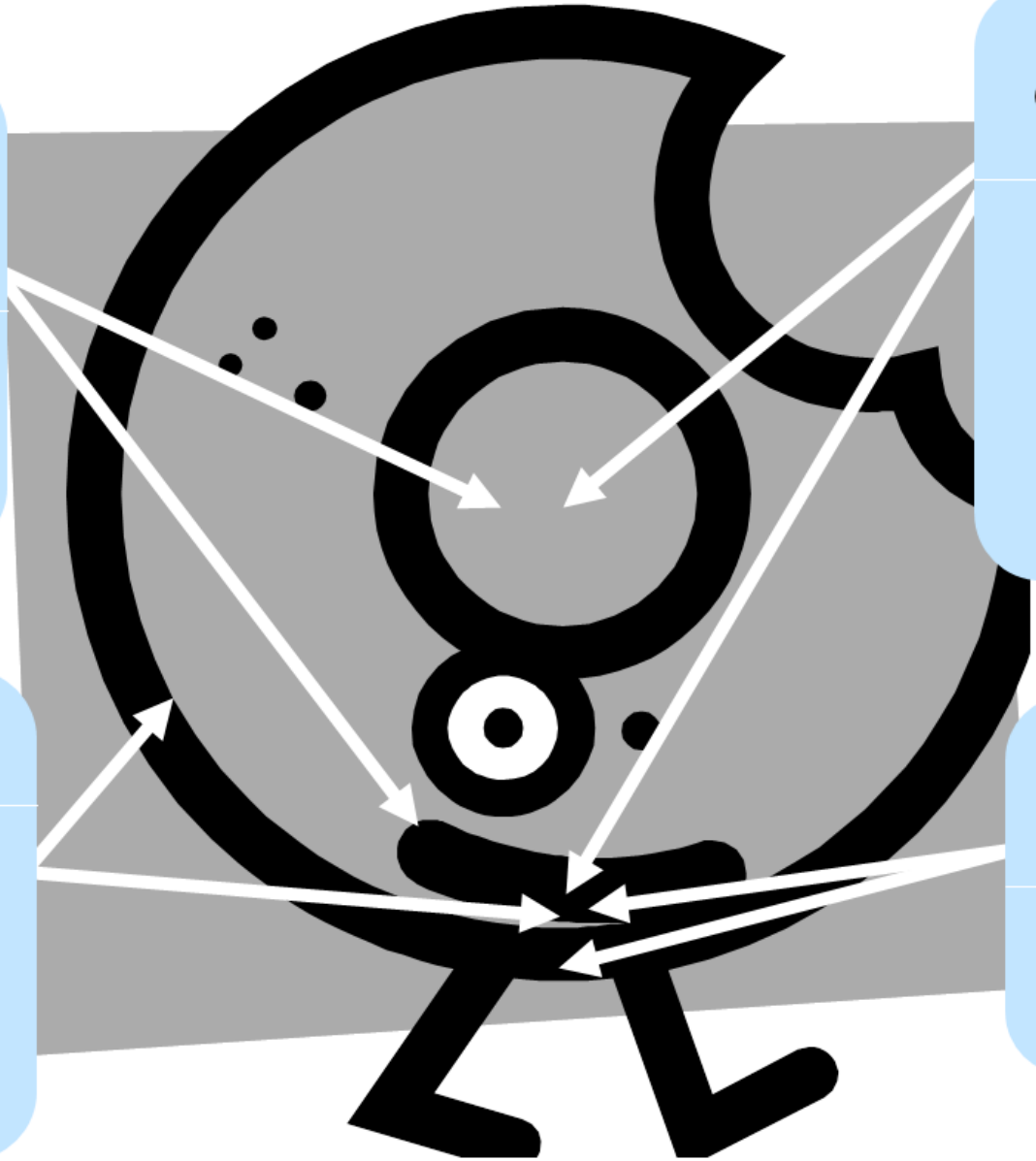
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Antibacterials

- Know and apply your spectrum of activity
- Know how they work
- Recommend appropriate antibiotics for common infections
- Undertake appropriate monitoring of antibiotics
- Provide patient information to support adherence

Revision game





Anaerobes
Mouth, teeth, throat, sinuses, lower bowel

Dental infection
Peritonitis
Appendicitis
Abscesses

Gram -ve
GI tract, genito-urinary, chest

Peritonitis
Biliary infection
Pancreatitis
UTI
PID
CAP/HAP/VAP
Sinusitis

Gram +ve
Skin, bone, chest

Cellulitis
Wound infection
Line infection
Osteomyelitis
Pneumonia
Sinusitis

Atypicals
Chest, genito-urinary

Pneumonia
Urethritis
PID

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Table of Bacterial Causes of Infection

✓ = Common Cause – = Not a Common cause ? = Uncommon Cause **OR** only under specific circumstances (see notes)

Clinical Scenarios	Gram-positive Bacteria								Anaerobes		Gram-negative Bacteria									Non-Culturable		
	Staphylococcus aureus (MSSA)	Staphylococcus aureus (MRSA)	Coagulase Negative Staphylococcus	Beta-haemolytic Streptococcus (A, B, C, G)	Enterococcus faecalis	Enterococcus faecium	Streptococcus pneumoniae	Listeria monocytogenes	Clostridium perfringens	Clostridium difficile	Bacteroides fragilis	Neisseria meningitidis	Neisseria gonorrhoeae	Haemophilus influenzae	Escherichia coli	ESBL-positive Escherichia coli	Enterobacteriaceae	Pseudomonas aeruginosa	Moraxella catarrhalis	Legionella pneumophila	Mycoplasma pneumoniae	Chlamydia spp.
Respiratory Infections																						
Community Acquired Pneumonia (CAP)	✓1	–	–	–	–	–	✓	–	–	–	–	–	–	✓	–	–	–	–	–	✓	✓	✓
Hospital Acquired Pneumonia (HAP)	✓	✓	–	–	–	–	✓	–	–	–	–	–	–	✓	?2	?2	✓	✓	–	–	–	–
Ventilator Associated Pneumonia (VAP)	✓	✓	–	–	–	–	✓	–	–	–	–	–	–	✓	✓	✓	✓	✓	–	–	–	–
Aspiration Pneumonia	✓	–	–	–	–	–	✓	–	–	–	✓	–	–	✓	✓	✓	✓	–	–	–	–	–
Exacerbation of COPD	✓	–	–	–	–	–	✓	–	–	–	–	–	–	✓	–	–	–	–	✓	–	–	–
Acute Bronchitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Head and Neck Infections																						
Otitis Media	–	–	–	–	–	–	✓	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–
Otitis Externa	✓	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Orbital Cellulitis	✓	–	–	✓	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sinusitis	✓	–	–	✓	–	–	✓	–	–	–	✓	–	–	✓	–	–	–	–	–	–	–	–
Urogenital Infections																						
Urinary Tract Infection (UTI)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	?3	–	–	–	–
Prostatitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	?3	–	–	–	–
STDs	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	✓
Skin, Soft Tissue, Bone and Joint Infections																						
Cellulitis	✓	✓	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cellulitis in Diabetes & Vascular Insufficiency	✓	✓	–	✓	–	–	–	–	✓	–	✓	–	–	–	✓	–	✓	✓	–	–	–	–
Bites	✓	–	–	✓	–	–	–	–	✓	–	✓	–	–	✓	–	–	–	–	–	–	–	–
Burns, Skin Grafts, Post-Operative	✓	✓	–	✓	–	–	–	–	✓	–	✓	–	–	–	✓	–	✓	✓	–	–	–	–
Intravenous Device Associated Infection	✓	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	?4	?4	–	–	–	–
Osteomyelitis	✓	✓	–	✓	–	–	–	–	–	–	–	–	–	–	?5	–	?5	–	–	–	–	–
Septic Arthritis	✓	✓	–	✓	–	–	–	–	–	–	–	–	–	–	?5	–	?5	–	–	–	–	–

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Table of Antibiotic Spectrum of Activity

✓ = Usually sensitive – = usually resistant **OR** inappropriate therapy **?** = Variable sensitivity **P** = Prophylaxis only

Antibiotic	Gram-positive Bacteria								Anaerobes		Gram-negative Bacteria									Non-Culturable		
	Staphylococcus aureus (MSSA)	Staphylococcus aureus (MRSA)	Coagulase Negative Staphylococcus	Beta-haemolytic Streptococcus (A, B, C, G)	Enterococcus faecalis	Enterococcus faecium	Streptococcus pneumoniae	Listeria monocytogenes	Clostridium perfringens	Clostridium difficile	Bacteroides fragilis	Neisseria meningitidis	Neisseria gonorrhoeae	Haemophilus influenzae	Escherichia coli	ESBL-positive Escherichia coli	Enterobacteriaceae	Pseudomonas aeruginosa	Moraxella catarrhalis	Legionella pneumophila	Mycoplasma pneumoniae	Chlamydia spp.
Penicillins																						
Benzylpenicillin	–	–	–	✓	✓	–	✓	✓	✓	–	–	✓	?	–	–	–	–	–	–	–	–	–
Amoxicillin / Ampicillin	–	–	–	✓	✓	–	✓	✓	✓	–	–	✓	?	?	?	–	–	–	–	–	–	–
Co-amoxiclav	✓	–	–	✓	✓	–	✓	–	✓	–	✓	–	?	✓	✓	–	?1	–	✓	–	–	–
Flucloxacillin	✓	–	?	✓	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Temocillin	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓	–	✓	–	–	–
Pivmecillinam Hydrochloride	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	–	–	–	–	–
Piptazobactam	✓	–	–	✓	✓	–	✓	–	✓	–	✓	–	–	✓	✓	–	✓1	✓	✓	–	–	–
Cephalosporins																						
Cefradine	✓	–	?	✓	–	–	✓	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–
Cefalexin	✓	–	?	✓	–	–	✓	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–
Cefuroxime	✓	–	?	✓	–	–	✓	–	–	–	–	–	–	✓	✓	–	?	–	✓	–	–	–
Ceftriaxone / Cefotaxime	✓	–	–	✓	–	–	✓	–	–	–	–	✓	✓	✓	✓	–	✓2	–	✓	–	–	–
Ceftazidime	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	✓2	✓	✓	–	–	–
Ceftazidime + Avibactam	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓6	✓6	✓6	✓6	✓	–	–	–
Ceftolozane + Tazobactam	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	–	✓	✓	–	–	–
Ceftaroline	✓	✓	✓	✓	–	–	✓	–	✓	–	–	–	–	✓	✓	–	✓2	–	✓	–	–	–
Carbapenems																						
Ertapenem	✓	–	–	✓	✓	–	✓	–	✓	–	✓	–	–	✓	✓	✓	✓	–	✓	–	–	–
Meropenem	✓	–	–	✓	✓	–	✓	✓	✓	–	✓	✓	–	✓	✓	✓	✓	✓	✓	–	–	–
Diaminopyramidines																						
Trimethoprim	?	?	–	–	–	–	–	–	–	–	–	–	–	?	✓	–	✓	–	–	–	–	–
Macrolides and Lincosamides																						
Erythromycin	✓	?	–	✓	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓
Clarithromycin	✓	?	–	✓	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓
Azithromycin	✓	–	–	✓	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓
Clindamycin	✓	?	–	✓	–	–	✓	–	✓	–	✓	–	–	–	–	–	–	–	✓	–	–	–

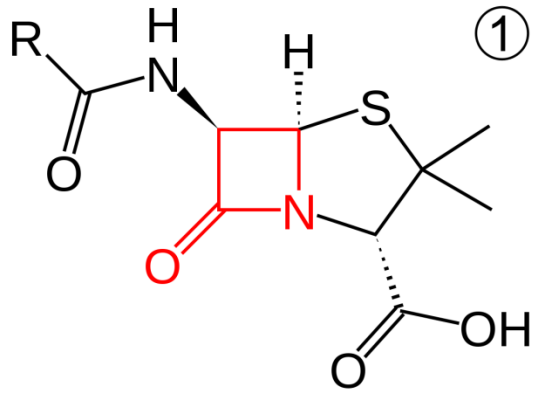
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	Spectrum of activity	Bactericidal/Bacteriostatic	Mechanism of action
penicillins	Broad spectrum*	Bactericidal	Interferes with cell wall synthesis
cephalosporins	Broad spectrum**	Bactericidal	Interferes with cell wall synthesis
carbapenems	Broad spectrum	Bactericidal	Interferes with cell wall synthesis
tetracyclines	Broad spectrum	Bacteriostatic	Inhibits bacterial protein synthesis
macrolides	Broad spectrum*	Bacteriostatic	Inhibits bacterial protein synthesis
clindamycin	Gram +ve cocci, anaerobes	Bacteriostatic	Inhibits bacterial protein synthesis
trimethoprim	Gram –ve bacillus	Bactericidal/bacteriostatic – depending on conditions	Interferes with folate synthesis
co-trimoxazole (trimethoprim + sulfamethoxazole)	Broad spectrum	Bacteriostatic	Interferes with folate synthesis
aminoglycosides	Narrow – mainly Gram –ve	Bactericidal	Inhibits bacterial protein synthesis
glycopeptides	Gram +ve	Bactericidal	Interferes with cell wall synthesis
quinolones	Gram –ve, some Gram +ve and pseudomonas	Bactericidal	Bacterial DNA fragmentation
metronidazole	Anaerobes	Bactericidal	Metabolites incorporated into bacterial DNA
nitrofurantoin	Gram –ve bacillus	Bactericidal	Damages DNA and interferes with translation***

***spectrum of activity differs between agents in class**
**** G-ve cover ↑ and G+ve cover ↓ with each generation (5 generations in total)**
***** exact mechanism unknown**

Penicillins

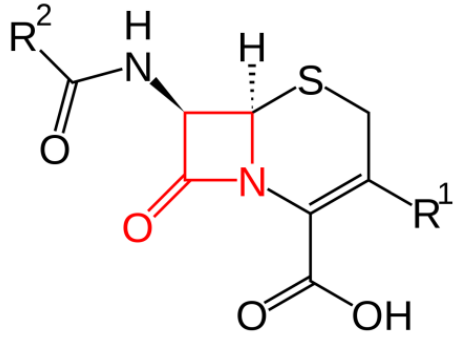
- Often **first line** choice antibiotics
- **Overcoming resistance**: penicillin + beta-lactamase inhibitor – e.g. co-amoxiclav, piperacillin/tazobactam
- **Commonly used for**: respiratory tract infections, cellulitis, some for UTIs, some for intra-abdominal infections (in combination)
- Generally considered safe in pregnancy and breastfeeding
- **Hepatic** disorder: risk of cholestatic jaundice and hepatitis



- **Timing** of food with administration e.g. flucloxacillin, phenoxymethylpenicillin (empty stomach)

Cephalosporins

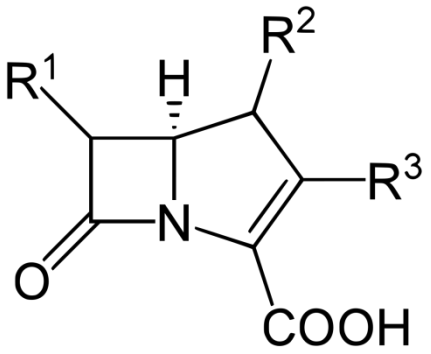
- 5 generations in total
  - 1st gen e.g. cefalexin, cefradine
  - 2nd gen e.g. cefuroxime
  - 3rd generation e.g. ceftriaxone, ceftazidime



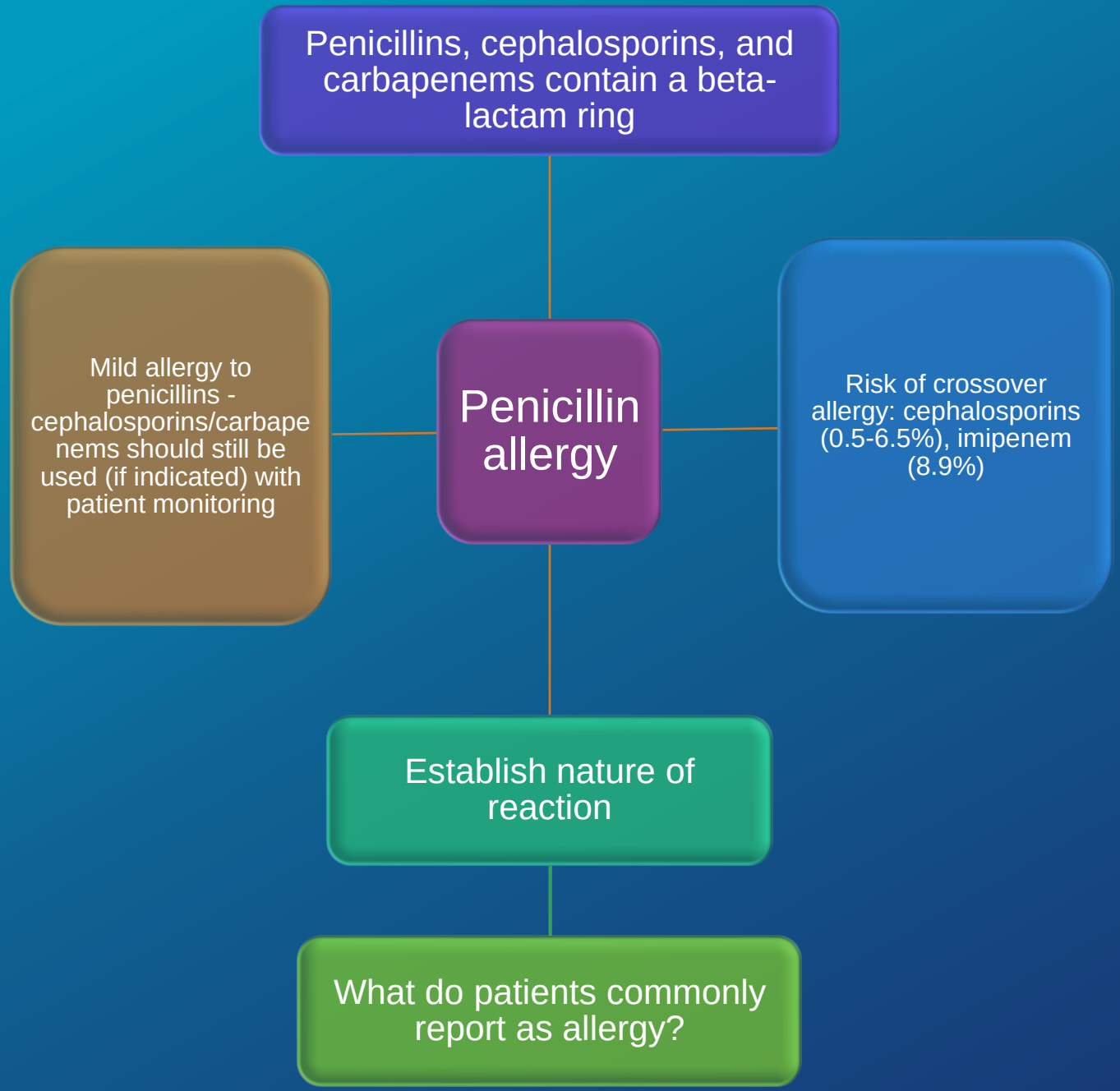
- Beta-lactams – **possible cross-sensitivity** with penicillin allergy (0.5-6.5%) → can be alternatives for patients with mild penicillin allergy
- Often **second line** choice antibiotics after penicillins
- Common uses: UTI/skin/respiratory infections
- **High risk for C.diff** so rarely used 1st line
- Generally considered safe in pregnancy and breastfeeding

Carbapenems

- Beta-lactam agents



- ?10% **cross sensitivity to penicillin** allergy
  - Avoid if severe penicillin allergy
- Reserved for severely ill patients
- Toxicity – **seizure risk** at high dose or in renal failure
- Significant interactions with valproate products


Penicillins, cephalosporins, and carbapenems contain a beta-lactam ring
Mild allergy to penicillins - cephalosporins/carbapenems should still be used (if indicated) with patient monitoring
Penicillin allergy
Risk of crossover allergy: cephalosporins (0.5-6.5%), imipenem (8.9%)
Establish nature of reaction
What do patients commonly report as allergy?

Tetracyclines

- Commonly used for: respiratory tract infections, skin infections, STIs
- **Avoid** in children/pregnancy/breast feeding – bones and teeth
- Oesophageal irritation, GI effects & photosensitivity
- Indigestion remedies, iron & zinc preparation ↓absorption
  - **Avoid** milk/dairy with tetracycline/oxytetracycline
  - **Avoid** iron preparation & calcium containing products with doxycycline

Macrolides

- Commonly used for: GI, skin and respiratory infections (as alternative to penicillins)
- Can cause **QT interval prolongation**
- GI disturbances but useful for erythromycin - used as prokinetic
- Common enzyme inhibitors – **multiple interactions**!
  - e.g. warfarin, carbamazepine, simvastatin

Clindamycin

- Lincosamide
- Commonly used for: skin/joint/bone infections
  - Good penetration into skin and bone
- 90% oral bioavailability
- Usually used when patient unable to have penicillin/in penicillin treatment failure
- High risk of *C. difficile* and can cause pseudomembranous colitis
  - Warning sign: diarrhoea

Trimethoprim & Co-trimoxazole

- Trimethoprim – commonly used for UTIs and skin infections
- Co-trimoxazole – commonly used for respiratory infections

- Caution with medications that also affect the folate pathway – **risk of severe bone marrow depression with methotrexate**

- Long-term use can cause blood disorders

- **Be aware of interactions**, for example phenytoin and warfarin

Aminoglycosides

- Commonly used for: urinary/abdominal sepsis, endocarditis, CF
- Frequently used in combination with other antibiotics
- **Dosing based on weight and renal function**
- **Narrow therapeutic index** - TDM required – levels vary depending on frequency of dosing and type of infection being treated.
- Risk of **nephrotoxicity & ototoxicity** (which is irreversible).
  - Monitor U&Es/urine output

Glycopeptides

- Mainly reserved for serious gram positive/MRSA infections, osteomyelitis, endocarditis, unresponsive skin infections
- **Dosing based on weight and renal function**
- **TDM required** – nephrotoxic
- Vancomycin:
  - Slow IV administration – risk of red man syndrome
  - Oral vancomycin not systemically absorbed – used for *C. difficile*

Quinolones

- Commonly used for: Respiratory infections, UTIs, bone and joint infections and STIs
  - **Usually reserved** for patients who can't have first line antibiotics
- Excellent oral bioavailability
- **Numerous issues**
  - Caution in epilepsy, elderly patients, under 16s
  - Can cause QT interval prolongation
  - Enzyme inhibitors – interactions common
  - Absorption decreased by antacid/calcium salts, iron & zinc
  - High risk of *C. difficile*, selective for MRSA
  - May induce convulsions in patients with or without a history of convulsions; taking NSAIDs at the same time may also induce them.
  - Risk of tendon damage

Metronidazole

- Commonly used for: GI tract infections
- **Disulfiram reaction** when taken with alcohol



- Usually used in combination with other agents
- Take with food – **GI disturbances**
- Very good bioavailability

Nitrofurantoin

- Treats lower UTIs
- Not systemically active, **requires adequate kidney function** to ensure it is excreted into urine - active
  - Avoid in severe renal impairment
- May discolour urine
- Take with/after food

Drugs used for tuberculosis (TB)

Management is divided in to 2 stages

- Initial phase (2 months)
  - Rifampicin, Isoniazid, Ethambutol, Pyrazinamide
- Continuation phase (4 months)
  - Rifampicin, Isoniazid

Rifampicin

- **Strong enzyme inducer** – watch out for interactions!
  - Examples includes: COC, ciclosporin, rivaroxaban
- Can cause **discoloration** (yellow, brown, orange or red colour) to teeth, urine, sweat, phlegm (sputum), saliva or tears and discolours soft contact lenses
- **Monitor** renal function, hepatic function and blood counts
  - Discontinue treatment if persistent nausea, vomiting, malaise or jaundice develop – could indicate liver disorder
- Take on an empty stomach (1 hour before food, or 2 hours after food)

Anti-tuberculosis drugs

Ethambutol

- Reversible (generally) ocular toxicity

Isoniazid

- **Peripheral neuropathy**
  - Co-prescribe pyridoxine
- Take on an empty stomach (1 hour before food, or 2 hours after food)

A. amoxicillin
B. azithromycin
C. cefuroxime
D. clindamycin
E. doxycycline
F. gentamicin
G. meropenem
H. teicoplanin

For the patient described, select the single most appropriate antibiotic from the list above. Each option may be used once, more than once, or not at all.

An 65-year old male with a past medical history of Clostridium difficile infection visits the dentist due to throbbing pain around his lower right wisdom tooth. The pain came on suddenly and has worsened over the last 48 hours. The tooth is tender to touch and impacting on eating and drinking. On examination the gum around the tooth appears red and swollen.

A. amoxicillin
B. azithromycin
C. cefuroxime
D. clindamycin
E. doxycycline
F. gentamicin
G. meropenem
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A. **chlamydia psittaci**
B. **clostridium difficile**
C. **escherichia coli**
D. **neisseria meningitidis**
E. **pneumocystis jirovecii**
F. **pseudomonas aeruginosa**
G. **streptococcus pneumoniae**

For the patient described, select the single most likely causative bacteria from the list above. Each option may be used once, more than once, or not at all.

A 85-year old male has a history of atrial fibrillation and COPD for which he normally takes apixaban 2.5mg twice a day, diltiazem 60mg three times a day, atorvastatin 20mg once a day, tiotropium 10 micrograms once a day, salbutamol 100 micrograms, when required . He presents at the emergency department with a productive cough and fever, which he has experienced for the last two days. His initial results on admission:

- Oxygen saturation 91% on air
- Respiratory rate 18
- Heart rate 110 bpm
- Temperature 38.3ºC

Blood and sputum cultures are taken and a chest x-ray is requested. The initial diagnosis is an infected exacerbation of COPD.

A. **chlamydia psittaci**
B. **clostridium difficile**
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- Oxygen saturation 91% on air
- Respiratory rate 18
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- Temperature 38.3^{o}C

Blood and sputum cultures are taken and a chest x-ray is requested. The initial diagnosis is an infected exacerbation of COPD.

An 8-year-old child is diagnosed with tonsillitis. He has past medical history of asthma and eczema for which he takes salbutamol 100micrograms metered dose inhaler, inhale two puffs when necessary. He has no known drug allergies. He is prescribed phenoxymethylpenicillin 250mg/5mL oral solution, one 5ml spoonful four times a day for 10 days. The prescription is brought to the community pharmacy to be dispensed.

What is the most appropriate advice to give?

A. Do not take indigestion remedies 2 hours before or after
B. Take an hour before food or 2 hours after food
C. Take 30 mins before food
D. Take with a full glass of water
E. Take with or just after food, or a meal

An 8-year-old child is diagnosed with tonsillitis. He has past medical history of asthma and eczema for which he takes salbutamol 100micrograms metered dose inhaler, inhale two puffs when necessary. He has no known drug allergies. He is prescribed phenoxymethylpenicillin 250mg/5mL oral solution, one 5ml spoonful four times a day for 10 days. The prescription is brought to the community pharmacy to be dispensed.

What is the most appropriate advice to give?

A. Do not take indigestion remedies 2 hours before or after
B. Take an hour before food or 2 hours after food
C. Take 30 mins before food
D. Take with a full glass of water
E. Take with or just after food, or a meal

A. **amoxicillin**
B. **azithromycin**
C. **cefuroxime**
D. **clindamycin**
E. **doxycycline**
F. **gentamicin**
G. **meropenem**
H. **teicoplanin**

For the patient described, select the single most appropriate causative antibiotic from the list above. Each option may be used once, more than once, or not at all.

A 52-year old male with epilepsy is admitted to hospital with a fall. He normally takes sodium valproate modified-release 500mg once a day and lamotrigine 100mg twice a day. and has. From a review of his medical notes: three days after his admission he became acutely unwell and was admitted to intensive care and diagnosed hospital acquired pneumonia for which he prescribed antibiotics. He experienced a seizure 48 hours after commencing antibiotics.

A. **amoxicillin**
B. **azithromycin**
C. **cefuroxime**
D. **clindamycin**
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A 48-year old female is to be prescribed an antibiotic for a complicated upper urinary tract infection. She has a past medical history of Addison's disease and is prescribed hydrocortisone10 mg in the morning, 5 mg at noon, and 5 mg in the early evening as well as fludrocortisone 150 micrograms once a day. She has an allergy to amoxicillin which caused throat and tongue swelling, and difficulty in breathing.

Which of the following antibacterial agents would be appropriate to prescribe for her?

A. ciprofloxacin
B. cefuroxime
C. co-amoxiclav
D. meropenem
E. piperacillin/tazobactam

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NHS
Nottingham University Hospitals
NHS Trust

Infections: session 2

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&

Lauren Rose – Specialist Clinical Pharmacist Antimicrobials and Infection Control
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Bacterial infections

REVIEW the patient information and make an appropriate diagnosis.

A 72-year old male is admitted to hospital for elective surgery. Seven days after surgery, he starts to develop a mild fever. This is shortly followed by a productive cough (thick green sputum). That night he still feels unwell and calls the out-of-hours doctor. The doctor remarks at how unwell the patient looks. The patient appears confused and has a raised temperature 38.9ºC

Answer: sepsis

Sepsis

- **Life-threatening** organ dysfunction due to dysregulated host response to infection

- High risk sepsis if proven or highly suspected infection and ≥ 1 of the following (see next slide)

- Antibiotics (broad –spectrum) should be commenced within 1 hour if there is evidence of high-risk sepsis

Newly **altered mental state**

Resp rate ≥25/min OR new need for oxygen (>40% FiO2) to maintain saturation >92% (or >88% in known COPD)

Heart rate ≥130/min

Systolic BP ≤ 90 mmHg or >40 mmHg below normal

Not passed urine in previous 18hour, or <0.5ml/kg of urine/hour if catheterised ≥2 consecutive hours

Mottled or ashen appearance cyanosis of skin, lips or tongue

Lactate >2 or AKI in the presence of deranged physiology

Non-blanching rash

https://www.nice.org.uk/guidance/ng51

Clostridium difficile Associated Diarrhoea

- Antibiotics disrupt bowel flora allowing colonisation with *Clostridium difficile*
  - Also known as C. difficile or C. diff

- Bacteria that can infect the bowel and cause diarrhoea

- **Certain antibiotics are regarded as high-risk for predisposing for *Clostridium difficile* infection and should be used with caution**
  REMEMBER THE "4Cs"
  - **C**ephalosporins
  - **C**iprofloxacin (and other **quinolones**)
  - **C**lindamycin
  - **C**o-amoxiclav



You are asked to recommend suitable treatment for the following patients.

For each of these patients, decide whether it is appropriate for you to recommend a non-prescription preparation in the first instance OR advise them to see their GP?

1. Patient with redness and thick sticky discharge in the left eye
2. Patient with blurred vision
3. Patient with pain in her eyes



You are asked to recommend suitable treatment for the following patients.

For each of these patients, decide whether it is appropriate for you to recommend a non-prescription preparation in the first instance OR advise them to see their GP?

1. Patient with redness and thick sticky discharge in the left eye - TREAT
2. Patient with blurred vision - REFER
3. Patient with pain in her eyes - REFER



Conjunctivitis

Causes	Epidemiology	Signs	Symptoms	Reasons for referral	Treatment
Bacterial or viral or allergic	Eye (usually both)	Bloodshot eye Pus around eye	Gritty feeling in eye Itchy eye	Contact lenses Suspect foreign body Eye injury Pain/swelling around eye Glaucoma Recent eye surgery Vomiting Clouding of cornea Photophobia	Can be self-limiting OTC chloramphenicol (not if <2, pregnant, breastfeeding)



https://www.nhs.uk/conditions/conjunctivitis/

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Cystitis

Causes	Epidemiology	Signs	Symptoms	Reasons for referral	Treatment	OTC restrictions
Bacterial	More common in females	Increased urine frequency (usually only passing small amounts) Urgency Dark/cloudy/smelly urine	Pain on urination Lower back pain	Red flag symptoms e.g. systemic infection, blood in urine, pregnancy Male Children Diabetic	Increase fluid intake Analgesia Sodium citrate sachets Potassium citrate sachets Preventative measures e.g. wipe from front to back	Caution in heart disease, hypertension, or renal impairment

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Antifungals

Bacterial

- Pain
- Swelling
- Redness*
- Heat
- Loss of function
- Discharge
- Temperature at extremities
- WCC, CRP, neutrophils – out of range
- Heart rate and BP

Fungal

- Itching
- Soreness
- Flaky skin

- Systemic infection – similar to bacterial

Viral

- Dehydration
- Diarrhoea
- Fever and aches
- Nausea and vomiting
- Rashes*
- Rhinorrhoea
- Sore throat

- Systemic infection – similar to bacterial

***Be mindful of skin tone**

Azoles

Triazoles

Used for both **prophylaxis** and **treatment** of fungal infections.
Immunosuppressed patients may receive antifungal prophylaxis

Examples: fluconazole, voriconazole, posaconazole, itraconazole

Check interactions – CYP450

Imidazoles

Used for local treatment of vaginal thrush and dermatophyte infections
Examples: clotrimazole, ketoconazole, miconazole

Amphotericin B

- **Different preparations** of intravenous amphotericin vary in their pharmacodynamics, pharmacokinetics, dosage, and administration; these should not be considered interchangeable.
  - **Prescribe by brand**
- Reserved for severe systemic fungal infections
- Can cause nephrotoxicity

Athlete's foot

Causes	Epidemiology	Signs	Symptoms	Reasons for referral	Treatment
Fungal infection	Feet – usually web spaces between toes	Skin appears white and "soggy"/red flaky patches Feet tend to smell	Itchy and sore	Skin is weeping Pus or yellow crusts Unresponsive to treatment Diabetic	Hygiene advice • Dry feet after washing them – particularly between toes • Use a separate towel for your feet, and wash towel regularly • Take shoes off when at home • Wear clean socks everyday – cotton socks are preferred OTC azoles (miconazole, clotrimazole, ketoconazole)

A 50 year old female asks to speak to the pharmacist. She weighs 105kg and complains of vaginal discharge over the past 2 days that is white “like cottage cheese” but is not particularly smelly, and has associated itchiness in the vaginal area. She is currently taking the following medication: metformin 1g twice a day, gliclazide 40mg twice a day, atorvastatin 20mg once a day.

What is the most appropriate course of advice in this situation?

A. apply clotrimazole 2% cream twice a day

B. use chlorphenamine 4mg twice a day

C. refer the patient to the GP

D. refer the patient to GP and supply clotrimazole 2% cream

E. refer the patient to the sexual health clinic

A 50 year old female asks to speak to the pharmacist. She weighs 105kg and complains of vaginal discharge over the past 2 days that is white “like cottage cheese” but is not particularly smelly, and has associated itchiness in the vaginal area. She is currently taking the following medication: metformin 1g twice a day, gliclazide 40mg twice a day, atorvastatin 20mg once a day.

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D. refer the patient to GP and supply clotrimazole 2% cream

E. refer the patient to the sexual health clinic

A. **amlodipine**
B. **beclometasone/formoterol**
C. **carbocisteine**
D. **co-codamol**
E. **donepezil**
F. **indapamide**
G. **salbutamol**
H. **tiotropium**

For the patient described, select the single most likely drug from the list above. Each option may be used once, more than once, or not at all.

A 74 year old male with hypertension, dementia and COPD is admitted from home following a fall. His blood pressure on admission is 92/58 mmHg. His current medications are Fostair 100/6 metered dose inhaler (beclometasone/formoterol) 2 puffs twice a day, salbutamol 100 microgram metered dose inhaler 2 puffs when necessary, tiotropium 10micrograms once a day, carbocisteine 750mg three times a day, amlodipine 5mg once a day, indapamide 2.5mg once a day, donepezil 5mg at night, co-codamol 30/500 one tablet four times a day. On review, he complains of a sore mouth and throat, with some white patches on the tongue.

A. amlodipine
B. beclometasone/formoterol
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Thrush

Causes	Epidemiology	Signs	Symptoms	Reasons for referral	Treatment
Fungal (candida) Can be induced by taking antibiotics	Can affect both men and women	White discharge (little/no odour and “cottage cheese” like	Itching and irritation around vagina/head o the penis/under the foreskin	Males Diabetic Immunosuppressed Pregnancy Recurrent attacks/medication failure Females <16 or >60	Clotrimazole cream/pessary Oral fluconazole
	Oral thrush common in babies Oral thrush common in elderly with dentures	Creamy white, soft elevated patches No taste/unpleasant taste in mouth Difficulty eating and drinking	Pain and soreness of mouth	Diabetic	Miconazole – treatment should be continued for up to 7 days after the symptoms have cleared If on steroid inhaler check technique

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Viral infections

Bacterial

- Pain
- Swelling
- Redness*
- Heat
- Loss of function
- Discharge
- Temperature at extremities
- WCC, CRP, neutrophils – out of range
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Fungal

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- Sore throat

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***Be mindful of skin tone**

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Viral infections

- Herpes simplex (Cold sore)
- Herpes Zoster (Shingles)
- Varicella Zoster (Chickenpox)
- Measles
- Influenza
- Coughs and cold
- Warts and verrucas
- Mumps

A 53 year old male has an appointment with his GP practice pharmacist has a past medical history of a gastric bleed and excess alcohol consumption, for which he currently takes omeprazole 20mg once a day, thiamine 100mg three times a day and Vitamin B Compound Strong once a day. He has no known allergies. He develops a rash which starts centrally in the upper-right region of his back, and follows a line around his body to the front, terminating just below his right nipple. He further informs you that there are several blisters present in this rash, and that it is accompanied by an intense tingling sensation like "pins and needles".

What is the most appropriate treatment to prescribe?

A. aciclovir 800mg five times a day for 7 days
B. cetraben emollient cream as necessary
C. flucloxacillin 500mg four times a day for 7 days
D. hydrocortisone 1% cream twice a day
E. metronidazole 0.75% cream twice a day



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D. hydrocortisone 1% cream twice a day
E. metronidazole 0.75% cream twice a day



Herpes virus infection

Herpes Simplex	Varicella-Zoster (Chickenpox)	Herpes Zoster (Shingles)
Mild infections are treated with topical antivirals e.g. aciclovir cream Severe infections/immunocompromised patients/genital herpes use oral treatment	Highly contagious itchy spotty rash Chickenpox usually mild if 1 month – 12 years, no antiviral treatment required Stay away from school, nursery or work until all spots have crusted over - calamine lotion, antihistamine, paracetamol More severe in adolescents and adults – requires antiviral treatment	Pain and rash that develops into itchy blisters, similar in appearance to chickenpox. Tingling/painful feeling Headache sometimes present Stay off work or school if the rash is still oozing fluid (weeping) and cannot be covered, or until the rash has dried out - you're only infectious to others while the rash oozes fluid

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Parasitic infections

A 22 year old female with no past medical history has just purchased some antimalarials prior to her planned trip abroad. She asks you if there are any ways she can protect herself from mosquito bites?

What would be the most appropriate additional advice to provide to the patient?

A. apply suncream with at least SPF30
B. avoid drinking alcohol
C. take loratadine 10mg once a day
D. take thiamine 100mg once a day
E. use DEET (N,N-Diethyl-m-tolumide) spray

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Malaria prophylaxis

- Non pharmacological preventative measures
- Diethyltoluamide (DEET) 20–50% formulations is safe >2 months of age.
  - Can be used during pregnancy and breast-feeding.
  - Reduces the SPF of sunscreen, so a sunscreen of SPF 30-50 should be applied, DEET should be applied after the sunscreen
- Detailed information in BNF
- https://www.fitfortravel.nhs.uk/

Parasiticical preparations

Scabies

- Itch rash with tiny red spots; burrow marks can be seen as wavy, silver-coloured lines on the skin
- Treatment: Permethrin cream
- All members of household should be treated
- Treatment should be applied to whole body (including scalp, neck, face and ears)
- 2 treatment applications, 1 week apart

Headlice

- Nits (brown or white empty head lice egg shells in hair)
- Wet combing
- Physical insecticide treatments

Threadworm

- Mebendazole
- Treat everyone in family
- If <2 years old need to refer to GP for a prescription
- Hygiene measures
- Treatment may be repeated after 2 weeks

Resources

- BNF/BNFc
- SPC/PIL
- NICE CKS
- GP notebook
- netdoctor
- Patient.info
- GP online
- CPPE
- NICE guideline [NG15] - Antimicrobial stewardship
- Microbiology nuts and bolts
- Fit for travel
- Community Pharmacy: Symptoms, Diagnosis and Treatment
- IFPP
  - e-LfH
- Medicines Learning Portal
- Specialist Pharmacy Service
- Medicines for Children
- Drug interactions

Your patients, prescriptions, medicines and colleagues

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Questions/Discussion



A 55-year old female visits her doctor complaining of dyspepsia. Following a review and investigation, she is diagnosed with a H. pylori infection. She is prescribed a 7 day course of: clarithromycin 500mg twice a day, metronidazole 400mg twice a day and omeprazole 20mg twice a day.

She has a past medical history of type 2 diabetes and pulmonary embolism for which she takes metformin modified-release 2g once a day, atorvastatin 20mg once a day, bisoprolol 5mg once a day and apixaban 5mg twice a day. She has no allergies.

What is the most appropriate course of action?

A. change the clarithromycin to co-amoxiclav
B. change the metronidazole to amoxicillin
C. lower the dose of atorvastatin to 10mg once a day
D. omit the atorvastatin whilst on antibiotic treatment
E. undertake ECG monitoring whilst on antibiotic treatment

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A. amoxicillin
B. azithromycin
C. cefuroxime
D. clindamycin
E. doxycycline
F. gentamicin
G. meropenem
H. teicoplanin

For the patient described, select the single most appropriate antibiotic from the list above. Each option may be used once, more than once, or not at all.

An 82-year old female contacts her urgent care provider. She has a history of heart attacks and type 2 diabetes. She regularly takes aspirin 75mg once a day, atorvastatin 80mg once a day, metformin 1g twice a day, gliclazide 80mg twice a day, ramipril 10mg once a day and bisoprolol 5mg once a day. She has been experiencing diarrhoea, which has been accompanied by an intense stomach pain. The diarrhoea is streaked with bright red blood.

A. amoxicillin
B. azithromycin
C. cefuroxime
D. clindamycin
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A 65 year old male is admitted to hospital with severe hospital acquired pneumonia. The patient has a history of rheumatoid arthritis and takes the following medications: co-codamol 30/500 1-2 tablets up to four times a day when required, calcium carbonate chewable tablets 1 tablet twice a day, methotrexate 12.5mg once a week on Friday and folic acid 5mg once a day on Saturday. The patient is allergic to penicillin (anaphylaxis). The patient is prescribed oral co-trimoxazole 1.44g twice a day.

What would be most appropriate course of action?

A. Change co-trimoxazole to co-amoxiclav
B. Change co-trimoxazole to levofloxacin
C. Monitor renal function during co-trimoxazole treatment
D. Refer the patient to the rheumatologist
E. Withhold methotrexate during co-trimoxazole treatment

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E. Withhold methotrexate during co-trimoxazole treatment

A 85-year old female is admitted to hospital with suspected sepsis of unknown origin. She is prescribed piperacillin/tazobactam 4.5g IV every six hours and a single dose of gentamicin IV 5mg/kg (reduced to 3mg/kg if creatinine clearance <40ml/min).

For gentamicin, if the patient's weight is >20% than the ideal body weight (IBW), then the dose should be calculated based on the dose determining weight (DDW).

The patient weighs 110kg and has a height of 1.65m. She has a serum creatinine value of 65 micromol/L.

IBW (female) = 45.4kg + [0.89 x (height (cm) – 152.4)]

DDW = IBW + (0.4 (actual body weight – IBW))

CrCl (ml/min) = [(140 – age) * weight * constant]/ serum creatinine (constant = 1.04 women; 1.23 men)

What is the correct dose that should be given to the patient? Round your answer to the nearest 40mg.

Answer:

IBW = 45.4 + 11.214 = 56.6kg

56.6kg * 1.2 (to see if patient's weight is >20% IBW) = 67.92kg – therefore patient is obese

DDW = 56.6kg + 0.4*(110 – 56.6kg) = 77.96kg

CrCl (using IBW) = [(140-85)*56.6*1.04]/65 = 49.8ml/min – no dose reduction required

Dose = 77.96kg*5mg/kg = 389.8mg, give 400mg (to nearest 40mg)

A 59 year old male with a past medical history of IV drug usage is admitted to hospital suspected endocarditis. Microbiology have advised to initially commence the patient on vancomycin 20mg/kg every 12 hours and gentamicin 1mg/kg every 12 hours.

The following gentamicin levels are back from the laboratory.

- pre-dose level = 0.75 mg/L
- post-dose level = 3.2 mg/L

Therapeutic drug monitoring

With intramuscular use or intravenous use in adults

For multiple daily dose regimen, one-hour ('peak') serum concentration should be 5–10 mg/litre; pre-dose ('trough') concentration should be less than 2 mg/litre.

For multiple daily dose regimen in endocarditis, one-hour ('peak') serum concentration should be 3–5 mg/litre; pre-dose ('trough') concentration should be less than 1 mg/litre. Serum-gentamicin concentration should be measured after 3 or 4 doses, then at least every 3 days and after a dose change (more frequently in renal impairment).

With intravenous use in adults

For once-daily dose regimen, consult local guidelines on monitoring serum-gentamicin concentration.

With intravenous use in children

Once daily dose regimen: pre-dose ('trough') concentration should be less than 1 mg/litre.

With intramuscular use or intravenous use in children

Multiple daily dose regimen: one hour ('peak') serum concentration should be 5–10 mg/litre ; pre-dose ('trough') concentration should be less than 2 mg/litre.

Multiple daily dose regimen for endocarditis: one hour ('peak') serum concentration should be 3–5 mg/litre; pre-dose ('trough') concentration should be less than 1 mg/litre. Serum-gentamicin concentration should be determined twice each week (more often in renal impairment).

Multiple daily dose regimen for cystic fibrosis: one hour ('peak') serum concentration should be 8–12 mg/litre; pre-dose ('trough') concentration should be less than 2 mg/litre.

With intrathecal use or intraventricular use in children

Intrathecal/intraventricular injection: cerebrospinal fluid concentration should not exceed 10 mg/litre.

Which of the following is the most appropriate method for dose rationalisation of gentamicin?

A. decrease the dose and decrease the dosage interval
B. increase the dose and increase the dosage interval
C. increase the dose and maintain the same dosage interval
D. maintain the same dose and the same dosage interval
E. maintain the same dose and increase the dosage interval

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A. clostridium difficile
B. escherichia coli
C. haemophilus influenzae
D. moraxella catarrhalis
E. neisseria meningitidis
F. pseudomonas aeruginosa
G. staphylococcus aureus
H. streptococcus pneumoniae

For the patient described, select the single most likely causative bacteria from the list above. Each option may be used once, more than once, or not at all.

A 56-year old male with no significant past medical or sexual history, presents to his GP practice pharmacist with urinary tract symptoms that started a few days previously. The symptoms included increased frequency and urgency, associated with suprapubic pain. The urine was noted to be cloudy. A mid-stream urine sample confirms a diagnosis of a lower UTI.

A. clostridium difficile
B. escherichia coli
C. haemophilus influenzae
D. moraxella catarrhalis
E. neisseria meningitidis
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A 55 year old male arrives to collect his prescription from your pharmacy. He is currently taking isoniazid 300mg once a day and rifampicin 600mg once a day for the continuation phase of treatment for pulmonary tuberculosis. In the fifth month of treatment, he reports a numbness and tingling in his feet and legs.

What is the most likely cause of the symptoms that he is experiencing?

A. agranulocytosis
B. anaemia
C. hepatitis
D. myopathy
E. peripheral neuropathy

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B. anaemia
C. hepatitis
D. myopathy
E. peripheral neuropathy

Which of the following caution and advisory labels are recommended on the dispensing label for the following medications:

a) Flucloxacillin
b) Ciprofloxacin
c) Metronidazole

1) Protect your skin from the sunlight - even on a bright but cloudy day. Do not use sunbeds
2) Suck or chew this medicine
3) Do not take indigestion remedies, or medicines containing iron or zinc, 2 hours before or after you take this medicine
4) With or just after food, or with a meal
5) Take this medicine when your stomach is empty. This means an hour before food or 2 hours after food

Which of the following caution and advisory labels are recommended on the dispensing label for the following medications:

a) Flucloxacillin **- 5**
b) Ciprofloxacin **- 3**
c) Metronidazole **- 4**

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Regarding penicillins, which of the following statements is/are true?

1. They act by interfering with bacterial cell wall synthesis

2. Patients who are allergic to one penicillin will be allergic to all penicillins

3. Flucloxacillin is a penicillinase-resistant penicillin

Answer – all are true

A 75 year old male takes warfarin tablets for atrial fibrillation. At his latest anticoagulant clinic visit it is noted that his international normalised ratio (INR) is 1.8 (2-3).

He has recently been prescribed some new medicines. Which of these medicines is/are likely to have caused his INR to decrease?

1. Rifampicin
2. Clarithromycin
3. Fluconazole

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Rifampicin is a potent liver enzyme inducing agent which increases the metabolism and clearance of warfarin from the body, which would cause the INR to decrease.

Clarithromycin and fluconazole are enzyme inhibitors.

A 47 year old female visits your pharmacy to ask for your advice on the treatment of diarrhoea. She usually has a bowel motion once a day, but recently has needed to open her bowels 3 to 4 times daily.

You notice from your patient medication record system (PMR) that she has recently started to take some new medicines. Which of the following medicines can cause diarrhoea?

1. Clindamycin capsules
2. Erythromycin e/c tablets
3. Ferrous sulfate tablets

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Clindamycin can cause antibiotic induced colitis – patients should be advised to discontinue and contact their doctor immediately particularly if severe, prolonged or bloody diarrhoea develops

Erythromycin can cause diarrhoea

Ferrous sulfate can cause gastro-intestinal irritation including both diarrhoea and constipation. See BNF

Which of the following medicines requires a dosage reduction in patients with renal impairment?

1. Lithium
2. Gentamicin
3. Omeprazole

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1. Lithium
2. Gentamicin
3. Omeprazole

Lithium and gentamicin are excreted mainly unchanged in the urine therefore a dosage reduction is necessary in patients with renal impairment.

A 71 year old male is admitted to hospital with pleuritic chest pain and shortness of breath. He has a cough, a temperature of 38.6°C and a heart rate of 101bpm.

He is diagnosed with high severity community acquired pneumonia. He has no known drug allergies and is on no regular medicines.

Given that there are no contraindications, which of the following options would you recommend as the most suitable treatment?

A. amoxicillin with metronidazole
B. co-amoxiclav with clarithromycin
C. levofloxacin with metronidazole
D. rifampicin with clindamycin
E. vancomycin with gentamicin

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