ANTIBIOTIC FORMULARY AND PRESCRIBING ADVICE FOR PAEDIATRIC PATIENTS OTHER THAN NEONATES

VERSION 1.2
EFFECTIVE 01 APRIL 2015

THIS DOCUMENT SUPERSEDES ALL ANTIBIOTIC GUIDANCE FROM ANY SOURCE REGARDING PAEDIATRIC PATIENTS OTHER THAN NEONATES DATED PRIOR TO THE ABOVE DATE

Northern Lincolnshire and Goole NHS Foundation Trust

United Lincolnshire Hospitals NHS Trust

Major Changes From Last Edition

Section 2

Minor changes and clarifications

Section 3

Minor changes and clarifications

Section 4

No major changes

Section 5

No major changes

Section 6

No major changes

1 Introduction

1.1 Aim

Antimicrobials and antibiotics are a very important part of the therapeutic regimen. Their indiscriminate use however, can affect many other patients through the selection of resistant organisms. Hence it is important that antibiotic use is controlled and profligate and unnecessary use, which selects for bacterial resistance, is avoided. The aim of this document is to encourage the appropriate use of this valuable resource.

The increase in meticillin resistant staphylococcus aureus (MRSA) and *Clostridium difficile* infections in adults is of concern with the continued widespread "routine" use of cephalosporins and fluoroquinolones.

Paediatric patients are no exceptions necessitating a complete revision of the Antibiotic Policy in paediatrics similar to that carried out in adults. The recommendations made in this document are specifically targeted at reducing the risk of the above organisms but also better patient outcome and savings for the health economy.

Specific instructions regarding difficult to treat organisms or infections is beyond the scope of this document and management of these organisms should be guided by reported sensitivities and advise from the consultant microbiologist. National documents and references including the British National Formulary and the British National Formulary for Children should be consulted.

1.2 Personnel

This document is aimed at all persons having prescribing rights for antibiotics.

1.3 Areas Covered

This guidance applies to all areas caring for the paediatric population excluding neonates served by the Northern Lincolnshire & Goole Hospitals NHS Foundation Trust (NLAG) and United Lincolnshire Hospitals NHS Trust (ULHT).

1.4 Antimicrobials

Antibiotics are compounds produced by micro-organisms to inhibit the growth of other micro-organisms while antimicrobials are chemically produced and modified compound. This difference is irrelevant in most clinical practice and thus the terms "Antibiotic" and "Antimicrobial" are used interchangeably throughout this document.

1.5 Samples

Appropriate antibiotic use is best achieved when the target organism is known. Obtaining appropriate samples **prior to the antibiotic being administered is mandatory** *unless* immediate empirical treatment is indicated**.** The procedures for collecting appropriate microbiological samples can be found in the Path Links Laboratory Handbook available on the intranet.

Obtaining and acting promptly on culture and sensitivity test results is vital to ensure only the most appropriate antibiotics are given. Any review and focus of antibiotic use arising from this must be clearly documented in the medical notes.

1.6 Contact Information

Advice regarding the appropriate use of antibiotics can be obtained from the Duty Consultant Microbiologist, contactable through switchboard out-of-hours or from Dr Vicca on ext 7550 (DPOW), Dr Cowling on ext 2350 (SGH), Dr Jagadeesan ext 6389 (Boston), Dr Papastergiou ext 3734 (Lincoln), or Dr Stoddart ext 4258 (Grantham) during office hours.

Scenarios where microbiologist advice may be particularly useful are marked M.

2 Prescribing of Antimicrobials

This advice is intended to:

- Ensure all antimicrobial agents are **clinically indicated and essential**.
- Ensure any **allergy information** relating to antimicrobials is clearly recorded on the front of all the prescription charts, including the nature of the reaction
- Ensure that prescriptions for antimicrobials are prescribed and administered at regular intervals.
- Ensure the **correct route** is prescribed
- Ensure all antimicrobial prescriptions have a **specific indication documented** on the prescription chart AND in the medical records at the point of prescribing
- Ensure all antimicrobial prescriptions have a **"review" or "stop" date** / length of course endorsed on the prescription chart at the point of prescribing. The duration should also be clear in the medical record.
- **Ensure all antimicrobials are reviewed at 48 hours** to focus therapy and either:
  - **Stop**
  - **De-escalate** from iv to oral therapy
  - **Change** to a narrow spectrum antibiotic
  - **Continue and review again** at 72 hours**.**
- Apply to all paediatric patients excluding neonates.
- Be used by medical, nursing and pharmacy staff.

2.1 General Points

Antimicrobials are only indicated when there is evidence of infection or when infection is to be actively avoided such as during surgery. The mere presence of an organism is not an indication for antimicrobials, thus an organism, even MRSA, isolated from a wound that is healing well with no signs of infection does not necessarily require antimicrobial treatment. Antimicrobials are not indicated for conditions that are generally of viral origin.

All doses given in these guidelines, unless specifically indicated otherwise, assume broadly normal renal and hepatic function. Doses may need to be adjusted if renal and hepatic function is impaired.

If a course of antimicrobials has not let to a cure, it should not be automatically repeated. Instead the diagnosis needs to be reviewed and specialist advice sought where necessary.

2.2 Allergy Information (see Section 3.5 also)

Any allergies to antimicrobials need to be clearly documented in the medical notes *and* on the prescription chart.

2.3 Indication

The indication for all orders of antibiotics on the drug chart ***must*** be included on each order.

If there is not a specific box for this information on the prescription chart, the "Additional Instructions" or "Pharmacy" box may be used.

2.4 Timely Administration

The sooner patients with severe sepsis receive appropriate antibiotics the lower the mortality risk. All patients should receive appropriate antibiotics within 1 hour of severe sepsis onset. (Obtain blood cultures BEFORE administration of antibiotics where possible).

- The initial dose should be prescribed on the "once only" section of the prescription chart.
- The exact time of prescribing and administration should be clearly documented.
- The prescribed should inform the patient's nurse of the need for urgent antibiotics
- Nurses should contact pharmacy as soon as possible if the required antibiotic is not stocked on the ward informing them of how urgent the antimicrobial is.

For more information see intranet.

It is good practice that the initial dose of all antimicrobial is prescribed on the "once only" section of the prescription chart, Care should be taken when prescribing the subsequent regular doses at the defined frequency to ensure this is taken in to account and avoid toxicity.
Antimicrobials must be prescribed at a defined frequency, e.g. every 8 hours, to ensure antimicrobials are administered at regular intervals.

Thus dosing at 0600, 1400 and 2200 is acceptable but 0800, 1300, 1700 is NOT acceptable.
Whilst there is an understandable tendency to adjust dosing times to fit with nursing medication rounds where possible, this should not be permitted to interfere with the above.

2.5 Course Duration and "Stop"/"Review" Date

All prescribers **must** document the intended duration on the prescription chart for **all** orders of antimicrobial agents. A "stop" / "review" date must be clearly indicated on the prescription chart at the point of prescribing any antimicrobial agent.

If there is not a specific box for any information on the prescription chart, the "Additional instructions" or "Pharmacy" box may be used.

2.5.1 Oral Antimicrobial Therapy

The average length of an oral course is assumed to be 5 days unless otherwise stated in the guidelines.

For some patients it may be difficult to endorse a definite stop date until the patient's condition begins to improve. Antimicrobial agents in these cases should have a review date about twice a week (e.g. consultant ward rounds and/or Fridays). As a minimum, oral prescriptions should be reviewed after 5 days and any reason for continuation must be documented in medical notes.

2.5.2 IV Antimicrobial Therapy

In patients with a severe infection who initially require iv antimicrobial therapy, they can be switched to oral therapy **within 48 hours** in the majority of cases with a number of advantages:

- Reduction in the likelihood of hospital acquired iv access associated infection.
- Reduce patient discomfort, improve mobility and possibly increase the potential for earlier hospital discharge.

- Save both medical and nursing time.
- Potentially reduce treatment costs.
- Potentially reduce the risk of adverse incidences; errors in preparation are significantly higher with parenteral drugs, compared with oral formulations.

The majority of iv antimicrobial agents will therefore require a “review” rather than a “stop” date prior to being converted to oral.

For any intravenous antimicrobials which are continued beyond 48 hours duration, the reason for continuation must be documented in the medical notes.

Intravenous antimicrobials which are re-prescribed beyond 48 hours should be reviewed daily. The decision on continuation/completion of antimicrobial therapy must be documented in the medical notes.

2.5.3 Review of Antimicrobial Therapy

There is the need to embed a “Start Smart – Then Focus” prescribing culture with daily review and documented evidence of an active review of all antibiotics after 48 hours. A day 3 prescribing decision should be documented within the notes, focusing therapy in line with cultures / sensitivities / additional clinical information on the patient at 48 hours to either:

- Stop
- De-escalate from iv to oral therapy
- Change to a narrow spectrum antibiotic
- Continue and review again at 72 hours

2.5.3.1 IV To Oral Switch Criteria

Suitability for the early switch from iv to oral therapy should be assessed by the attending clinician on a case-by-case basis but patients should generally have all of the “COMS” criteria.

“COMS” criteria to consider:

- **C**linical improvement observed
- **O**ral route is not compromised and suitable oral antimicrobial option is available (see Section 6 for recommended oral switches and costs). N.B. If NG / PEG feeding then please consult your ward pharmacist.
- **M**arkers indicate a trend towards normal
- **S**pecific indication / deep-seated infection not present (see exceptions*)

*Exceptions:

- Deep-seated infections (may require an initial 2 weeks of iv therapy but seek microbiology advice)
    - Osteomyelitis, septic arthritis (N.B. high-dose oral clindamycin may be appropriate once patient is stable – seek microbiology advice).
- High risk infections requiring prolonged iv therapy (seek microbiology advice regarding the length of treatment):
    - Endocarditis
    - Exacerbations of cystic fibrosis/bronchiectasis

- Infected implants/prosthetics
- Intracranial abscesses
- Legionella pneumonia
- Mediastinitis
- Meningitis/encephalitis
- Severe infections during chemotherapy-related neutropenia
- Severe or necrotising soft tissue infections
- *Staphylococcus aureus* or *Pseudomonas spp*.bacteraemia

- Certain multi-resistant organisms may require treatment with agents that are only available in an iv form (seek microbiology advice regarding length of treatment).

For a specific indication / deep-seated infection it is still appropriate to prescribe a review date to ensure clinical response. Antimicrobial agents in these cases should have a review date at least once a week (e.g. consultant ward rounds and/or Fridays). It is recommended that longer term iv prescriptions should be reviewed after 5 days.

2.5.3.2 Recording the Route of Administration

When a course of antimicrobials is initiated, or switched from IV to oral, the route of administration must not only be entered onto the prescription chart, but must also be recorded in the medical notes.

2.6 Actions for Healthcare Professionals

2.6.1 Actions For Doctors

- Prior to prescribing any antibiotic **confirm the allergy status** of a patient, including the nature of the reaction. Ensure that the allergy box on the front of the prescription chart is completed.

- All prescriptions for antimicrobials should include an indication (enter in the Pharmacy/ 'Additional Instructions' box).

- **Write a "stop" date / intended course duration or a "review" date on the prescription chart for each antimicrobial agent prescribed.**

- The majority of iv antimicrobial therapy will require a "review" date rather than a "stop" date prior to being converted to oral. (See exceptions*)

- Review points should be targeted for lunchtime doses where possible and should avoid weekends unless the patient is due for daily consultant review.

- Antimicrobial review should be clearly documented in the medical notes **and** on the chart by completing and signing the review box where available. If there is not a review box, the Additional Instruction or Pharmacy box may be used. Endorse a new review date if to continue.

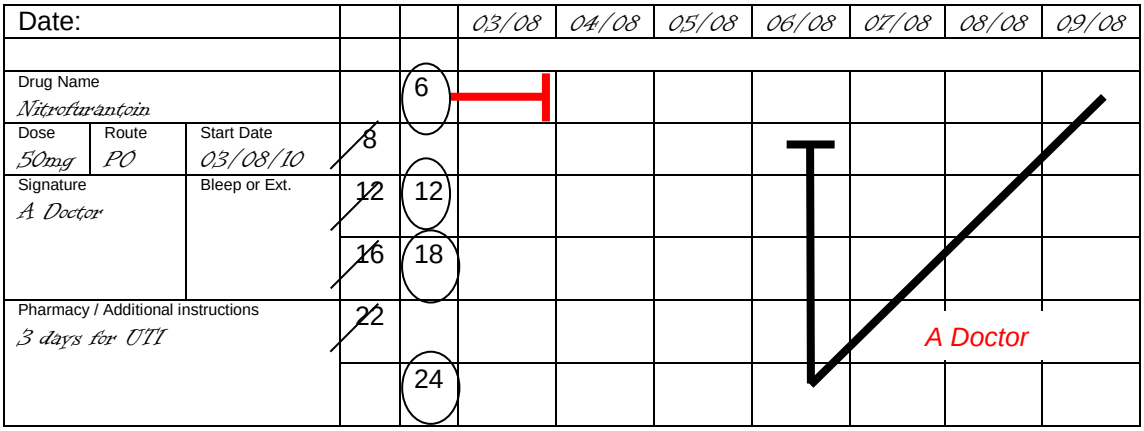
    - For some infections it may be difficult to endorse a definite review / stop date until the patient's clinical condition begins to improve. Antimicrobials in these circumstances should have review dates about twice a week (e.g. Consultant ward rounds and/or Fridays).

- Following an iv to oral switch a stop / course duration must be endorsed for each as either of the following:

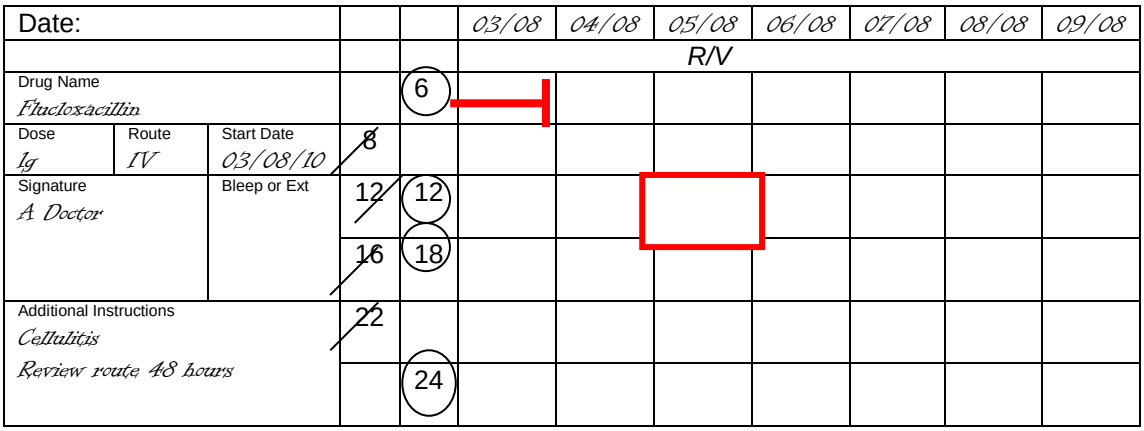
    - "….. days more" i.e. …days of oral following iv therapy
    - "….. days in total" i.e. the total required duration of iv and po together
    - Or put a stop date (e.g. "stop 09/08/2010")

- Antimicrobial agents should be stopped / reviewed earlier than the date shown if clinically indicated.

Example with stop date (mostly appropriate for oral therapy):



Example with review date (mostly appropriate for initial IV therapy):



NOTE:

When rewriting treatment sheets containing prescriptions for antibiotics, ensure that the ORIGINAL START DATE of any antibiotic prescription which needs to be continued is transferred onto the new prescription for that antibiotic, rather than the date the treatment sheet is rewritten.

2.6.2 Actions For Nurses

- Prior to administering any antibiotic **confirm the allergy status** of a patient, including the nature of the reaction. Ensure that the allergy box on the front of the prescription chart is completed by a prescriber or appropriate member of pharmacy.
- Request the Dr to write a “review” / “stop” date on the prescription chart for all antimicrobial agents where appropriate (see exceptions*).
- Query all prescriptions continuing beyond the “review” / “stop” dates without a review being apparent.
- Whilst awaiting review **continue to administer the antimicrobial**
- Ask the Dr to review a prescription if a number of doses have been missed during the prescribed course, especially if the patient is still unwell or at a weekend where regular review is unlikely.

2.6.3 Actions For Pharmacists

- Prior to checking and/or supplying any antibiotic **confirm the allergy status** of a patient, including the nature of the reaction. Ensure that the allergy box on the front of the prescription chart is completed.

- Ensure all prescriptions for restricted antibiotics adhere to the Antibiotic Formulary and Prescribing Advice.

- Request an indication and "review" / "stop" date to be written on the prescription chart for all antimicrobial agents

- Inform the prescriber that the standard is to include a specific indication and "review" / "stop" date every time an order for an antimicrobial agent is made (see exceptions*). This request should be made within 48-72 hours of the prescription being written.

- If the prescription is written in the presence of a pharmacist, request an indication and "review" / "stop" date as part of the prescription writing process.

- Query all prescriptions continuing beyond the "review" / "stop" dates without a review being apparent.

- Ask the doctor to review a prescription if a number of doses have been missed during the prescribed course, especially if the patient is still unwell or at a weekend where regular review is unlikely.

If the above is not possible, write in the notes requesting for a "review" / "stop" date for the antimicrobial agent or annotate the prescription chart "review route". Review of dosage points should be targeted for lunchtime doses where possible and should avoid weekends unless the patient is due for daily consultant review.

2.7 De-escalation Of IV To Oral And Costs of Antimicrobials

Please see Section 6.

3 Notes on Specific Compounds

The local availability of antimicrobials is grouped into 3 categories:

3.1 Freely Available Antimicrobials

Aciclovir (iv/po)
Amoxicillin (iv/po)
Benzyl penicillin (iv)
Clarithromycin (iv/po)
Co-amoxiclav (iv/po)
Doxycycline (po)
Flucloxacillin (iv/po)
Gentamicin (iv/im)
Metronidazole (po/pr/iv)
Nitrofurantoin (po)
Phenoxymethylpenicillin [Penicillin V] (po)
Topical Chloramphenicol
Topical Fusidic Acid (eyes)
Trimethoprim (po)
Vancomycin (iv)

3.2 Restricted by Indication

Must match indications below or "On Microbiology Advice" documented in case notes and on prescription sheet.

Agent	Indication
Anti-mycobacterial Agents	for TB (paediatric infectious diseases)
Azithromycin (po)	Sexual Health or LRTI prophylaxis from tertiary centre
Cefixime (po)	Sexual Health
Cefotaxime (iv) or Ceftriaxone (iv)	Meningitis or other CNS infection (or as listed elsewhere in this guideline)
Cefuroxime (iv)	As listed elsewhere in this guideline
Cefalexin (po)	UTI where no other oral agent is suitable
Ceftazidime (iv)	Cystic fibrosis
Ciprofloxacin (po)	Indications as listed elsewhere in this guideline
Ciprofloxacin (iv)	Only where (a) Ciprofloxacin use is indicated and/or (b) patient unable to take ANY oral medication
Clindamycin (iv/po)	Indications as listed elsewhere in this guideline
Colistin (nebulised)	Cystic fibrosis
Cotrimoxazole (iv/po)	Pneumocystis prophylaxis and treatment
Erythromycin (iv/po)	Prokinetic agent in neonatal intensive care
Meropenem (iv)	Indications as listed elsewhere in this guideline
Ofloxacin (po)	Sexual Health only
Ofloxacin (topical)	Ophthalmology

Agent	Indication
Oxytetracycline (po)	Dermatology
Piperacillin/tazobactam [Tazocin](iv)	As listed elsewhere in this guideline
Pivmecillinam (po)	Resistant UTI if no other oral agent is suitable
Rifampicin (po/iv)	TB, MRSA infection
Sulfadiazine	Toxoplasmosis
Teicoplanin (iv)	Coagulase negative staph sepsis
Tobramycin (nebulised)	CF use only
Vancomycin (po)	Clostridium difficile infection only

3.3 Requiring Consultant Microbiologist Authorisation

Must be documented “On Microbiology Advice” in case notes & on prescription

Amikacin (iv)
Aztreonam (iv)
Ceftaroline (iv)
Chloramphenicol (iv/po)
Colistin (iv)
Daptomycin (iv)
Ertapenem (iv)
Fidaxomicin (po)
Fusidic Acid (iv/po)
Fosfomycin (iv/po)
Imipenem/cilastatin (iv)
Levofloxacin (iv/po)
Linezolid (iv/po)
Moxifloxacin (po/iv)
Rifampicin (po/iv) (except in TB)
Rifaximin (po)
Streptomycin (iv) (except in TB)
Temocillin (iv)
Ticarcillin [Timentin] – available during piperacillin/tazobactam shortage only
Tigecycline (iv)
Tobramycin (iv)

3.4 Antimicrobials That Are “Not On Formulary” And Are NOT Stocked

Ampicillin
Cefaclor
Cefadroxil (po)
Cefpodoxime
Cefradine (iv/po)
Cefuroxime axetil (po)
Co-fluampicil (Magnapen)
Doripenem
Methenamine
Nalidixic Acid
Neomycin
Netilmicin
Norfloxacin
Telithromycin
Tinidazole

NB Use non-proprietary preparations where available.
Change to narrow spectrum and oral antibiotics when possible.

3.5 Note On Penicillin Allergy

"Penicillin allergy" appears to be very common in hospitalised patients, being listed amongst the known drug allergies in up to half of in-patients. In practice genuine penicillin allergy is significantly rarer.

Before any patient is labelled penicillin allergic, confirm that the allergy is genuine.

Symptom	Interpretation
Nausea, vomiting, abdominal pain:	Frequently accompany oral antibiotics use. These are not usually allergies.
Maculopapular rash developing several days into a course of antibiotics	May be a non-allergic rash, particularly common with amoxicillin given during EBV infection. Any features of Stevens-Johnson syndrome should result in immediate discontinuation of the drug and prohibition of use in the future.
Immediate onset angioedema, rhinitis, dyspnoea, wheeze, hypotension, etc	These are very suspicious of IgE mediated allergy. Do not use any beta-lactam if a beta-lactam was the provoking drug. Do NOT use a "test dose" to "find out". Discuss cefalosporin or carbapenem use with Consultant Microbiologist.
"My mum told me I was allergic to penicillin, I don't know why"	Each case will need individual assessment. A specific IgE blood test for IgE against penicillin compounds is specific, but very insensitive. A negative penicillin `RAST' test therefore by no means excludes penicillin allergy.

Please note:

- Penicillin allergy is NOT inherited. Testing is NOT indicated even if a relative has true penicillin allergy.
- Skin testing for penicillin is the `gold standard' but reagents for this have stopped being manufactured and this service cannot be offered by the Immunology Department at the present time.
- A detailed history including timing and type of reaction is essential in assessing patients with possible drug allergy.

It is often valuable to check previous drug administration sheets to determine whether or not the patient has received a penicillin in the past without adverse effect.

List of Penicillin- containing antibiotics

Benzylpenicillin
Phenoxymethylpenicillin
Flucloxacillin
Amoxicillin
Co-Amoxiclav (**Augmentin**)
Co-fluampicil (**Magnapen**)
Temocillin
Piperacillin
Piperacillin/tazobactam (**Tazocin**)
Ticarcillin
Ticarcillin/clavulanate (**Timentin**)

List of Other Beta-lactam Antibiotics

Patients with a penicillin allergy (history of anaphylaxis, urticaria, Stevens-Johnson syndrome, or rash immediately after penicillin administration) SHOULD NOT receive a penicillin or any other beta-lactam antibiotic listed below.

If a patient has a minor rash (ie non confluent, non-pruritic rash restricted to a small area of the body), with a penicillin or a rash that appears more than 72 hours after administration, they may be able to safely tolerate another beta-lactam antibiotic such as those below but proceed with caution.

Please seek expert microbiology advice in cases of SEVERE infections.

Aztreonam	Cefuroxime
Cefalexin	Doripenem
Cefradroxil	Ertapenem
Cefixime	Imipenem
Cefotaxime	Meropenem
Ceftazidime	Pivmecillinam
Ceftriaxone	Ceftaroline

3.5.1 Inadvertent administration of a beta-lactam based antibiotic to a patient with a history of adverse reactions to penicillin, with no apparent reaction.

Administration of a penicillin based antibiotic to a patient with a previously recorded adverse reaction **is a serious clinical error**, and all efforts to avoid it must be made. However, it is acknowledged that this error does occasionally occur, and the result can yield useful information which may be of benefit to the patient.

First there must be duty of candour – discuss the situation with the patient and apologise for the error. Involve the consultant in charge of the patient's care as soon as practical. Complete an incident report form (IR1).

Nature of previous reaction	Mechanism	Action to be taken
Anaphylaxis, angioedema, acute urticaria	Type 1 hypersensitivity	Inadvertent test of hypersensitivity. If no reaction at first dose, risk of reaction to subsequent doses is no greater than for the rest of the population. Reassure patient and re-label notes as not Type 1 hypersensitivity.
Stevens-Johnson syndrome, erythema multiforme, severe mouth ulcers, toxic epidermal necrolysis (TEN)	Delayed hypersensitivity, drug acts as a hapten	Stop the antibiotic immediately and discuss with a microbiologist. Careful history regarding timing of antibiotics in previous reaction needed – it may have been the underlying infection that caused the reaction.
Rash after amoxicillin for sore throat	Amoxicillin / EBV effect	Reassure. If symptoms recur, reclassify as delayed onset rash.
Delayed onset rash	T-cell mediated	If single dose only, switch to an alternative agent. If 2 or more doses, watch and manage symptoms if they occur. If no reaction, reassure and re-label.
Drug fever / serum sickness-like reaction	Immune complex / type III	Review need for antibiotics. Discuss alternatives with a microbiologist
Nausea, vomiting or diarrhoea	GI intolerance	Reassure patient. If symptoms recur, review need for antibiotics. Discuss alternatives with a microbiologist if necessary.
Clostridium difficile colitis or previous GDH positivity	Imbalance of GI flora	Review need for antibiotics. Discuss alternatives with a microbiologist
Thrush	Super-infection with *Candida* spp.	Should resolve on stopping antibiotics. Manage symptoms according to the antibiotic formulary.
HIV disease-related drug reaction	CD4 <200	Seek specialist advice.
Unknown	Unknown	If no reaction, continue antibiotic and watch for symptoms. If they occur, manage accordingly. If not, reassure and re-label.

If the patient is found not to be allergic to the agent administered, communicate the finding to the rest of the medical and nursing team, re-label the medical records and drug chart, explain to and reassure the patient, and inform the GP.

3.6 Therapeutic Drug Monitoring: Use of Gentamicin

3.6.1 Background

Once daily dosing of gentamicin has been shown, in randomised clinical trials, to be as effective as multiple daily dosing regimens. Evidence suggests that, when compared to multiple daily dosing, aminoglycosides administered once daily also have a lower risk of nephrotoxicity and no greater risk of ototoxicity [1]. Despite the fact that the majority of these randomised controlled trials have been conducted in adults, the limited paediatric data available reflects these adult findings [2-5]. Most of these studies on once daily gentamicin in children have used a dose of 7mg/kg IBW and this is now the dose recommended in BNFc.

This document is intended to guide the prescribing and monitoring of once daily gentamicin therapy and should be used in preference to doses and monitoring schedules in BNFc.

3.6.2 Dosage and Monitoring

Dose: 1 month to 18 years = 7 mg/kg per dose

Dose for Haematology/Oncology patients and those currently on nephrotoxic drugs:

1 month to 12 years	= 6mg/kg per dose
>12 years	= 5mg/kg per dose

If obese, calculate dose based on ideal weight for height, e.g. if height 90th centile use 90th centile weight.

Administration: Slow IV infusion over 15 – 20 minutes.
Dilute with sodium chloride 0.9% or glucose 5% (volume not critical).

Monitoring:

- Prescribe one dose initially and wait for levels before further doses are prescribed.
- Only one timed level should be monitored.
- Take level 12 – 24 hours after the start of the infusion.
- Record the following on the drug card and laboratory request form:

1. Exact time dose given.
2. Exact time post dose that the sample was taken.

Thereafter take level:

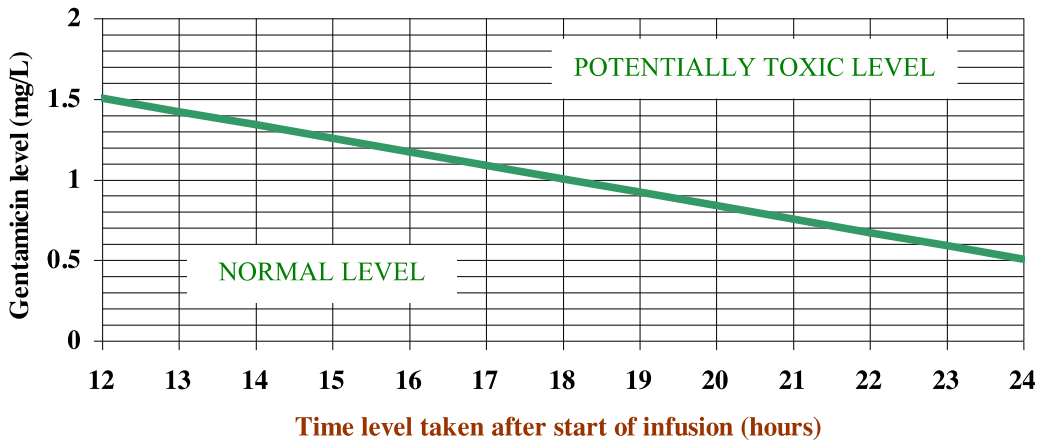
- twice weekly if stable, 12 - 24 hours after last dose
- if renal function is fluctuating, take level 12 to 24 hours after each dose
- Whenever possible, send levels to microbiology during normal working hours. Always mark request forms with ‘Once daily High Dose’ gentamicin.
- Where a neonate >32 weeks PMA is transferred to the hospital on 4mg/kg, change the next dose to 5mg/kg and monitor levels at 12 – 24 hours.

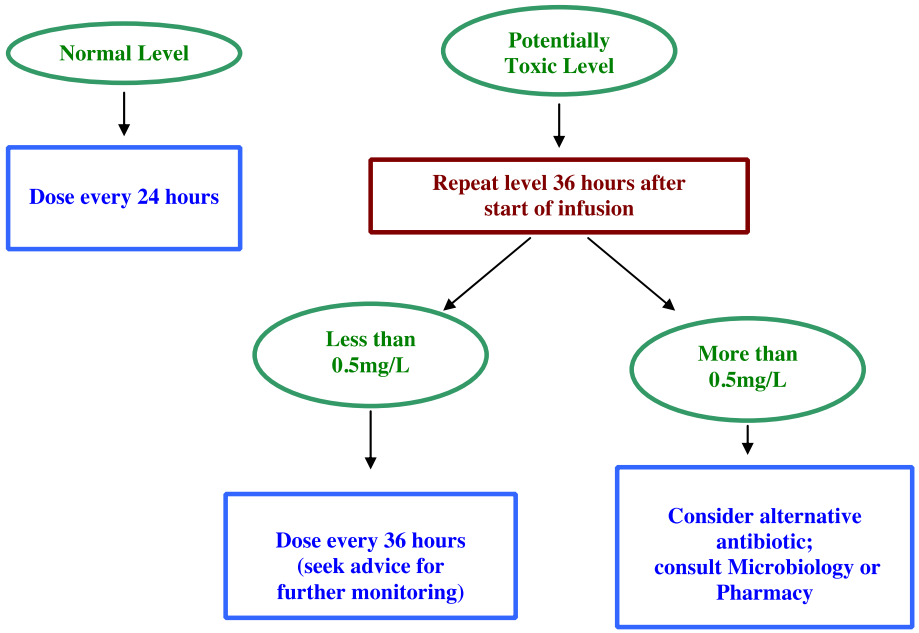
Renal function:

- Monitor serum creatinine when starting gentamicin and then twice weekly thereafter. If the patient is unstable, monitor more frequently.

- If renal function impaired, consider alternative treatment. If gentamicin used must seek guidance from Microbiology or Pharmacy.

3.6.3 Interpretation of Gentamicin Levels





NB: Any deviations from the guideline should only be made on the advice of senior medical staff, Microbiology or Pharmacy and these should be documented.

3.6.4 Contra-Indications and Warnings

- The narrow spectrum of activity of gentamicin must be kept in mind, as used alone it provides no cover for streptococci or anaerobes.
- Lower doses of gentamicin given more than once a day and in combination with other antibiotics are recommended in endocarditis.
- A once daily aminoglycoside regimen (Tobramycin) has been separately evaluated in patients with Cystic Fibrosis (CF). Consult the antibiotic guidelines for CF patients.
- The once daily regimen should be used with extreme caution in patients with renal impairment or in patients receiving other nephrotoxic drugs. Seek specialist advice from Microbiology or Pharmacy.
- Patients should be well hydrated during therapy.
- Extra caution in children with urinary outflow problems (bladder obstruction, urinary retention) renal impairment or dehydration.

3.6.5 Side Effects

Nephrotoxicity and ototoxicity can occur if optimum blood levels are exceeded.

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4 Empirical Antimicrobial Chemotherapy

4.1 Urinary Tract Infections

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Under 3 months	Cefotaxime iv	Discuss with Consultant Microbiologist
Over 3 months - uncomplicated	Trimethoprim oral 3 days Nitrofurantoin tablets	Amoxicillin Co-amoxiclav Nitrofurantoin suspension
Over 3 months -systemically unwell	Co-amoxiclav oral 7-10 days	Cefotaxime or ceftriaxone iv for first 2-4 days if oral cannot be used Gentamicin iv
See also NICE CG54 August 2007		

4.2 Upper Respiratory Tract Infections

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Throat infection Most cases will resolve without antibiotic. Treat if severe symptoms or high risk of complications.	Phenoxymethypenicillin oral Avoid amoxicillin if possibility of glandular fever	Clarithromycin
Peritonsillar abscess	Benzylpenicillin iv	
Acute otitis media Most cases will resolve without antibiotic. Treat if severe symptoms or high risk of complications.	Amoxicillin	Co-amoxiclav Clarithromycin
Sinusitis Most cases will resolve without antibiotic. Treat if persisting ≥7 days, severe symptoms or high risk of complications.	Amoxicillin severe cases: Co-amoxiclav +/- Metronidazole oral or iv	Clarithromycin Doxycycline (over age 12)
Epiglottitis (H influenzae)	Cefotaxime	
See also NICE CG69 July 2008		

4.3 Lower Respiratory Infections (BTS 2011)

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Bronchitis, bronchiolitis Most cases will resolve without antibiotic. Treat if severe symptoms or high risk of complications.	Amoxicillin oral	Clarithromycin oral Co-amoxiclav oral
Pneumonia	See British Thoracic Society guideline 2011	
Community-acquired pneumonia, early-onset hospital-acquired (<5 days from admission)	Amoxicillin oral	Clarithromycin oral Co-amoxiclav oral
2^0 to influenza	Co-amoxiclav oral	Clarithromycin oral Doxycycline oral (over age 12)
Severe or not tolerating oral	Co-amoxiclav iv	Cefuroxime iv
Monotherapy if suspected mycoplasma or chlamydia; add to first line antibiotic if very severe or not responding	Clarithromycin oral (use iv only enteral route not possible)	Doxycycline oral (over age 12)
Late-onset hospital acquired (≥5 days after admission) or resistant organism suspected (eg severe neurodisability, repeated antibiotics)	Piperacillin with tazobactam	Meropenem Ceftazidime
	(add gentamicin if known Pseudomonas)	
Pertussis Antibiotics have little effect on course of illness but may reduce transmission	Clarithromycin	
Tuberculosis	Seek advice from TB team	
Cystic fibrosis exacerbation	See national guidance here.	

4.4 Skin & soft tissues

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Impetigo small area	Topical mupirocin	
Impetigo widespread*	Flucloxacillin	Co-amoxiclav Clarithromycin
Erysipelas*	Penicillin V po or Benzylpenicillin iv	Clindamycin Clarithromycin

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Cellulitis*	Flucloxacillin Penicillin if known Group A strep	Clindamycin Clarithromycin
Staphylococcal scalded skin syndrome	Flucloxacillin	Clarithromycin
Paronychia*	Flucloxacillin	Co-amoxiclav Clarithromycin
Surgical site infection*	Flucloxacillin	Clindamycin
* If both streptococci and staphylococci suspected, use both penicillin and flucloxacillin pending culture results. For known or suspected MRSA infection discuss with Consultant Microbiologist M		
Human and animal bites	Co-amoxiclav	Clindamycin Clarithromycin
Necrotising fasciitis – urgent surgical debridement mandatory M	Meropenem + clindamycin	

4.5 Meningitis and meningococcal disease

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Suspected or confirmed bacterial meningitis, 3 months or older	Ceftriaxone (or cefotaxime) iv N. meningitidis : ≥7 days H. influenzae: ≥10 days S. pneumoniae: ≥14 days	
Suspected or confirmed meningococcal septicaemia	Ceftriaxone (or cefotaxime) iv ≥7 days	
Suspected or confirmed bacterial meningitis, under 3 months, initial Rx • Group B streptococcus • Listeria • Gram-negative bacilli	Cefotaxime + amoxicillin iv Adjust when organism identified: Cefotaxime ≥14 days Amoxicillin ≥21 days + Gentamicin ≥ first 7 days Cefotaxime ≥21 days	
If suspected bacterial meningitis and recent travel outside UK, add vancomycin IV to above until sensitivities known M If known or suspected severe beta-lactam allergy, discuss with Consultant Microbiologist M If herpes simplex encephalitis suspected add aciclovir See also NICE CG102 June 2010		

4.6 Gastrointestinal Infection

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Gastroenteritis: Do not routinely treat with antibiotic.	See NICE CG84 April 2009	
Campylobacter – severe disease	Clarithromycin oral	Ciprofloxacin oral
Non-typhi Salmonella – severe or invasive or under 6 months; Salmonella typhi – all cases M	Ciprofloxacin oral	Cefotaxime iv
Shigella dysentery	Azithromycin oral	Trimethoprim oral Ciprofloxacin oral
Amoebic dysentery	Metronidazole oral followed by Diloxanide furoate	
Giardia	Metronidazole oral	
C. difficile	Metronidazole oral	If recurrent or not responding to metronidazole, oral vancomycin
Peritonitis (surgical abdomen)	Co-amoxiclav iv +/- metronidazole iv	Cefuroxime iv + metronidazole iv ***or*** Vancomycin iv + metronidazole iv + gentamicin iv
Helicobacter	Amoxicillin + clarithromycin (initial treatment, with PPI)	Amoxicillin + metronidazole (if recurrent, with PPI)

4.7 Genital Tract

Sexually transmitted disease: for post-exposure prophylaxis see intranet guideline, for suspected or confirmed infection seek advice from Sexual Health

4.8 Septicaemia

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Community acquired	Cefotaxime	Amoxicillin + gentamicin
Hospital-acquired	Piperacillin with tazobactam +/- gentamicin +/- vancomycin	Consider preceding illness, operation, lines, MRSA status
Vascular line-associated	Vancomycin iv	
For known or suspected MRSA septicaemia discuss with Consultant Microbiologist M For infective endocarditis seek advice from regional paediatric cardiology unit		

4.9 Eye

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Conjunctivitis	Chloramphenicol drops	Fusidic acid drops Ofloxacin drops
Peri-orbital cellulitis	Cefotaxime + flucloxacillin	

4.10 Bone and joint

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Refer to Orthopaedics		
Osteomyelitis	Flucloxacillin	Clindamycin
Septic arthritis	Flucloxacillin Cefotaxime if Gram-negative suspected	Clindamycin

Addition of second agent should follow after 48 hours. Choice should be guided by culture results/response to initial therapy. If in doubt, discuss with Consultant Microbiologist.

5 Prophylaxis

Clinical Scenario	First Line Choice	Alternatives where first line choice contraindicated (eg allergy), not tolerated or not effective
Close contacts of Meningococcal disease see also HPA 2011	Ciprofloxacin oral single dose after discussion with Health Protection Agency	Rifampicin oral 2 days Ceftriaxone im single dose
Close contacts of invasive H influenzae type B disease	Rifampicin 4 days after discussion with Health Protection Agency	
Vulnerable close contacts of pertussis within 3 weeks of onset of cough in index case	Clarithromycin 7 days	
Asplenia or sickle-cell disease See also BCSH guideline 2012	Phenoxymethylpenicillin long-term	Amoxicillin Clarithromycin
Nephrotic syndrome	Phenoxymethylpenicillin until in remission	Clarithromycin
Urinary tract infection: prophylaxis is not routinely indicated at any age (NICE CG54), but may be useful in recurrent symptomatic UTI.	Trimethoprim once daily	Nitrofurantoin once daily Consider sensitivity pattern of breakthrough infections
Latent tuberculosis Unimmunised contacts of tuberculosis under age 2	Seek advice from TB team	
Surgical prophylaxis	Refer to Antibiotic Formulary and Prescribing Advice for Adult Patients section 5.4 for specific procedures, using BNFC to adjust doses by weight	

6 De-escalation of IV to oral and costs of antimicrobial agents

IV Antibiotics			Oral Alternative		
IV drug	**Dose Range**	**Cost per day * (£)****	**Oral drug**	**Dose Range**	**Cost per day * (£)**
Amoxicillin	500mg 8 hourly	1.68	Amoxicillin caps Amoxicillin caps Amoxicillin suspension 125mg/5ml Amoxicillin 250mg/5ml	250mg 8 hourly 500mg 8 hourly 125mg 8 hourly 250mg 8 hourly	0.14 0.17 0.17 0.19
Benzylpenicillin	600mg 4 - 6 hourly 1.2g 4 - 6 hourly	3.8 - 5.7 7.56 – 11.34	Phenoxymethylpenicillin tablets Phenoxymethylpenicillin 250mg/5ml suspension Phenoxymethylpenicillin 125mg/5ml suspension	250mg-500mg 6 hourly 250mg 6 hourly 125mg 6 hourly	0.16 - 0.32 0.52 0.38
Cefotaxime	500mg 8 - 12 hourly 1g 8 - 12 hourly	4.28 – 6.42 8.62- 12.93	Respiratory Tract Infection: Co-amoxiclav		See below for costs
			Urinary Tract Infection: Cefalexin 125mg/5ml Cefalexin 250mg/5ml Cefalexin 250mg caps Cefalexin 500mg caps	 125mg 8 hourly 250mg 8 hourly 250mg 8 hourly 8 hourly	 0.25 0.31 0.22 0.28
Ceftriaxone	1 - 2g 12 - 24 hourly	10.17 – 20.36	Respiratory Tract Infection: co-amoxiclav		See below for costs
			Urinary Tract Infection: Cefalexin 125mg/5ml Cefalexin 250mg/5ml Cefalexin 250mg caps Cefalexin 500mg caps	 125mg 8 hourly 250mg 8 hourly 250mg 8 hourly 8 hourly	 0.25 0.31 0.22 0.28
Cefuroxime	250mg – 500mg 8 hourly 750mg – 1.5g 8 hourly	2.82 – 5.64 7.02 – 15.15	Respiratory Tract Infection: Co-amoxiclav		See below for costs
			Urinary Tract Infection: Cefalexin 125mg/5ml Cefalexin 250mg/5ml Cefalexin 250mg caps Cefalexin 500mg caps	 125mg 8 hourly 250mg 8 hourly 250mg 8 hourly 8 hourly	 0.25 0.31 0.22 0.28
Ciprofloxacin	100mg 12 hourly 200mg 12 hourly 400mg 12 hourly	16.0 30.0 45.7	Ciprofloxacin 250mg/5ml Ciprofloxacin 250mg tablets Ciprofloxacin 500mg tablets	250mg 12 hourly 250mg 12 hourly 500mg 12 hourly	1.68 0.19 0.20
Clarithromycin	500mg 12 hourly	18.9	Clarithromycin 125mg/5ml Clarithromycin 250mg/5ml Clarithromycin 250mg tablets Clarithromycin 500mg tablets	125mg 12 hourly 250mg 12 hourly 250mg 12 hourly 500mg 12 hourly	0.79 1.58 0.36 0.50
Clindamycin	300 - 600mg 6 hourly	23.2 – 49.4	Clindamycin No suspension commercially available. 'Special order' preparation available. Note cost and licensing implications.	150mg - 450mg 6 hourly	1.14 – 6.86
Co-amoxiclav	600mg 8 hourly 1.2g 8 hourly	3.63 7.83	Co-amoxiclav 125/31 Co-amoxiclav 250/62 Co-amoxiclav400/57 Co-amoxiclav tablets	125/31 8 hourly 250/62 8 hourly 400/57 12 hourly 375mg 8 hourly 625mg 8 hourly	0.37 0.94 1.18 0.33 0.46
Ertapenem	1g od	31.65	Seek Microbiology advice		

IV Antibiotics			Oral Alternative		
IV drug	**Dose Range**	**Cost per day * (£)****	**Oral drug**	**Dose Range**	**Cost per day * (£)**
Flucloxacillin	250mg – 2g 6 hourly	4.92 - 39.2	Flucloxacillin 125mg/5ml Flucloxacillin 250mg/5ml Flucloxacillin caps	125mg 6 hourly 250mg 6 hourly 500mg 6 hourly 1g 6 hourly	2.62 6.00 0.41 0.82
Fluconazole	50mg - 400mg od	7.32 – 58.54	Fluconazole 50mg/5ml Fluconazole caps	50mg od 50mg - 400mg od	2.37 0.14 – 1.42
Gentamicin	40mg/ml 40mg od	1.40	Seek Microbiology advice		
Levofloxacin	500mg 12 hourly	52.8	Levofloxacin	500mg 12 hourly	5.17
Linezolid	600mg 12 hourly	89.0	Linezolid 100mg/5ml Linezolid tablets	100mg-600mg 12 hourly 600mg 12 hourly	14.8 - 89 89.0
Meropenem	500mg - 1g 8 hourly	23.22 – 51.57	Seek Microbiology advice		
Metronidazole	500mg 8 hourly	3.66	Metronidazole 200mg/5ml Metronidazole tablets	200mg 8 hourly 200mg 8 hourly 400mg 8 hourly	1.68 0.19 0.19
Moxifloxacin	400mg od	39.95	Moxifloxacin	400mg od	2.49
Nitrofurantoin			Nitrofurantoin oral suspension 25mg/5ml Nitrofurantoin tablets	50mg 6 hourly 50mg 6 hourly 100mg 6 hourly	13.2 0.26 0.71
Piperacillin / tazobactam	4.5g 8 hourly	42.63	Seek Microbiology advice		
Rifampicin	600mg 12 hourly	15.34	Rifampicin 100mg/5ml Rifampicin 300mg caps	100mg 12 hourly 300mg 12 hourly 600mg 12 hourly	0.30 0.90 0.83
Teicoplanin	200 - 400mg od	3.57 – 6.1	Seek Microbiology advice		
Trimethoprim			Trimethoprim 50mg/5ml Trimethoprim 100mg tablets Trimethoprim 200mg tablets	50mg 12 hourly	0.20 0.06 0.12
Vancomycin	500mg od to 12 hourly 1g od to 12 hourly	7.25 - 14.5 14.5 – 29.0	Seek Microbiology advice		

Note that antimicrobial doses in Paediatric patients are in general specific and based on body weight. Therefore the above is used as a guide to antimicrobial costs only.

* BNF 64 Prices (September 2012)
** Associated costs e.g. consumables are NOT included