ANTIBIOTIC POLICY
GOVERNMENT HEALTH SERVICES
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This Antibiotic Policy is designed only as a reference and prescribing guide for doctors working in the Government Health Services. While every effort is made to ensure that the contents are accurate, the Committee can accept no responsibility for errors or omissions.
FOREWORD

The aim of this work is to suggest up-to-date, efficacious and safe antibiotic regimens for the treatment or prevention of disease due to microorganisms. The guidelines followed were: the need for preventing the emergence and proliferation of antibiotic resistant strains, the possible side-effects of the chemotherapeutic agents, concern for cost-containment and availability of these regimens.

It is stressed that these regimens are not intended as a single modality treatment of any infection. The prophylaxis and treatment of sepsis should be based on four corner-stones:

(i) strict observation of aseptic technique
(ii) proper surgical technique
(iii) adequate drainage where indicated
(iv) correct use of antibiotics in prophylaxis and treatment of infection.

Sepsis is still an important cause of morbidity and death in our patients. The awareness of the limitations of antibiotics and the need for defining their role has stimulated a multitude of trials and publications of varying quality. Some of these, for example the ones concerning the prophylactic use of antibiotics, are hotly debated.

The Committee was given the responsibility to distill the essence from these writings and temper it with experience, knowledge of antibiotic resistance of local strains of micro-organisms, and hopefully, a dash of wisdom. We would like to thank all those colleagues who so generously gave sound advice.

It is earnestly hoped that all those who consult this work will also refer to Sir Robert Hutchinson’s “Medical Litany” conveniently printed on the back-cover. May this “litany”, a veritable pearl of illuminated thought, guide our future efforts.

The Chairman
Antibiotic Policy Committee
DEDICATION
To all those patients who have suffered, are suffering or will suffer from the misuse of antibiotics.
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INTRODUCTION

Many surveys have shown that inappropriate antibiotic prescribing is widespread in hospital practice. Misuse of antimicrobial drugs subjects patients to unnecessary adverse effects of the drugs, encourages the emergence and proliferation of antibiotic-resistant microorganisms and wastes money. Furthermore, within a given institution, bad prescribing habits of clinicians can directly affect the patients of their colleagues via selection of, and cross-infection by, antibiotic-resistant microorganisms.

PRINCIPLES OF ANTIBIOTIC USE

1. **Topical antimicrobials** should be restricted to proven indications, e.g. ophthalmological use, because of their potent capacity for selecting resistant organisms, and for sensitising patients. Topical antiseptics usually provide a satisfactory alternative.

2. **Prophylactic antibiotics** should be restricted to a limited range of drugs of proven efficacy. Surgical antibiotic prophylaxis should generally be given by the parenteral route, commencing just before the procedure and usually continuing for no more than 1 or 2 doses post-surgery. The aim is to achieve high plasma and tissue levels of antibiotic at the time of maximum risk.

3. **Narrow spectrum antibiotics**, directed against specific organisms, should be used whenever practicable. Broad spectrum drugs can lead to superinfection and the selection of resistance on a broad front, e.g. the widespread use of cephalosporin antibiotics to treat Gram-negative infections may also select out methicillin-resistant staphylococci.

4. **Antibiotic combinations** are sometimes acceptable in order to extend the spectrum of cover, achieve a more rapid and complete bactericidal effect (synergy) or prevent the emergence of resistant organisms. For example, fusidic acid or rifampicin should never be used alone against infections caused by methicillin-resistant staphylococci but rather should be combined with each other or possibly with flucloxacillin.

5. **Cost** should determine the selection of a particular antimicrobial drug when microbiological, pharmacological and other relevant properties are similar.

6. **Choice of particular agents** within a broad group of antimicrobials, including newer agents, should take into consideration factors such as antimicrobial spectrum, clinical experience, safety, efficacy, potential for selecting resistant organisms and cost. These decisions are particularly
important in choosing among certain penicillins and the many cephalosporin and aminoglycoside antibiotics currently available.

(i) Penicillins
Flucloxacillin appears to be more reliably absorbed by the oral route than cloxacillin and it may cause less gastro-intestinal upset. The microbiological activity of the two products is similar and thus the parenteral form of flucloxacillin offers no special advantage over cloxacillin.

Amoxycillin is more reliably absorbed after oral administration than ampicillin, and thus need only be administered 8-hourly by this route. The antimicrobial spectrum and activity of both products is similar. In this booklet (amoxy) ampicillin refers to either of these products.

Amoxycillin, in combination with the beta-lactamase inhibitor clavulanic acid, has proved useful for treating infections due to beta-lactamase producing gonococci and H. influenzae. This combination possesses a wider spectrum of activity than amoxycillin. Nevertheless at the time of going to print, it cannot be recommended for routine use.

Ticarcillin is a more active derivative of carbenicillin and requires a smaller daily dose, thereby reducing the risk of platelet dysfunction and minimising the sodium load (and possible electrolyte imbalance) that is sometimes a problem with carbenicillin. It is recommended that ticarcillin should replace carbenicillin.

(ii) Cephalosporins and related drugs
5.8 to 9.0% of patients showing allergic reactions to penicillin also react to cephalosporins. Since these cross reactions cannot be easily predicted, cephalosporins should certainly be avoided in patients with a history of immediate-type penicillin reactions, and preferably avoided, if another suitable agent is available, in all patients with a history of penicillin allergy. “First generation” cephalosporins include cephalothin, cephalaxin, cephalozin, cephradine and cefaclor; “second generation” drugs include cefoxitin, cefuroxime and cefamandole; “third generation” products include cefotaxime, latamoxef, ceftaizidime and cefoperazone.

(iii) Aminoglycosides
Different aminoglycoside antibiotics are indicated in specific clinical situations.
Gentamicin has the virtue of activity against *Pseudomonas aeruginosa*, and some kanamycin-resistant organisms, and is suitable for most cases of hospital-acquired aerobic Gram-negative sepsis. Kanamycin is still appropriate for severe aerobic Gram-negative sepsis acquired outside hospital.

Tobramycin is more active than gentamicin against *Pseudomonas aeruginosa* (but not other aerobic Gram-negative bacteria) and is the drug of choice, in combination with ticarcillin, for suspected or proven pseudomonas septicaemia. Tobramycin is possibly less nephrotoxic than gentamicin.

Netilmicin is less ototoxic and nephrotoxic than either gentamicin or tobramycin. It will possibly replace gentamicin in the near future.

Amikacin should be restricted for use against infections proven or presumed to be due to organisms resistant to other aminoglycosides.

The use of earlier aminoglycosides such as kanamycin and gentamicin, where appropriate, can be expected to delay the emergence of resistance to later drugs and decrease costs as newer agents are inevitably more expensive than the old.

(iv) *Co-trimoxazole (trimethoprim / sulphamethoxazole)*

Trimethoprim is available as a single agent. Clinical trials have shown that this drug achieves comparable results to co-trimoxazole for uncomplicated urinary tract infections and it has less adverse reactions due to the absence of the sulphonamide component. However, fears that its use as a single agent will increase the number of trimethoprim-resistant micro-organisms have yet to be disproved.
GENERAL PRESCRIBING CONSIDERATIONS

1. The following regimens apply to normal, non-pregnant, average sized adults. If the patient has renal or liver failure the dosages may need to be adjusted and antibiotic assays may be necessary to monitor therapy. (For drug doses in renal failure see Appendix). These regimens are merely guidelines and are not a substitute for obtaining the opinion of a doctor who is experienced in the treatment of the particular infection involved.

2. It is essential to obtain appropriate microbiological specimens for culture and sensitivity testing before commencing antibiotic therapy. A Gram stain report (e.g. in cases of pneumonia or urethral discharge) may help to narrow the choice of antibiotics.

3. In all serious infections, but especially in patients with endocarditis, osteomyelitis, infection associated with prosthetic devices and infection occurring in immuno-compromised hosts, additional microbiological tests are often valuable. Microbiologists and physicians may be consulted for advice on these and other related matters.

4. In treating any patient, it may appear necessary to alter the antibiotic treatment in the light of bacteriological results. Before doing so, the clinical situation should be reassessed, not only because the organism isolated may not be the causative agent, but also because the response of the patient may differ from that predicted by in-vitro sensitivity testing.

5. A course of oral therapy may be preceded by intravenous or intramuscular injection, particularly if the disease is severe. Higher doses than those recommended may also be useful for severe disease.

6. Ototoxicity is cumulative with the various aminoglycosides and all contribute to the total risk. As a general rule no aminoglycoside should be used for more than two weeks at a time. The use of this group of antibiotics should be controlled by careful monitoring of the patient’s renal function and by antibiotic assays. When used for severe sepsis the use of a larger initial loading dose of an aminoglycoside may be considered.

7. Pregnancy. The guidelines have not taken the problems of placental transfer and foetal effects into account. Many antibiotics cross the placenta. Others may be excreted in breast milk. For details on individual drugs consult:
   (2) Ron Batagol, The Royal Women’s Hospital Reference Guide on Drugs and Pregnancy, The Royal Women’s Hospital, Australia, 1983.
8. Children require doses of antibiotics which often differ from those used in adult medicine. In the case of neonates, pre-term babies and children, consult the Formulary, Government Pharmaceutical Services where the appropriate dosage recommendations have been made.
RECOMMENDATIONS

(1) DO NOT start or change antibiotics without good reason. Take account of special circumstances (e.g. pregnancy, renal impairment) and the age and size of the patient.

(2) DO NOT use restricted antibiotics without consulting your senior clinical and/or microbiological colleagues.

(3) DO NOT give gentamicin or other aminoglycosides without laboratory control. Take advice.

(4) DO NOT use ampicillin for sore throats when there is a suspicion of glandular fever.

(5) DO NOT use antibiotics for bedsores or undiagnosed ulcers. Topical antibiotics should be used only with great care.

(6) DO NOT use tetracyclines in patients with renal impairment, in children, or in pregnant women, without advice.

(7) DO NOT treat tuberculosis without advice.

(8) DO NOT use antibiotics for genital discharges without taking smears.

(9) DO NOT use fusidic acid alone because resistant strains of staphylococcus may rapidly emerge. This risk is minimised by giving fusidic acid in combination.

(10) DO NOT use cephalosporins indiscriminately. Their use should be confined to the few situations defined in this policy, and to certain forms of short-term (no longer than 24 - 48 hours) peri-operative prophylaxis.

(11) DO NOT use chloramphenicol indiscriminately. Remember that it may adversely affect the bone marrow.

(12) Chemoprophylaxis should be confined only to certain well defined indications, e.g. for prevention of bacteraemia in certain forms of surgery. Ask your consultant for advice. Also see section on chemoprophylaxis in the policy.

(13) Please give the laboratory adequate clinical details.
RESPIRATORY TRACT INFECTIONS
PNEUMONIA

Treatment will frequently have to be initiated for a patient with the clinical or X-ray features of pneumonia before a bacteriological diagnosis can be confirmed. If the clinical response to parenteral therapy is satisfactory, high dose oral therapy may be substituted after a few days.

1. Typical pneumonia
Pneumonia in a previously healthy adult, post-operative pneumonia, post-aspiration pneumonia or broncho-pneumonia following chronic bronchitis.

Common causative bacteria: Str. pneumoniae / H. influenzae.

procaine penicillin, 1.5 g (1.5 million units), intramuscularly, daily, for five days (mild disease only)

OR

benzyl penicillin, 600 mg (1.0 million units), intravenously, 4 to 6-hourly, for five to ten days (moderate to severe disease).

If the patient fails to respond to such treatment bacteriological investigations should be performed. It should be noted that the tissue concentrations of benzyl penicillin produced by these regimens are adequate to deal with most strains of H. influenzae and the practice of combining intravenous penicillin with (amoxy) ampicillin, or using intravenous (amoxy) ampicillin alone, is thought to be unnecessary and is certainly more expensive. However, if after initial parenteral treatment it is planned to continue with oral administration, phenoxy methyl penicillin may be unsatisfactory, and (amoxy) ampicillin or co-trimoxazole should be used.

2. Staphylococcal Pneumonia
If suspected on clinical or radiological grounds

flucloxacillin, 1 - 2 g, intravenously, 4-hourly

It may be advisable to add gentamicin, 3 - 5mg/kg, intramuscularly or intravenously, daily, in divided doses every 8 hours until bacteriology is clarified. This combination will usually be synergistic against Staph. aureus and also covers many Gram-negative organisms in case of mis-diagnosis.

Patients with pneumonia suspected or proven to be due to methicillin-resistant staphylococci can be treated initially with vancomycin, 1.0 g intravenously, 12-hourly or 500 mg intravenously, 6-hourly. These patients
should be nursed in isolation.

3. **Gram-Negative Pneumonia**  
If suspected (e.g. *Klebsiella* spp. in a chronic alcoholic)

- gentamicin, 3 - 5 mg/kg. intramuscularly or intravenously, daily, in divided doses, every 8 hours.

**TOGETHER WITH EITHER**

- benzyl penicillin, 600 mg (1.0 million units), intravenously, 4 to 6-hourly until bacteriology is clarified.

**OR**

- ticarcillin/carbenicillin

  - ticarcillin, 15 - 20 g intravenously daily, in divided doses, every 4 - 8 hours; or carbenicillin, 20-30 g intravenously daily, in divided doses, every 4 - 6 hours.

The combination of gentamicin and benzylpenicillin covers *Str. pneumoniae* in case of mis-diagnosis.

If, in treating any of 1, 2 and 3 above, the patient is hypersensitive to penicillin, erythromycin 1.0 g, intravenously 6-hourly could be used instead. (See also note on cephalosporins under “Principles of Antibiotic Use”).

4. **Atypical Pneumonia**  
For non-viral aetiology e.g. Mycoplasma, Psittacosis or Q fever.

- tetracycline 500 mg, orally, 6-hourly for 7 to 10 days  
  (In case of renal decompensation, doxycycline would be preferred).

If severe, use intravenous rolitetracycline, 275 mg, 8-hourly (infused over 30 minutes).

For mycoplasma pneumonia, erythromycin is an equally satisfactory alternative, 500 mg-1.0 g intravenously, 6-hourly, then 500 mg orally, 6-hourly, depending upon severity, for 7 to 10 days.

If Legionnaires’ Disease is suspected or proven, erythromycin is the drug of choice, administered as for mycoplasma pneumonia.

5. **Tuberculous Pneumonia**

  - rifampicin 600 mg, orally, daily
PLUS
isoniazid 300 mg, orally, daily
PLUS
ethambutol 25 mg/kg, orally, daily for the first two months then reducing to 15 mg/kg daily.

If the patient is critically ill streptomycin (1g intramuscularly daily for patients under the age of 40 and 0.75g intramuscularly daily in patients above the age of 40) may be preferred instead of ethambutol as the former has a greater bactericidal effect. Treatment should consist of three months triple therapy followed by a further 6 months of rifampicin and isoniazid. All the medications should be given as a single dose together, one hour before breakfast.

6. Severe Undiagnosed Pneumonia in the Compromised Patient

(i) Immunosuppressed
A bronchoscopy and biopsy are often necessary for diagnosis. The causative agent may be viral (e.g. cytomegalovirus), bacterial (e.g. Pseudomonas spp.), fungal (e.g. Aspergillus), or protozoal (e.g. Pneumocystis). Due to the wide range of possibilities a microbiologist or physician should be consulted as to the most appropriate diagnostic and therapeutic measures.

(ii) Intensive Care Areas

- gentamicin, 1.5 mg/kg, intravenously, 8-hourly
- TOGETHER WITH
- benzyl penicillin, 600 mg (1.0 million units), 4 to 6-hourly, until bacteriology is clarified.
- OR AS A SINGLE AGENT
- cefotaxime, up to 12g, intravenously or intramuscularly, daily, in 3 - 4 divided doses.

If there is a high incidence of antibiotic-resistant organisms in a particular unit then a different antibiotic regimen, using reserve antibiotics, may need to be considered after appropriate microbiological consultation.
INFECTIONS OF THE CARDIOVASCULAR SYSTEM
ENDOCARDITIS

A total of six weeks’ therapy is usually required. The initial treatment should be given intravenously. There are a number of proven regimens reported in the literature. The use of an aminoglycoside in combination with penicillin adds to the risk of toxicity, but appears to offer a better chance of a favourable outcome. If the patient’s response and bacteriological monitoring are satisfactory, it may be possible to shorten the period of intravenous antibiotics and substitute it with intramuscular and/or oral therapy. This should be done in consultation with a microbiologist or a physician.

1. **Streptococci highly sensitive to penicillin (M.I.C. less than 0.1 mg/L)**

   benzyl penicillin, 1.2 - 2.4 g (2.0 - 4.0 million units),
   intravenously, 4-hourly for 4 to 6 weeks

   TOGETHER WITH

   gentamicin, 1.0 mg/kg, intramuscularly or intravenously,
   8-hourly for two weeks.

   If the aminoglycoside is omitted because of anticipated toxicity (eg. due to age or renal impairment) then penicillin alone must be given for a full 6 weeks.

   If a six week course is indicated, the last 2 weeks of penicillin therapy may be given orally; phenoxymethyl penicillin 500 mg, 6-hourly with probenecid 500 mg orally, 6-hourly should be used. Laboratory monitoring of the adequacy of antibiotic therapy should be continued during this period.

2. **Streptococci relatively resistant to penicillin (M.I.C. greater than 0.1 mg/L)**

   benzyl penicillin, 1.2 - 2.4 g (2.0 - 4.0 million units),
   intravenously, 4-hourly for six weeks, the dose depending upon severity*

   TOGETHER WITH

   gentamicin, 1.0 mg/kg, intramuscularly or intravenously,
   8-hourly for six weeks.

* For *Strep. faecalis*, some would prefer (amoxy) ampicillin.
3. **Staph. aureus** (methicillin / flucloxacillin sensitive)

flucloxacillin, 2.0 g intravenously, 4-hourly, for at least six weeks

TOGETHER WITH

gentamicin, 1.0 mg/kg, intramuscularly or intravenously, 8-hourly for two weeks.

Please consult the Microbiology Department if:
(i) The disease is fulminating*.
(ii) The patient is hypersensitive to penicillin.
(iii) The patient has a prosthetic valve in situ.*
(iv) The organism is not one specified above or is unknown.

* Patients with fulminant disease or infected prosthetic valves may require urgent surgery before the infection is controlled.

**SEPTICAEMIA**

1. **Unknown Organism but focus of infection known/presumed**

   (i) **Urinary Tract or Biliary Tree**

   (amoxy) ampicillin, 1.0 - 2.0 g, intravenously, 4-hourly

   TOGETHER WITH

   gentamicin, 1.5 mg/kg, intravenously, 8-hourly until bacteriology is defined.

   (ii) **Bowel**

   (amoxy) ampicillin, 1.0 - 2.0 g, intravenously, 4-hourly

   TOGETHER WITH

   gentamicin, 1.5 mg/kg, intravenously, 8-hourly

   TOGETHER WITH EITHER

   metronidazole, 500 mg, intravenously, 8-hourly (infuse over 20 minutes). Metronidazole suppositories (1.0 g, 8-hourly) may be substituted for the intravenous form depending upon the patient’s clinical condition.

   OR
clindamycin, 600 mg, intravenously, 8-hourly or 1.2 g 12-hourly (diluted in 100 ml and infused over at least 30 minutes).

(iii) Intravascular cannulae, including central venous lines
Remove and culture the cannula(e). Common infecting organisms include *Staph. aureus*, *Staph. epidermidis* and, more rarely, aerobic Gram-negative bacilli. Flucloxacillin or cephalothin may be satisfactory initial therapy, however if the patient is critically ill, the addition of an aminoglycoside should be considered. In every case the patient should be reviewed carefully after 12 hours; a rapid response to removal of the cannula(e) may obviate further antibiotic therapy.

2. Immunosuppressed Patients.
Common infecting organisms are aerobic bowel flora (sometimes with an increased incidence of *Pseudomonas*), *Staph. aureus* and other Gram-positive cocci. In general, the initial therapy of febrile episodes in these patients will require a combination of an aminoglycoside (e.g. gentamicin) with ticarcillin/azlocillin. If there is a high incidence of antibiotic-resistant organisms in a particular unit consultation regarding a different antibiotic regimen, using reserve antibiotics, may be required.

3. Specific Organisms
(i) *Pseudomonas aeruginosa*
   tobramycin, 1.5 mg/kg, intravenously, 8-hourly
   TOGETHER WITH
   ticarcillin, 2.0 - 3.0 g, intravenously, 4-hourly

(ii) Methicillin-resistant *Staphylococcus aureus* (MRSA)
For life-threatening infections
   vancomycin, 1.0 g, intravenously, 12-hourly or 500 mg, intravenously, 6-hourly

Other alternatives are available when the infection is controlled, or for less severe problems and if the particular strain is shown to be sensitive.

(iii) Other organisms
Consult the Microbiology Department.
INFECTIONS OF THE CENTRAL NERVOUS SYSTEM

TRAUMATIC C.S.F. LEAK

ampicillin, 500 mg, intravenously, 6-hourly for 7 days
AND
sulphadiazine, 500 mg, intravenously, 6-hourly for 7 days
(after a loading dose of 1 g)

Doses of both drugs are then halved and treatment continued for 7 days
(after cessation of CSF leak). A neurosurgeon is to be consulted immediately.

MENINGITIS

1. Causative Organism not yet known
   benzyl penicillin, 1.2 g (2.0 million units),
   intravenously, 2-hourly
   TOGETHER WITH
   chloramphenicol, 1.0 g, intravenously, 6-hourly.

In case of penicillin allergy, use chloramphenicol alone.

The inappropriate drug should be stopped when the causative organism
is identified, and its sensitivity pattern determined; otherwise continue
for 10-14 days.

2. Pneumococcal
   benzyl penicillin, 1.2 - 2.4 g (2.0 - 4.0 million units),
   intravenously, 4-hourly for 10-14 days.

A few very ill patients may require treatment for up to 21 days.

3. Meningococcal
   Treatment as for pneumococcal meningitis.

Contacts: Close contacts should all have nasal and posterior pharyngeal
swabs. All children (and probably adults who are close contacts) should
immediately begin a five day course of oral (amoxy) ampicillin. Those
deciding to take the drug should be instructed to report early symptoms
immediately.
Carriers: Those whose swabs are positive for *Neisseria meningitidis* should be advised to take a 3-4 day course of oral rifampicin to eradicate the carrier state.

4. *Haemophilus influenzae* type b

    chloramphenicol, 1.0 g, intravenously, 6-hourly

In 3-4 days, when the patient is well enough to take oral medication, chloramphenicol can be given orally*, in the same dosage. The total duration of treatment should be 10 to 14 days.

* The paediatric suspension of chloramphenicol palmitate may be inadequately absorbed in some children and may vary in bioavailability.

(Amoxy) ampicillin is no longer recommended for empirical treatment because of the increasing incidence of (amoxy) ampicillin-resistant strains being isolated.

Contacts: *H. influenzae* type b, like the meningococcus, may also spread to close contacts, particularly children. Such contacts should receive a 3-4 day course of rifampicin.

5. Special Considerations

Older cephalosporins and systemic aminoglycosides are not effective in the treatment of meningitis. Some of the newer cephalosporins may prove useful for this purpose, but at the moment clinical experience is limited.

Consultations with either a microbiologist or a physician experienced in this field is essential if there are uncertainties in treating a patient with bacterial meningitis. Consultation is particularly advisable in the case of:

(i) Causative organisms not specified above.
(ii) Patients hypersensitive to penicillin.
(iii) Meningitis complicating neurosurgery (particularly shunts).
INFECTIONS OF THE EYE AND ADNEXA

1. INFECTIONS OF THE EYELIDS

(i) Acute Chalazion

Local application, three times daily, of the following antibiotic or antibiotic with steroid ointments:

- framycetin sulphate 0.5% eye ointment
- OR
- dexamethasone 0.05%, framycetin sulphate 0.5%, gramicidin 0.005% eye ointment
- OR
- chloramphenicol 0.5% eye ointment
- OR
- hydrocortisone 0.5% with chloramphenicol 0.2% eye ointment/drops.

(ii) Blepharitis

Blepharitis, acute or chronic, similar treatment as for chalazion.

2. INFECTIONS OF THE LACRIMAL DUCTS

(i) Canaliculitis, Acute or Chronic Dacryocystitis

Antibiotics according to sensitivity results or broad spectrum antibiotics should be used.

Drops should be instilled at least 5 times daily and ointment applied at night to maintain antibiotic concentration; ointment should be also applied to the skin above the lesion 3 times daily.

- chlortetracycline/tetracycline 1% eye drops and eye ointment
- OR
- gentamicin 0.3% eye drops and eye ointment

3. INFECTIONS OF THE CONJUNCTIVA

(i) Bacterial Conjunctivitis

Antibiotics according to sensitivity results or broad spectrum antibiotics
should be used.

Drops should be instilled at least 5 times daily and ointment applied at night to maintain antibiotic concentration. In case of heavy infection the drops may be applied hourly or more often.

- framycetin sulphate 0.5% eye drops and eye ointment
- chloramphenicol eye drops 0.5% and eye ointment 1%
- chlortetracycline/tetracycline 1% eye drops and eye ointment
- gentamicin 0.3% eye drops and eye ointment
- antibiotics in combination e.g.: gramicidin 25 units, neomycin sulphate 0.25%, polymyxin B sulphate 500 units/ml, eye drops.

4. INFECTIONS OF THE CORNEA

(i) Corneal Infiltrate and Ulcer

Antibiotics according to sensitivity results or broad spectrum antibiotics should be used. The eye drops should be instilled at least 5 times daily and the ointment applied 3 times daily to maintain antibiotic concentration. A strong mydriatic should also be used.

- chloramphenicol eye drops 0.5% and eye ointment 1%
- gentamicin 0.3% eye drops and eye ointment
- antibiotics in combination e.g.: gramicidin 25 units, neomycin sulphate 0.25%, polymyxin B sulphate 500 units/ml, eye drops.

In several corneal ulcers, combinations of antibiotics (both eye drops and eye ointments) should be used together with gentamicin subconjunctival injection, 16 mg daily, until improvement occurs.
(ii) Herpetic Infections of the Cornea, Disciform Dendritic Keratitis and Herpetic Ulcers.

The patient should be admitted to hospital

idoxuridine 0.1% eye drops, instilled hourly for first day, then 5 times daily for subsequent 6 days

WITH

idoxuridine 0.5% eye ointment, 3 times daily.

In case of no response

acyclovir eye ointment 5 times daily

TOGETHER WITH (IN SEVERE CONDITIONS)

acyclovir, 200 mg, orally, 5 times daily

In cases of disciform keratitis without epithelial defect, careful use of steroids is possible. Antibiotic cover is needed in more severe conditions.

5. INTRA-OCULAR INFECTIONS

Bacterial Endophthalmitis

gentamicin 16 mg, by subconjunctival injection, daily

In some severe conditions it may be necessary to administer gentamicin by intra-vitreal injection generally in combination with broad spectrum antibiotics, in order to achieve a wider spectrum of cover e.g. ampicillin, flucloxacillin and gentamicin. Initially the treatment should be administered intramuscularly; following response, treatment may then be given orally.

6. ORBITAL INFECTIONS

Orbitocellulitis, bacterial dacryoadenitis, phlegmona orbitae: treat the primary source of infection which is usually sinusitis.
COMMON INFECTIOUS DISEASES IN E.N.T.

EAR INFECTIONS

1. Otitis Externa and Furuncle

Common organisms are *Streptococcus, Staphylococcus, Pseudomonas aeruginosa*. Fungi are usually present as secondary invaders.

Treatment: the external auditory meatus should be packed with ichthammol in glycerine on strip gauze, or aluminium acetate wick, depending upon the extent of oedema.

(i) In Otitis Externa

Local instillation of the following antibiotic ear drops, depending on the type of organisms, 3 - 4 times daily:

For bacterial infection

- hydrocortisone 1%, neomycin sulphate 0.439%, polymyxin B sulphate 0.119%, ear drops
- OR
dexamethasone sodium metasulphobenzoate 0.05%, framycetin sulphate 0.5%, gramicidin 0.005% ear drops
- OR
gentamicin 0.3% ear drops.

For fungal infection
tolnaftate 1% solution.

(ii) In Furunculosis

- ampicillin, 250 mg, orally, 6-hourly, for 8 days TOGETHER WITH
- flucloxacillin, 250 mg, orally, 6-hourly, for 8 days
- OR
erthromycin, 500 mg, orally, 6-hourly, for 8 days.

2. Perichondritis of the Pinna

- ampicillin, 500mg, orally, 6-hourly until the organisms and their sensitivity are known.
3. **Dermatitis of the Skin of the External Auditory Meatus**

drops and ointment containing dexamethasone 0.05%, framycetin sulphate 0.5%, gramicidin 0.005%. Apply drops 3 - 4 times daily; apply ointment 2 - 3 times daily and at bedtime.

4. **Otitis Media**

(i) **Acute Otitis Media**

Common organisms are *Streptococcus* spp., *Haemophilus* spp., and sometimes pneumococcus.

Systemic antibiotics are indicated and route of administration depends upon the severity of the infection.

- benzyl penicillin, 600 mg (1million units), intramuscularly, 6-hourly
  OR
- amoxycillin, 500 mg, orally, 8-hourly, for 5 to 7 days
  OR
- ampicillin, 500 mg, orally, 6-hourly, for 5 to 7 days.

In case of allergy use co-trimoxazole, 960 mg, orally, twice daily.

(ii) **Benign Chronic Suppurative Otitis Media**

Local instillation of antibiotic and steroid drops are indicated. Duration and type of drops used depends upon the response to treatment. Commonly used are:

- hydrocortisone 1%, neomycin sulphate 0.439%, polymyxin B sulphate 0.119% drops
  OR
- gentamicin, 0.3% drops

When the treatment is prolonged, tolnaftate 1% solution is usually mixed with other drops to avoid secondary fungal infection.

(iii) **Serous Otitis Media**

This is most common in children; usually systemic antibiotics are indicated.

- erythromycin, 250 - 500 mg, orally, 6-hourly, for 10 days
amoxycillin, 250 - 500 mg, orally, 8-hourly, for 10 days
OR
ampicillin, 250 - 500 mg, orally, 6-hourly, for 10 days

Operative treatment is required if there is no sufficient improvement with conservative treatment.

THROAT

1. Acute Tonsillitis

Tonsillitis is a specific bacterial infection requiring antibiotics. Common causative bacteria are Beta haemolytic streptococci, pneumococci and H. influenzae. Str. pyogenes is the most commonly encountered organism. Viruses are responsible for about 50% of the cases.

Treatment of bacterial tonsillitis includes bed rest, analgesics and antibiotics. In severe infections

   benzyl penicillin, 600 mg (1 million units), intramuscularly, 6-hourly, for seven to ten days.

In less severe cases

   amoxycillin, 500 mg, orally, 8-hourly, for seven to ten days
OR
   ampicillin, 500 mg, orally, 6-hourly, for seven to ten days
OR
   erythromycin, 250 mg, orally, 6-hourly, for seven to ten days.

2. Peritonsillitis

   Systemic penicillin injection can abort abscess formation in early cases.

3. Acute Pharyngitis

   Less than 50% of the cases are bacterial in origin and many will not need antibiotics.

   (i) Streptococcal Sore Throat

   phenoxymethyl penicillin, 500 mg, orally, 6-hourly, for ten days
OR
   erythromycin, 500 mg, orally, 6-hourly, for ten days.
4. Oral and Perioral Fungal Infection

amphotericin B lozenges, 1 lozenge dissolved in the mouth, 4-8 times daily. To prevent relapse, treatment should be continued for 48 hours after clinical cure.

NOSE AND SINUSES

1. Sinusitis

Maxillary sinusitis is the most common type.

(i) Acute Sinusitis

ephrine 1% nasal drops
OR
xylometazoline hydrochloride 0.1% nasal drops.

Menthol or Friar’s Balsam steam inhalations are also recommended.

In severe cases

benzyl penicillin, 600 mg (1 million units), intravenously or intramuscularly, 6-hourly, for seven to ten days
OR
amoxycillin, 500 mg, orally, 8-hourly, for seven to ten days
OR
ampicillin, 500 mg, orally, 6-hourly, for seven to ten days

(ii) Chronic Sinusitis

Surgical drainage with systemic antibiotics is indicated

erythromycin, 250 mg, orally, 6-hourly, for seven to ten days
OR
co-trimoxazole, 960 mg, orally, twice daily, for seven to ten days.

2. Bacterial Rhinitis

This is usually treated with broad spectrum antibiotics like amoxycillin, 500 mg, orally, 8-hourly or ampicillin 500 mg, orally, 6-hourly. Other antibiotics may be required depending upon the culture and sensitivity report. Douching is best avoided.
INFECTIONS OF SKIN, MUSCLE AND BONE

IMPETIGO

This may resolve with topical antiseptic treatment, e.g. chlorhexidine or povidone-iodine. Topical antibiotics are not recommended. The organisms commonly encountered are *Str. pyogenes*, *Staph. aureus* or a mixture of the two. If an antibiotic is required:

- **erythromycin** 500 mg, orally, 6-hourly, for ten days
- **flucloxacillin** 1.0 g, orally, 6-hourly, for ten days.

CELLULITIS

1. **Str. pyogenes** - classically the causative organism.

   Severe
   - benzyl penicillin, 1.2 g (2.0 million units), intravenously, 4-hourly.

   Less severe
   - procaine penicillin, 1.0 g (1 million units), intramuscularly, 12-hourly
   - **phenoxymethyl penicillin**, 500 mg, orally, 6-hourly.

2. **Staph. aureus** - if proven or suspected.

   Severe
   - **flucloxacillin**, 1.0 g, intravenously, 4-hourly
   - **fusidic acid**, up to 3 g, daily, orally, with **erythromycin**, 1.0 g, intravenously, 6-hourly

   Less severe
   - **flucloxacillin**, 500 mg - 1.0 g, orally, 6-hourly
   - **erythromycin**, 500 mg, orally, 6-hourly.
HERPES
Most cases need simple measures to relieve pain and prevent secondary bacterial infection.

- idoxuridine in dimethylsulphoxide solution 5%, topically, 4 times daily
- OR
- acyclovir ointment, 3%, topically, 5 times daily

May be applied to the affected area in Herpes genitalis.

CLOSTRIDIAL INFECTION
1. Cellulitis
   benzyl penicillin, 1.2g (2.0 million units), intravenously, 4-hourly

2. Myositis (gas gangrene)
   benzyl penicillin, 2.4g (4.0 million units), intravenously, 4-hourly, as a single agent.
   OR IN COMBINATION WITH
   metronidazole. Depending on the clinical condition of the patient either 500 mg, intravenously, 8-hourly (infused over 20 minutes), or rectally, 1.0g, 8-hourly for 3 days, then 1.0g, 12-hourly.

If the patient is allergic to penicillin, use erythromycin, 1.5g, intravenously, 6-hourly or, with due precautions, cephalothin, 3.0g, intravenously, 4-hourly. Some strains of Clostridium perfringens may be cephalothin-resistant. Other measures are vitally important and require expert advice. It is suggested that because of the emergence of resistant strains, tetracyclines should not be used unless sensitivity results are available.

SYNERGISTIC G ANGRENE (NECROTISING FASCITIS)
Causative organisms are usually mixed aerobes and anaerobes, e.g. E. coli, Bacteroides fragilis, streptococci and staphylococci.
benzyl penicillin, 1.2 - 2.4 g (2.0 - 4.0 million units), intravenously, 4-hourly

PLUS

gentamicin, 1.5 mg/kg, intravenously or intramuscularly, 8-hourly

TOGETHER WITH EITHER

clindamycin, 600 mg, intravenously, 8-hourly or 1.2 g, intravenously, 12-hourly (dilute in 100 ml, infuse over at least 30 minutes)

OR

metronidazole, 500 mg, intravenously, 8-hourly, (infused over 20 minutes), or 1.0 g, rectally, 8-hourly, depending upon the clinical condition of the patient.

Depending on the organisms subsequently isolated, other antibiotic combinations may be indicated.

SUPPURATIVE WOUND INFECTIONS

Antibiotics are not usually indicated. Local measures such as surgical drainage, irrigation with isotonic stabilised sodium hypochlorite solution, or local antiseptic or saline dressings usually suffice.

OSTEOMYELITIS/SEPTIC ARTHRITIS

Acute

Until bacteriology is known, treat as *Staph. aureus*.

sodium fusidate, 20 mg/kg body wt., orally or intravenously, over 24 hours, in 3 divided doses

WITH EITHER

flucloxacillin, 0.5 - 1.0 g, orally or intravenously, 6-hourly

OR (especially in penicillin hypersensitive subjects)

erthyromycin, 0.5 - 1.0 g, orally or intravenously, 6-hourly.

This policy applies to emergency cases coming to the doctor’s attention for the first time. Thereafter the antibiotic regimens and dosages will have to be closely monitored by the attending consultant, depending on the results of laboratory investigations and the patient’s clinical course.
Chronic

Chronic infections, as a rule, do not require emergency antibiotic treatment. A mixture of micro-organisms often predominates and there are no hard and fast rules as to standard antibiotic policy. Antibiotic selection and regimens are usually decided upon by the consultant concerned on clinical criteria but mainly on the evidence of culture and sensitivity tests. Only in acute flare-ups of chronic sepsis e.g. spreading cellulitis, abscess formation, do antibiotics need to be given urgently. In such cases, the protocol outlined above for acute cases is to be observed.

Chronic osteomyelitis may require months or years of supervised therapy. This should be carried out in consultation with the Microbiology Department.
INFECTIONS RELATED TO THE ALIMENTARY TRACT
ORAL AND DENTAL INFECTIONS

Causative organisms are usually mixed anaerobic and aerobic oral flora. In virtually all instances referral to a dental surgeon is advisable to exclude or treat any underlying cause.

1. Gingival Infections

In the absence of systemic signs or symptoms antibiotic therapy is not usually indicated and local dental care to control bacterial plaque will often suffice. If accompanied by systemic signs or symptoms

- phenoxytmethyl penicillin, 250 mg - 500 mg, orally, 6-hourly for 5 days
- OR
- metronidazole, 200 mg - 400 mg, orally, 8-hourly for 5 days

and refer for dental management.

2. Pericoronitis or Tooth Abscess

In the absence of systemic signs or symptoms antibiotic therapy is not usually indicated and local dental care will often suffice. In the case of a tooth abscess removal of the infected pulp tissue and extraction of the tooth is usually required.

If accompanied by systemic signs or symptoms

- procaine penicillin, 900 mg (0.9 million units), intramuscularly, daily, for 5 days
- OR (for the milder case)
- phenoxytmethyl penicillin, 250 mg - 500 mg, orally, 6-hourly for 5 days

and refer for dental management within 24 hours.

3. Cellulitis of the Face / Neck

Cellulitis is treated by the administration of antibiotics usually

- benzyl penicillin, 1.2 g (2 million units), intravenously, 4 hourly, for 7 days.

The patient should be referred for urgent dental assessment.
Hypersensitivity to Penicillin

erythromycin, 0.5 g - 1.0 g, orally or intravenously, 6-hourly, for 7 days.

ACUTE CHOLECYSTITIS

Causative organisms are usually aerobic bowel flora, e.g. E. coli, Klebsiella spp., Str. faecalis.

(amoxy) ampicillin, 1.0 g, intravenously or intramuscularly, 4 to 6-hourly

OR

rolitetracycline, 275 mg, intravenously, once to three times daily or 350 mg, intramuscularly, once or twice daily

OR

a cephalosporin intravenously or intramuscularly e.g. cephalothin 1.0 g, intravenously, 4 to 6-hourly.

Ascending cholangitis is associated with septicaemia. See suggested treatment regimen of septicaemia under “Infections of the Cardiovascular System”.

ACUTE PERITONITIS

This is usually a mixed infection caused by aerobic and anaerobic bowel flora. The aerobic bowel flora is most likely to produce mortality due to septicaemia while the anaerobes commonly cause morbidity due to intra-abdominal abscesses and wound infection. Elimination of only a proportion of this flora may be associated with a satisfactory outcome if the patient’s host defences can cope with what remains.

(i) Three drug regimen

(covers virtually all aerobic and anaerobic bowel flora)

(amoxy) ampicillin, 2.0 g, intravenously, 4-hourly

TOGETHER WITH

gentamicin, 1.5 mg/kg, intravenously, 8-hourly

TOGETHER WITH EITHER

clindamycin, 600 mg, intravenously, 8-hourly or 1.2 g, intravenously, 12-hourly (dilute in 100 ml and infuse over at least
30 minutes)

OR

metronidazole, 500 mg, intravenously, 8-hourly, (infused over 20 minutes). Metronidazole suppositories (1.0 g, 8-hourly) may be substituted for the intravenous form, depending upon the condition of the patient.

(ii) Two drug regimen

(Does not reliably cover Str. faecalis)

cefotaxime, up to 12 g, intravenously or intramuscularly, in 3 or 4 divided doses

AND

metronidazole (dose as under three drug regimen, above).

N.B. Several other combinations are also acceptable e.g. gentamicin/clin-damycin or gentamicin/metronidazole.

ANTIBIOTIC-ASSOCIATED DIARRHOEA
(PSEUDOMEMBRANOUS COLITIS)

Toxigenic Clostridium difficile, proven or suspected.

Cease treatment with any antimicrobial agent likely to be causing the symptoms. If severe:

vancomycin, 125-500 mg, orally, 6-hourly, for 7 - 14 days, depending upon severity.

ACUTE INFECTIOUS DIARRHOEA

The causative organisms may include Salmonella, Shigella, Campylobacter, Yersinia or Vibrio species. Antibiotic therapy is only necessary in specific circumstances and the Microbiology Department should be consulted regarding both the need for therapy and patient isolation.

BOWEL PREPARATION FOR COLO-RECTAL SURGERY

The use of antimicrobials for the above purpose is controversial. If used at all, the following regimens are recommended:
1. ‘Systemic’ Method

   metronidazole, 500 mg, intravenously, 8-hourly

   TOGETHER WITH

   cefuroxime, 1.5g, intravenously, followed by
   0.75g, intravenously, 8-hourly.

   OR

   gentamicin, 1.5 mg/kg, intravenously, 8-hourly.

Treatment should be started on the morning of the operation and con-
continued for 24 hours post-operatively (using the parenteral route). If there
is contamination at operation, treatment should be continued for a
minimum of five days post-operatively.

2. ‘Traditional’ Method

   metronidazole, 200 mg, orally, 8-hourly, for 5 days
   pre-operatively

   TOGETHER WITH EITHER

   neomycin, 1g, orally, 4-hourly, for 1 day pre-operatively

   OR

   phthalylsulphathiazole, 3 g, orally, 6-hourly, for 5 days
   pre-operatively.

N.B. The mechanical aspects of bowel preparation for colo-rectal surgery
are much more crucial to the success of the procedure.
GENITO-URINARY TRACT INFECTIONS

Antimicrobial therapy of urinary tract infections will be assisted by a high fluid intake, complete bladder emptying and, in most instances, by alkalinisation of the urine (e.g. potassium citrate 2.5g orally, 6-hourly).

1. ACUTE URINARY TRACT INFECTIONS

(i) Single dose therapy
   co-trimoxazole, 2.88 g, orally
   OR
   amoxycillin, 3.0 g, orally
   OR
   kanamycin, 500 mg, intramuscularly

(ii) Multiple dose therapy (5 to 7 day course)
   co-trimoxazole, 960 mg, orally, 12-hourly.
   OR
   amoxycillin, 250 mg, orally, 8-hourly
   OR
   ampicillin, 250 mg, orally, 6-hourly

Where the clinical presentation suggests predominantly lower urinary tract involvement and renal function is normal, further alternatives to the above are a 5 to 7 day course of

EITHER
   nitrofurantoin, 50 - 100 mg, orally, 6-hourly
   OR
   nalidixic acid, 1.0 g orally, 6-hourly.

Any of the above regimens can be expected to cure 70 - 80% of uncomplicated urinary tract infections.

Treatment failures will usually be due to either the infection being caused by an organism resistant to the agent selected or an unsuspected underlying abnormality of the urinary tract.
2. **COMPLICATED URINARY TRACT INFECTIONS**

In general, attempts should be made to define or exclude any underlying anatomical or functional abnormality.

The antibiotic sensitivities of organisms cultured from complicated urinary tract infections are often difficult to predict and therapy may need to be prolonged, maintained at a high dose, and on occasions given parenterally. It is most important that adequate urine cultures are performed.

Consultation with the Microbiology Department may assist in selecting the most appropriate therapeutic regimen, both for initial therapy and, if modification is required, when culture and sensitivity results become available.

(i) **Recurrent or Chronic Urinary Tract Infections**

These generally occur either as a relapse of previously treated infection or because of reinfection. In female patients, instruction on perineal hygiene, and micturition after intercourse may assist in preventing reinfection. Prophylaxis, instituted after successful treatment, can reduce or prevent subsequent attacks and may be continued for 3 to 6 months, or on occasions longer. Appropriate prophylactic therapy is usually given at night, but may be taken by women after intercourse. Acidification of urine in certain cases using vitamin C, 0.5g, 3 times daily may be of help.

EITHER

- nitrofurantoin, 50 - 100 mg, orally, at night

OR

- co-trimoxazole, 480 mg, orally, at night.

(ii) **Suspected Septicaemia**

Septicaemia is likely to occur in patients with severe underlying renal disease, urinary tract abnormalities, or where there has been instrumentation of the renal tract. Treatment is designed to cover *E. coli, Klebsiella, Pseudomonas, Str. faecalis* and similar organisms.

(amoxy) ampicillin, 2.0 g, intravenously, 4-hourly

TOGETHER WITH

- gentamicin, 1.5 mg/kg, intravenously, 8-hourly.

The above dosage regimen will require modification in the presence of
renal impairment (see Appendix) If infection is likely to have been hospital-acquired, the possibility of gentamicin-resistant organisms should be discussed with the Microbiology Department.

(iii) Catheter Associated Urinary Infections

As a general rule these should only be treated if the patient shows signs of systemic infection, e.g. fever, rigors or loin pain. If required, antibiotics should be selected on the basis of the most recent urine culture results. Removal of the catheter, whenever possible, is still the best single means of effecting a cure.

Prolonged or sequential courses of antibiotics given for the treatment of catheter associated urinary tract infections, whilst the catheter remains in situ, are usually unsuccessful and tend to select for organisms resistant to many antibiotics. In general, local irrigation with antibiotics should be avoided for similar reasons. Irrigation with appropriate antiseptic solutions should be considered.

Where instrumentation is contemplated in the presence of urinary infection, consideration should be given to covering the procedure with a single I.M. or I.V. dose of an antibiotic. This should be appropriate to the sensitivity of the current infecting organisms, if known. If this information is not available use gentamicin 2.0 mg/kg. Ideally, the dose should be administered 30 - 60 minutes before the procedure is undertaken.

3. PELVIC SEPSIS IN FEMALES

(i) Pelvic Sepsis Likely to be Sexually Acquired

i.e. Neisseria gonorrhoeae or Chlamydia trachomatis (the latter is now being increasingly recognised).

benzyl penicillin, 1.2 g (2.0 million units), intravenously, 4-hourly, reducing to 600 mg (1.0 million units), intravenously, 6-hourly

PLUS

tetracycline, 250 - 500 mg, orally, 6-hourly, preferably 1 hour before or 2 hours after meals (doxycycline in renal decompensation).

Treatment may be required for up to two weeks or at least until all clinical symptoms resolve. Sexual partners will need examination and, possibly, empirical treatment.
Pelvic Sepsis related to Trauma

i.e. puerperal, post-abortal, post-operative, and in association with an intrauterine device. Treatment is designed to cover mixed anaerobes, haemolytic streptococci, aerobic Gram-negative bacilli and Neisseria gonorrhoeae.

If severe - remove any intra-uterine device.

(amoxy) ampicillin, 1.0 - 2.0 g, intravenously, 4-hourly

TOGETHER WITH EITHER

clindamycin, 600 mg, intravenously, 8-hourly (dilute in 100 ml and infuse over at least 30 minutes)

OR

metronidazole, 500 mg, intravenously, 8-hourly (infused over 20 minutes) or 1.0 g rectally, 8-hourly, depending upon the clinical condition of the patient.

If infection with Str. pyogenes or Clostridium perfringens is suspected or proven then benzyl penicillin, 2.4 g (4.0 million units), intravenously, 4-hourly, is the antibiotic of choice.

Less severe - remove any intra-uterine device

amoxy-cillin, 500 mg, orally, 8-hourly

OR

ampicillin, 500 mg, orally, 6-hourly

TOGETHER WITH ONE OF THE FOLLOWING

metronidazole, 400 mg, orally, 8-hourly

OR

clindamycin, 300 mg, orally, 6-hourly.

Treatment should be continued for 7 - 10 days.

For the treatment of gonorrhoea and non-specific urethritis see section on Venereal Infections.

4. OTHER INFECTIOUS DISEASES

(i) Trichomonas Infection

metronidazole, 200 mg, orally, 8-hourly, for 7 days.
Both partners should be treated.

(ii) **Candidiasis**

    clotrimazole, 100 mg, vaginally, at night, for 10 days.

Occasionally in recurrent infections oral treatment is necessary.

    nystatin, (500,000 units), 1 tablet orally, 8-hourly for 10 days.

Both partners should be treated. (Diabetes mellitus should be excluded)

(iii.) **Other Non Specific Infections**

Treatment as dictated by microbiological and sensitivity investigations.
VENEREAL INFECTIONS

UNCOMPlicated GONORRHoeA

Antibiotic sensitivity should be determined by culture.

- benzyl penicillin, 2.4 g (4 million units), intramuscularly, immediately preceded by probenecid, 1 g, orally.

In penicillin allergy or resistance

- spectinomycin, 2 g, intramuscularly (4 g for females).

COMPlIcATED GONORRHoeA

i.e. pharyngitis, proctitis, salpingitis, arthritis, ophthalmitis, disseminated disease or gonorrhoea in pregnancy. Single dose therapy is not sufficient. For details on the treatment of gonococcal pelvic sepsis in females see "Pelvic Sepsis in Females." For other gonococcal infections consult a venereologist, microbiologist or physician.

NON·SPECIFIC URETHRITIS

- tetracycline, 500 mg, orally, 6-hourly, for 14 days.
  (In case of renal decompensation use doxycyline, 200 mg, orally, statim, then 100 mg, orally, daily for 14 days)
  OR
  - erythromycin, 500 mg, orally, 6-hourly, for 14 days (can be used safely in pregnancy).

A second course together with further investigation of the aetiology may be required if the symptoms persist or recur.

Female contacts of males with non-specific urethritis should also be treated empirically to prevent recurrence in the male and to guard against chlamydial salpingitis developing in the female.

PRIMARY, SECONDARY OR EARLY LATENT SYPHILIS

In a patient NOT hypersensitive to penicillin

- procaine penicillin, 1.5 g (1.5 million units), intramuscularly, daily, for 10 days.

If the patient is hypersensitive to penicillin
tetracycline, 500 mg, orally, 6-hourly, for 2 weeks.
(doxycycline, 100 mg, orally, 8-hourly, for 3 weeks in renal decompensation).

LATE LATENT OR TERTIARY SYPHILIS (e.g. NEUROSYphilis)

In a patient NOT hypersensitive to penicillin

benzyl penicillin, 600 mg (1.0 million units), intramuscularly or intravenously, 6-hourly, for 2 - 4 weeks

TOGETHER WITH

probenecid, 500 mg, orally, 6-hourly, for 2 - 4 weeks.

If the patient is hypersensitive to penicillin

tetracycline, 500 mg, orally, 6-hourly, for 4 weeks
(doxycycline, 100 mg, orally, 8-hourly, for 5 weeks, in renal decompensation).

Serological follow-up at 3-monthly intervals after treatment should be carried out for 1 year for primary disease and in addition at 18 and 24 months for secondary, latent and late disease.
SOME SPECIFIC INFECTIOUS DISEASES

TYPHOID
Chloramphenicol is the drug of choice in acute infection and the suggested regime is a loading dose of 50 mg per kg body weight, followed by the same amount given daily in three divided doses, at 8 hour intervals. When the patient is afebrile, the dose can be reduced to 2 g per day. Chloramphenicol should be continued for a total of 14 days. In rare cases of strains which are not sensitive to chloramphenicol, the use of amoxycillin (2 g daily in divided doses) is suggested. Treatment of the carrier state depends on whether there is evidence of biliary disease. If there is no such evidence, prolonged treatment with amoxycillin or cotrimoxazole is usually effective.

TYPHUS
Tetracycline (2 g orally daily in divided doses) or chloramphenicol (2 g orally daily, in divided doses) is effective.

BRUCELLOSIS
Tetracycline is the drug of choice at a dosage of 2 g daily in divided doses, for a period of three weeks. In combination with streptomycin fewer relapses occur, and in seriously ill patients addition of streptomycin may enhance the efficacy of treatment. The concurrent use of corticosteroids may be considered in seriously ill patients to decrease systemic toxicity.

WHOOPING COUGH
As regards specific treatment, antibiotics may shorten the period of communicability but often have little effect on symptomatology. Erythromycin is used in infants and young children.

DIPHTHERIA
If this is suspected, antitoxin should be given without awaiting bacteriological confirmation. After ruling out hypersensitivity, a single dose of 20,000 to 100,000 units is given, depending on duration and severity of symptoms. Both penicillin and erythromycin are effective against the organism and either should be administered in conjunction with (but not as a substitute for) antitoxin. In the case of a carrier state, procaine
penicillin, 0.6 - 2.0 g (0.6 - 2.0 million units), intramuscularly, daily for 10 days or erythromycin, 1 g, orally, daily, in divided doses for 1 week, should be administered.

LEISHMANIASIS

Sodium antimony gluconate is the drug of choice. The dose is 600 mg given daily by intramuscular or intravenous injection. Skin lesions are treated for 10 days. Visceral disease is treated with a 21 day course.

MALARIA

In emergency treatment of serious infections 300 mg of chloroquine base may be administered intramuscularly every 6 hours, up to a maximum of 900 mg of chloroquine base in 24 hours. All parenteral drugs should be discontinued as soon as oral therapy is practicable. After 3 days treatment with chloroquine, treatment with primaquine (15mg daily) should be started and given for a further 14 days.

Before commencing treatment it is recommended to send blood for glucose-6-phosphate dehydrogenase assay.

LEPTOSPIROSIS

A high index of suspicion is essential in diagnosing this usually non-fatal disease with a highly variable clinical course; as antimicrobial therapy is probably only effective if started by the fourth day of illness. The drug of choice is benzyl penicillin, 1.8 - 2.4 g (3.0 - 4.0 million units), parenterally, daily. Tetracycline, 2 g orally, daily, in divided doses, may reduce the incidence of renal, hepatic, meningeal and haemorrhagic complications; it eliminates leptospires from the kidney, whereas penicillin does not. Treatment is usually continued for seven days.
NON-SURGICAL ANTIBIOTIC PROPHYLAXIS
PREVENTION OF RECURRENT RHEUMATIC FEVER

phenoxymethyl penicillin, 250 mg, orally, twice daily, continuously for some years

In case of allergy to penicillin use

erythromycin, 250 mg, twice daily.

If patient compliance is likely to be poor, long acting benzathine penicillin, 900 mg (1.2 million units), intramuscularly, at intervals of 2 - 4 weeks is an alternative. A disadvantage of benzathine penicillin is that any allergic response is likely to be protracted.

PREVENTION OF MENINGOCOCCAL AND H. INFLUENZAE TYPE b MENINGITIS

See under "Infections of Central Nervous System".

PREVENTION OF TUBERCULOSIS

For recent tuberculin converters (secondary prophylaxis)

isoniazid, 300 mg, orally, daily for 6 to 12 months. (Children 5 mg/kg daily; dose not to exceed 300 mg).

To prevent reactivation in susceptible patients (including immunosuppressive therapy and surgery), isoniazid alone may not be appropriate.

Further information is contained in the publication: Modern Drug Treatment in Tuberculosis - Chapter VII - Sixth Edition, 1983 - Published by the Chest, Heart and Stroke Association, London.

PREVENTION OF ENDOCARDITIS OR INFECTION OF PROSTHETIC IMPLANTS

(i) Dental Work

If the patient is NOT receiving long-term penicillin

benzyl penicillin, 0.6 g (1.0 million units) plus procaine penicillin, 0.6 g (0.6 million units), intramuscularly, 30 to 60 minutes before procedure; then phenoxyethyl penicillin, 500 mg, orally, 6-hourly for 3 days.

OR

(amoxy) ampicillin, 1.0 g, intravenously or intramuscularly,
followed by 1 g by the same route, 8-hourly for 3 doses. To continue treatment orally for up to 3 days after procedure.

In patients with a history of infective endocarditis or with prosthetic valves, a single injection of gentamicin, 1.5 mg/kg, intramuscularly, should be given in addition, immediately before the dental procedure. It is acknowledged that other regimens have been suggested.

For patients hypersensitive to penicillin or patients receiving long-term penicillin

erythromycin, 1.0 g orally or intravenously, one hour before treatment followed by 0.5 g, orally, 6-hourly for 3 days. Each dose of erythromycin should be taken either one hour before a meal or two hours after a meal.

OR

vancomycin, 1.0 g, intravenously, for 2 doses, the first being administered 15 to 30 minutes before the procedure, followed by a second dose 12 hours later.

This last recommendation is especially suitable for patients with prosthetic valves or a past history of infective endocarditis in whom the cover may be supplemented by a single injection of gentamicin, 1.5 mg/kg, intramuscularly, 30 to 60 minutes before the procedure.

(ii) Genito-urinary, gastrointestinal surgery, or labour

Patients who are NOT hypersensitive to penicillin

benzyl penicillin, 2.4 g (4.0 million units), intravenously, 4-hourly

TOGETHER WITH

gentamicin, 1.5 mg/kg, intravenously or intramuscularly, 8-hourly for 3 days.

Patients hypersensitive to penicillin

vancomycin, 1.0 g, intravenously, for 2 doses, the first being administered 15 to 30 minutes before the procedure, followed by a second dose 12 hours later.

TOGETHER WITH

gentamicin, 1.5 mg/kg, intravenously or intramuscularly, 15 to
30 minutes before the procedure, for one dose only.

This regimen may not be satisfactory for all patients, e.g. those with renal impairment, clinical infection or prolonged labour. In such cases, please consult a microbiologist or a physician.

(iii) Cardiac catheterisation

Immediately prior to insertion in a patient with valve abnormalities

- flucloxacillin, 1.0 g, intravenously
- TOGETHER WITH
- gentamicin, 1.5 mg/kg, intravenously, both for one dose only.

**PREVENTION OF PACEMAKER INFECTION**

Immediately prior to insertion

use regimen for cardiac catheterisation, above.

**OTHER EXAMPLES OF NON-SURGICAL CHEMOPROPHYLAXIS**

One rarely may consider chemoprophylaxis in many other situations in clinical medicine. Sometimes the question arises whether hospital staff members should receive chemoprophylaxis when they have been involved with the care of a patient subsequently shown to have an infectious disease, e.g. diphtheria, tuberculosis, typhoid fever or syphilis. In general, chemoprophylaxis is not advised, and the problem should be discussed with either a microbiologist or a physician.
1. The use of antibiotics in surgery for prophylaxis, e.g. elective colonic resection, must be distinguished from their use in early treatment, where infection is already established although not necessarily evident pre-operatively, e.g. removal of a perforated appendix.

2. Prophylaxis should be considered where the surgical procedure being undertaken is associated with a high risk of infection (e.g. colonic resection), or where post-operative infection, even if uncommon, would be expected to have serious consequences (e.g. infection associated with a prosthetic implant.)

The decision to use antibiotic prophylaxis for a particular surgical procedure should take into account the known or predicted infection rate. The types of organisms known or likely to be responsible for such infections and their local sensitivity to the antibiotics under consideration should also be considered.

3. In general, antimicrobials should be directed against the likely causative organism(s); however, an effective prophylactic or early treatment regimen need not necessarily include antibiotics that are active against every potential pathogen. Regimens that only decrease the total number of organisms may assist host defences and prevent infection. The choice of antimicrobial agents should take into account the organisms causing infections and their patterns of sensitivity.

4. The route of administration, timing and duration of prophylactic antibiotics should be chosen to achieve high plasma and tissue levels of the drug(s) during and shortly after the surgical procedure when bacterial contamination is maximal.

(a) Route of Administration - usually parenteral, either intravenously or intramuscularly, but in certain instances rectal or oral administration may be appropriate.

(b) Timing - intravenous antibiotics require administration immediately after induction of anaesthesia. This requires co-ordination with the anaesthetist and prior organisation to ensure that drugs are available in the theatre. Intramuscular antibiotics should be given at the time of premedication for surgery. Rectally administered metronidazole should be given 2 - 4 hours before surgery.
(c) **Duration** - animal work clearly shows that the critical period for successful prophylaxis lies in the 4 hours following implantation of organisms into a wound. In general a single dose of a parenteral drug may be sufficient, with a second dose being given if surgery is delayed or prolonged. The recommended duration of prophylaxis against contamination varies in the different specialities:

- gastrointestinal surgery - maximum 24 hours
- vascular surgery - maximum 24 hours (unless an indwelling catheter remains for a longer period)
- orthopaedic surgery - maximum 3 days
- urological surgery - maximum 3 days (also depending on duration of indwelling catheter)

5. With the exception of ophthalmic surgery and in burns or situations involving extensive skin loss, topical antibiotic prophylaxis is not recommended.

6. Prophylactic or early treatment regimens should be agreed upon, implemented and adhered to by a surgeon. Chosen regimens should be reviewed on a regular basis but only varied if their effectiveness (based on the infection rate for a given procedure) is in question, or if verified data on an alternative regimen suggest that a more appropriate choice can be made (on the grounds of efficacy, cost, toxicity or ease of administration).

7. The following notes and tables are intended as a guide to those contemplating antibiotic prophylaxis in surgery. Where a prophylactic regimen is marked with an asterisk (*), there is general acceptance of its value. For the rest, prophylaxis is controversial.

**INDICATIONS FOR SURGICAL ANTIBIOTIC PROPHYLAXIS**

**Arterial Reconstructive Surgery** - Surgery involving the abdominal aorta and/or the lower limb, particularly if a groin incision is involved, may benefit from the administration of prophylactic antibiotics. Patients undergoing any vascular procedure involving a prosthesis should probably also receive prophylaxis. The incidence of infection after operations on the brachial and carotid arteries, not involving prosthetic materials, is too low to justify the use of prophylactic antibiotics.

**Orthopaedic Surgery** - There is some evidence that an antibiotic with proven activity against strains of staphylococci predominating at a par-
ticular time can decrease the incidence of infection of prosthetic joints following joint replacement. Similarly, a decrease in the infection rate has been demonstrated for fractures treated with internal fixation under appropriate antistaphylococcal antibiotic cover. It is considered mandatory nowadays to use prophylactic antibiotics for other orthopaedic procedures involving insertion of prosthetic material. Such an antibiotic has to cover a wide spectrum of micro-organisms and is to be used over a short period of time following the induction dose i.e. intravenous doses over a post-operative period of 24 to 28 hours.

The value of incorporating antibiotic into cement for primary or non-infected joint insertion is unproven, but it has been used successfully in the replacement of infected joint prosthesis.

It is firmly recommended that antibiotic prophylaxis be given in situations involving severe musculo-skeletal and soft tissue trauma especially open fractures; nevertheless, it cannot be emphasised strongly enough that antibiotic prophylaxis is no substitute but only an adjuvant to the scrupulous practice of the basic surgical principles of primary wound care.

**Head, Neck and Thoracic Surgery** (including Ear, Nose, Throat and Dental Procedures) - Prophylaxis should in general be considered for those procedures that involve an incision through oral, nasal, pharyngeal or oesophageal mucosa, stapedectomy or similar operations, or the insertion of prosthetic material. Where an established focus of infection is suspected or shown to be present, e.g. chronic mastoiditis, an early treatment regimen may be appropriate.

**Gastroduodenal Surgery** - When the stomach or duodenum is to be opened prophylaxis should be considered if the mechanisms that normally inhibit bacterial growth in the stomach and duodenum, namely gastric acidity and gastrointestinal motility, are diminished by conditions such as obstruction, haemorrhage, gastric ulceration, gastric malignancy, previous gastric surgery, e.g. vagotomy, gastrectomy, or drugs reducing gastric acidity e.g. cimetidine.

**Biliary Tract Surgery** - Prophylaxis should generally be considered only for patients at increased risk of acquiring infection e.g. those (i) older than 70 years; (ii) with acute cholecystitis; (iii) in whom complicated surgery or re-operation is to be undertaken; (iv) having surgery involving the common bile duct, particularly in the presence of obstruction, where anaerobic organisms are more likely to be present.

**Colorectal Surgery** - The measures that can be taken to reduce the high
risk of infection associated with colorectal surgery are not equally applicable to both elective and emergency procedures.

**Elective procedures** - Mechanical bowel preparation pre-operatively, with appropriate peri-operative antibiotic(s) administered parenterally, rectally or orally have been shown to substantially reduce infective complications, especially when drugs active against *Bacteroides fragilis* are used.*

**Emergency procedures** - Mechanical bowel preparation is not possible and parenterally administered antibiotics are recommended*. If obvious peritonitis is detected at the time of surgery or if major peritoneal soiling occurs then an early treatment regimen should be adopted.

**Appendicectomy** - The ideal regimen is not yet established. The decision to give prophylaxis is best made when the appendix is inspected. A gangrenous, perforated, severely inflamed or complicated appendix requires a longer duration of therapy. However, if there are pre-operative signs of generalised peritonitis, appropriate antibiotic treatment should be started immediately (see also peritonitis, under "Infections related to the Alimentary Tract").

**Penetrating Abdominal Wounds** - Antibiotic regimen to be decided upon after laparotomy.

**Obstetric and Gynaecological Surgery - Abdominal** : Routine antibiotic prophylaxis is not usually recommended. However, where there is a potential risk antibiotic cover with (amoxy) ampicillin is recommended. **Vaginal**: In the presence of an indwelling catheter, co-trimoxazole is recommended.

**Urological Surgery** - Prophylaxis is not usually recommended for patients with sterile urine at the time of urological surgery. Patients suspected of having urinary tract infection should be treated pre-operatively to prevent post-operative sepsis and ideally this should be on the basis of prior urine culture, with therapy being guided by sensitivity results. Strict maintenance of closed-catheter drainage can prevent urinary tract infection in patients who temporarily require an indwelling catheter; use of neomycin-polymyxin irrigants does not provide any additional benefit and may select out resistant organisms.
Lower Limb Amputation - Amputation, particularly of an ischaemic leg*, carries a small but important risk of clostridial infection. Skin preparation with povidone-iodine or an alcoholic tincture of iodine, as well as prophylaxis with penicillin, is indicated.

Cardiac Surgery - Conclusive evidence, based on controlled trials, for the effectiveness of prophylactic antibiotics in this area is lacking. However, prophylaxis is commonly given when prosthetic heart valves are inserted. The current infection rate associated with such procedures should be considered when deciding whether prophylaxis is to be used.

Neurosurgery- Prophylactic antibiotic therapy may be prescribed in:

1. Craniotomy involving the implantation of prosthetic material e.g. shunts, dural substitutes, acrylic and metallic implants.
2. Operative interventions during which tissues are exposed for more than approximately 4 hours.
3. Cerebro-spinal fluid leakage.

Except for (1), prophylactic antibiotic use is usually prescribed according to the case in question; thus, in cases of massive C.S.F. leakage, it has been proved that antibiotics do not attain an adequate level in C.S.F. because of a 'washout' phenomenon.

In C.S.F. leakage that is not complicated by meningitis, ampicillin and sulphadiazine are usually prescribed in that ampicillin does not cross the blood-brain barrier to a therapeutic level whereas sulpha drugs do so. In craniotomy involving prosthetic implants, flucloxacillin is the drug of choice but ampicillin and co-trimoxazole have also been found very useful.

* See Principles No 7
CLASSIFICATION OF SURGICAL WOUNDS ACCORDING TO CONTAMINATION, RISK OF INFECTION AND NEED FOR ANTIMICROBIAL PREVENTION

(U.S.A. National Research Council 1964)

I Clean - Incision through intact skin without entry into colonized or infected lumen. No breach in aseptic technique. Primary closure.

II Clean-contaminated - Incision through intact skin. Entry into respiratory, alimentary or genito-urinary tract without significant spillage.

III Contaminated - Open, fresh traumatic wound from relatively clean source. Major breach in technique. Incision encountering acute non-purulent inflammation. Spillage from gastro-intestinal tract.

IV Dirty - Old traumatic wounds. Perforated viscera or operations for purulent infection, foreign bodies or devitalised tissue.

Clean surgery usually does not require antimicrobial prophylaxis except where implants are used.

Clean-contaminated surgery is the only clean cut indication for short-term antibiotic prophylaxis.

Contaminated surgery represents a borderline situation and is a relative indication.

With dirty wounds therapy should be regarded as therapeutic and not prophylactic.
## SURGICAL ANTIBIOTIC PROPHYLAXIS

<table>
<thead>
<tr>
<th>NATURE OF OPERATION</th>
<th>LIKELY PATHOGENS</th>
<th>RECOMMENDED REGIMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Cardiovascular</td>
<td>Staphylococcus aureus, Staphylococcus epidermidis, diphtheroids, aerobic Gram-negative bacilli.</td>
<td>flucloxacillin 1.0-2.0 g I.V. TOGETHER WITH gentamicin 1.5 mg/kg I.V. OR (as a single agent) cephalothin 2.0 g I.V.</td>
</tr>
<tr>
<td>Arterial reconstructive surgery involving a prosthesis and/or groin incision</td>
<td>Staphylococcus aureus, aerobic Gram-negative bacilli.</td>
<td>as above</td>
</tr>
<tr>
<td>Orthopaedic</td>
<td>Staphylococcus aureus, Staphylococcus epidermidis</td>
<td>flucloxacillin 1.0-2.0 g I.V.</td>
</tr>
<tr>
<td>Joint replacement, internal fixation of selected fractures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>Streptococcus pneumoniae</td>
<td>ampicillin 500 mg, orally, I.M. or I.V. and sulphadiazine 1.0 g stat I.M. or I.V., 500 mg 4 hourly thereafter.</td>
</tr>
<tr>
<td>Craniotomy involving prosthetic implants.</td>
<td>Staphylococcus aureus, Staphylococcus epidermidis, diphtheroids.</td>
<td>flucloxacillin 1.0-2.0 g I.V.</td>
</tr>
<tr>
<td>Clean Contaminated Head, Neck and Thoracic</td>
<td>Mixed aerobic and anaerobic upper respiratory tract flora.</td>
<td>benzyl penicillin 600 mg (1 million units) I.V.</td>
</tr>
<tr>
<td>Involving oral, pharyngeal or oesophageal mucosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastroduodenal</td>
<td>Aerobic Gram-negative bacilli, streptococci including Str. faecalis and some anaerobic bacteria.</td>
<td>(amoxy) ampicillin 1.0g I.V. OR cephalothin 1.0 g I.V.</td>
</tr>
<tr>
<td>Incision into lumen with predisposing factors (see pg. 44)</td>
<td></td>
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</tbody>
</table>

* See Principles No 7.
**SURGICAL ANTIBIOTIC PROPHYLAXIS**

<table>
<thead>
<tr>
<th>NATURE OF OPERATION</th>
<th>LIKELY PATHOGENS</th>
<th>RECOMMENDED REGIMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEAN CONTAMINATED</td>
<td></td>
<td>(usually 1-2 doses only)</td>
</tr>
</tbody>
</table>

**Biliary Tract**
- Those with predisposing factors (see pg. 44)
- Aerobic Gram-negative bacilli, *Streptococcus faecalis*.
- If obstruction present, anaerobic bacteria.

**Colorectal**
- Elective *
  - Anaerobic bacteria, streptococci including *Streptococcus faecalis*, aerobic Gram-negative bacilli.
  - metronidazole 1.0 g rectally TO WHICH MAY BE ADDED gentamicin 1.5 mg/kg I.V. or I.M.
- Emergency *(See also, peritonitis, pg. 27 appendicitis, pg. 45)*
  - As above.
  - clindamycin 600 mg I.V. or metronidazole 500 mg I.V. TOGETHER WITH gentamicin 1.5 mg/kg I.V. OR cefuroxime 1.5 g I.V. followed by 0.75g I.V. 8-hourly for 24 hours

**Obstetrics and Gynaecology**
- Hysterectomy
  - Anaerobic bacteria, aerobic Gram-negative bacilli, streptococci.
  - metronidazole 1.0 g rectally
- Caesarean section high risk only
  - As above, but increased risk of aerobic Gram-negative organisms.
  - cephalothin 1 g I.V.

**Urological**
- For proven or suspected urinary infection
  - Aerobic Gram-negative bacilli, *Streptococcus faecalis* and staphylococci.
  - according to urine culture and sensitivity. If data unavailable, gentamicin 2.0 mg/kg I.M. or I.V.

* See PRINCIPLES No 7
# SURGICAL ANTIBIOTIC PROPHYLAXIS

## NATURE OF OPERATION

### CLEAN CONTAMINATED

**Amputation**

Involving a lower limb for ischaemia*

**Likely Pathogens**

*Clostridium perfringens*

**Recommended Regimen**

(usually 1-2 doses only)

- Benzyl penicillin 600 mg I.V., 6-hourly for 48 hours
- Metronidazole 1.0 g rectally or 500 mg I.V. 8-hourly for 48 hrs.

## CONTAMINATED (EARLY TREATMENT)

**Ruptured, perforated or gangrenous viscus**

E.g. perforated colon or appendix

**Likely Pathogens**

Aerobic Gram-negative bacilli, anaerobic bacteria, *Streptococcus faecalis* and other streptococci.

**Recommended Regimen**

- See management of peritonitis, pg. 27

**Muscular, skeletal and soft tissue trauma**

Particularly, if severe, and/or with compound fractures.

**Likely Pathogens**

*Staphylococcus aureus*, *Streptococcus pyogenes*, *Clostridium perfringens*, aerobic Gram-negative bacilli.

**Recommended Regimen**

- Flucloxacillin 1.0-2.0 g I.V. 4-hourly
- TOGETHER WITH Cefuroxime 1.5 g I.V. followed by 0.75g I.V. 8-hourly for 24 hrs.

## MISCELLANEOUS (TOPICAL TREATMENT)

**Burns, extensive skin loss**

*Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, aerobic Gram-negative bacilli.

**Recommended Regimen**

- Silver sulphadiazine, or mafenide with chlorhexidine, topically.

**Ophthalmic**

*Staphylococcus aureus*, and streptococci.

**Recommended Regimen**

- Chloramphenicol eye drops or ointment.

* See Principles No 7.
### APPENDIX

**ANTIMICROBIAL DRUGS AND THE KIDNEY**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Major Excretion Routes</th>
<th>Half-Life (T½)</th>
<th>Normal Dose Interval</th>
<th>Plasma Protein Binding</th>
<th>Volume of Distribution</th>
<th>Adjustment for Renal Failure</th>
<th>Glomerular Filtration Rate (GFR)</th>
<th>Removal by Dialysis</th>
<th>Remarks on Toxicity and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antifungal drugs</strong></td>
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<tr>
<td>amphotericin B</td>
<td>Nonrenal</td>
<td>24 h</td>
<td>24</td>
<td>24</td>
<td>90</td>
<td>4</td>
<td>24</td>
<td>24</td>
<td>24*</td>
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<td>50</td>
<td>10-50</td>
<td>&lt;10</td>
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<td></td>
<td></td>
<td>20 to 36 mg/kg needed after hemodialysis.</td>
<td></td>
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</tr>
<tr>
<td>flucytosine</td>
<td>Renal</td>
<td>3-6 h</td>
<td>70</td>
<td>6</td>
<td>&lt;10</td>
<td>0.6</td>
<td>12-24</td>
<td>24-48</td>
<td>Hepatic dysfunction, marrow suppression commoner in azotemic patients.</td>
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</table>

* Nephrotoxic; renal tubular acidosis, hypokalemia; nephrogenic diabetes insipidus; renal failure.
* Terminal phase elimination T½ is 15 days due to drug movement from a slowly equilibrating compartment.
* Ineffective for renal parenchymal infection.

**Drug**

| Antifungal drugs | amphotericin B | flucytosine | miconazole |

<table>
<thead>
<tr>
<th><strong>Antituberculous drugs</strong></th>
<th><strong>ethambutol</strong></th>
<th>Renal</th>
<th>4</th>
<th>8</th>
<th>24</th>
<th>&lt;10</th>
<th>0.8</th>
<th>I</th>
<th>24</th>
<th>24-36</th>
<th>48</th>
<th>Yes (H, P)</th>
<th>Decreased visual acuity, peripheral neuritis.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>isoniazid</strong></td>
<td>(renal)</td>
<td>Hepatic*</td>
<td>2-4 slow acetylators; 0.5-1.5 rapid acetylators</td>
<td>4</td>
<td>24</td>
<td>&lt;10</td>
<td>?</td>
<td>D</td>
<td>← Unchanged →</td>
<td>66-100</td>
<td>Yes (H, P)</td>
<td>* Genetic variation in hepatic acetylation.</td>
<td></td>
</tr>
<tr>
<td><strong>rifampicin</strong></td>
<td>Hepatic</td>
<td>2-5</td>
<td>2-5</td>
<td>24</td>
<td>60-90</td>
<td>?</td>
<td>D</td>
<td>← Unchanged →</td>
<td>?No</td>
<td>May cause acute renal failure (toxic or immunologic).</td>
<td></td>
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<td></td>
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</tbody>
</table>

**Aminoglycoside antibiotics.**

<table>
<thead>
<tr>
<th><strong>amikacin</strong></th>
<th>Renal</th>
<th>2-2.5</th>
<th>30</th>
<th>8-12</th>
<th>0</th>
<th>0.08</th>
<th>I</th>
<th>12-18</th>
<th>24-36</th>
<th>36-48</th>
<th>Yes (H, P)</th>
<th>Group remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>gentamicin</strong></td>
<td>Renal</td>
<td>2</td>
<td>24-48</td>
<td>8</td>
<td>0-20</td>
<td>0.2</td>
<td>D</td>
<td>75-100</td>
<td>50-75</td>
<td>25-50</td>
<td>Yes(H, P)*</td>
<td>Group remarks</td>
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<td>Concurrent penicillins may result in subtherapeutic blood levels.</td>
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<td></td>
<td>* May add 4 to 5 mg/L to peritoneal dialysate to obtain adequate serum levels.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>kanamycin</strong></th>
<th>Renal</th>
<th>2-3</th>
<th>27-30</th>
<th>8</th>
<th>0</th>
<th>0.22</th>
<th>I</th>
<th>24</th>
<th>24-72</th>
<th>72-96</th>
<th>Yes(H, P)*</th>
<th>Group remarks. *May add to peritoneal</th>
</tr>
</thead>
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<tr>
<td>Drug</td>
<td>Pharmacokinetic Variables</td>
<td>Adjustment for Renal Failure</td>
<td>Remarks on Toxicity and Notes</td>
<td>Drug</td>
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<td></td>
<td>Major Excretion Routes</td>
<td>Normal Plasma Volume Method</td>
<td>Glomerular Filtration Rate (GFR)</td>
<td>Removal by Dialysis</td>
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<tr>
<td></td>
<td>Half-Life (T½) Normal ESRD</td>
<td>Distribution</td>
<td>&gt;50 10-50 &lt;10</td>
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<tr>
<td>neomycin</td>
<td>Renal</td>
<td>2 h 12-24 % Likg mL/min</td>
<td>6 12-18 18-24 Yes(H, ? P)</td>
<td>kanamycin (cont.)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>netilmicin</td>
<td>Renal</td>
<td>2.1-2.4 h 16-30 % Likg mL/min</td>
<td>8 12-24 24-48 Yes</td>
<td>neomycin</td>
<td></td>
<td></td>
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<tr>
<td>streptomycin</td>
<td>Renal</td>
<td>2.5 h 100-110 % Likg mL/min</td>
<td>12 35 24-72 72-96 Yes (H)</td>
<td>netilmicin</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tobramycin</td>
<td>Renal</td>
<td>2.5 h 56 % Likg mL/min</td>
<td>8 0-20 0.26 D 75-100 50-75 25-50 Yes(H, P)</td>
<td>streptomycin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalosporins</td>
<td></td>
<td></td>
<td></td>
<td>tobramycin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cephalosporins 
All agents in this group may be nephrotoxic in combination with aminoglycoside antibiotics, diuretics, and volume depletion.
<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Category</th>
<th>Renal Clearance (mL/min)</th>
<th>dosages (mg)</th>
<th>half-life (h)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefotaxime</td>
<td>Renal</td>
<td>1.2</td>
<td>2.3-3.6</td>
<td>12</td>
<td>38</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>Renal</td>
<td>0.7</td>
<td>13-22</td>
<td>6-8</td>
<td>73</td>
</tr>
<tr>
<td>Cephalothin</td>
<td>Renal</td>
<td>0.5-0.9</td>
<td>3-18</td>
<td>6</td>
<td>65</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>Renal</td>
<td>0.9</td>
<td>5-30</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Cephradine</td>
<td>Renal</td>
<td>1.3</td>
<td>8-15</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>Hepatic</td>
<td>2.5</td>
<td>3-7*</td>
<td>6</td>
<td>60</td>
</tr>
</tbody>
</table>

* T ½ may be markedly prolonged when hepatic and renal dysfunction coexist.
* Slight decrease in binding with ESRD and cirrhosis.
### Drug Pharmacokinetic Variables

<table>
<thead>
<tr>
<th>Drug</th>
<th>Major Excretion Routes</th>
<th>Half-Life (T½)</th>
<th>Normal Dose Interval</th>
<th>Plasma Protein Binding</th>
<th>Volume of Distribution</th>
<th>Method</th>
<th>Glomerular Filtration Rate (GFR)</th>
<th>Glomerular Filtration Rate (GFR)</th>
<th>Removal by Dialysis</th>
<th>Remarks on Toxicity and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>chloroquine</td>
<td>Nonrenal</td>
<td>48 h</td>
<td>24</td>
<td>55</td>
<td>%</td>
<td>L/kg</td>
<td>ml/min</td>
<td>ml/min</td>
<td>&gt;50</td>
<td>10-50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>clindamycin</td>
<td>Hepatic (renal)</td>
<td>2-2.5</td>
<td>1.5-3.5</td>
<td>60-95</td>
<td>?</td>
<td>D</td>
<td>Unchanged</td>
<td>50*</td>
<td>No (H, P)</td>
<td>Pseudomembranous enterocolitis may cause volume depletion.</td>
</tr>
<tr>
<td>erythromycin</td>
<td>Hepatic</td>
<td>1-2.2</td>
<td>4-6</td>
<td>70-75</td>
<td>0.5*</td>
<td>D</td>
<td>Unchanged</td>
<td>?No (H, P)</td>
<td>* Doubled in ESRD; may be ototoxic in renal failure.</td>
<td></td>
</tr>
<tr>
<td>lincomycin</td>
<td>Hepatic (renal)</td>
<td>4-5</td>
<td>10</td>
<td>70</td>
<td>0.6</td>
<td>L</td>
<td>6</td>
<td>12</td>
<td>24</td>
<td>No (H, P)</td>
</tr>
<tr>
<td>metronidazole*</td>
<td>Hepatic</td>
<td>6-14</td>
<td>8-15</td>
<td>8 20</td>
<td>0.80</td>
<td>L</td>
<td>8</td>
<td>8</td>
<td>8-12</td>
<td>Yes (H)</td>
</tr>
</tbody>
</table>

* Recommendations pertain to bacterial infections.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Effect on Renal Function</th>
<th>Volume of Distribution</th>
<th>Half-Life</th>
<th>Excretion</th>
<th>Metabolism</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>nalidixic acid</td>
<td>Renal (hepatic)</td>
<td>1.5 21 6 93</td>
<td>D → Unchanged → Avoid*</td>
<td>?</td>
<td></td>
<td>*Metabolites accumulate, rapid resistance of most pathogens; metabolic acidosis reported with overdosage.</td>
</tr>
<tr>
<td>nitrofurantoin</td>
<td>Renal</td>
<td>0.3 1 8 25-60</td>
<td>D Unchanged Avoid* Avoid* Yes (H)</td>
<td>?</td>
<td>Peripheral sensory neuropathy due to accumulation of metabolites. Excretion enhanced in alkaline urine. May elevate BUN and urinary creatinine levels spuriously.</td>
<td>nitrofurantoin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* Ineffective when GFR &lt; 20 to 30 mL/min.</td>
</tr>
<tr>
<td>Penicillins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Group remarks.</td>
</tr>
<tr>
<td>amoxycillin</td>
<td>Renal</td>
<td>0.9-2.3 5-20 8 15-25 0.25-0.42 l 6 6-12 12-16* Yes (H) No (P)</td>
<td></td>
<td></td>
<td>* Normal doses needed to treat urinary infections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Group remarks.</td>
</tr>
<tr>
<td>ampicillin</td>
<td>Renal (hepatic)</td>
<td>1.5 7-20 6 8-20 0.17-0.31 l 6 6-12 12-16* Yes (H) No (P)</td>
<td></td>
<td></td>
<td>* Normal doses needed to treat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Drug</td>
<td>Pharmacokinetic Variables</td>
<td>Adjustment for Renal Failure</td>
<td>Remarks on Toxicity and Notes</td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Major Excretion Routes</td>
<td>Half-Life (T½)</td>
<td>Normal Dose Interval</td>
<td>Normal Plasma Protein Binding</td>
<td>Volume of Distribution</td>
<td>Method</td>
</tr>
<tr>
<td>carbenicillin</td>
<td>Renal (hepatic)</td>
<td>1.5</td>
<td>10-20</td>
<td>4</td>
<td>50</td>
<td>0.12-0.2</td>
</tr>
<tr>
<td>cloxacillin</td>
<td>Hepatic (renal)</td>
<td>0.4-0.6</td>
<td>0.8</td>
<td>6</td>
<td>94</td>
<td>0.15-0.2</td>
</tr>
<tr>
<td>methicillin</td>
<td>Renal (hepatic)</td>
<td>0.5</td>
<td>4</td>
<td>4</td>
<td>35-60</td>
<td>0.31</td>
</tr>
</tbody>
</table>

urinary infections. Contains 3 meq sodium/gm; adverse reactions commoner in renal failure.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Renal Activity</th>
<th>Dose</th>
<th>T1/2</th>
<th>Volume</th>
<th>Clearance</th>
<th>Creatinine &gt; 2 mg/dL</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin G (hepatic)</td>
<td>Renal</td>
<td>0.5</td>
<td>6-20*</td>
<td>8</td>
<td>20-60</td>
<td>0.3-0.42</td>
<td>D 100 I 8 75 25-50 Yes (H) No (P) Group remarks. An upper limit of 4 to 6 million U/d is suggested in severe renal failure; potassium salt has 1.7 meq/million U; false-positive urine protein reactions with biuret reagent and sulfosalicylic acid. * T 1/2 prolonged by many drugs. ** May add to peritoneal dialysate.</td>
</tr>
<tr>
<td>Ticarcillin (hepatic)</td>
<td>Renal</td>
<td>1-1.5</td>
<td>16</td>
<td>4-6</td>
<td>45</td>
<td>0.14-0.21</td>
<td>D 75 I 8-12 50 25 25-48 Yes (H, P) Group remarks. Same remarks as for carbenicillin.</td>
</tr>
<tr>
<td>Pyrimethamine (hepatic)</td>
<td>Nonrenal</td>
<td>1.5-5d</td>
<td>?</td>
<td>24</td>
<td>27</td>
<td>D → Unchanged ← ?</td>
<td>* Metabolites excreted in urine for weeks because of tissue storage.</td>
</tr>
<tr>
<td>Quinine (hepatic)</td>
<td>Nonrenal</td>
<td>5-16</td>
<td>?</td>
<td>8</td>
<td>70</td>
<td>? I 8 8-12 24 Yes (H) No (P) *Marked tissue accumulation.</td>
<td></td>
</tr>
<tr>
<td>Sulfamethoxazole-trimethoprim</td>
<td>Renal</td>
<td>24 12 40-70 1-2</td>
<td>I 12 18 24</td>
<td>Yes (H) * T 1/2 reduced if urine alkaline. ** Binding to plasma proteins decreased in ESRD. * May cause increase in serum creatinine in patients with creatine &gt; 2 mg/dL; this may reflect secretory competition with creatinine or a nephrotoxic.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug</td>
<td>Pharmacokinetic Variables</td>
<td>Adjustment for Renal Failure</td>
<td>Remarks on Toxicity and Notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>-----------------------------</td>
<td>------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetracyclines</td>
<td></td>
<td></td>
<td></td>
<td>reaction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a May achieve adequate urine concentration in patient with low GFR using normal doses.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hematologic side effects due to antifolate action.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tetracyclines**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Excretion Routes</th>
<th>Half-Life (T½)</th>
<th>Normal Dose Interval</th>
<th>Plasma Protein Binding</th>
<th>Volume Distribution</th>
<th>Method</th>
<th>Glomerular Filtration Rate (GFR)</th>
<th>Removal by Dialysis</th>
<th>Remarks on Toxicity and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>doxycycline</td>
<td>Renal (hepatic)</td>
<td>14-25</td>
<td>15-36</td>
<td>12</td>
<td>80-93</td>
<td>?</td>
<td>12</td>
<td>2-18</td>
<td>No (H, P) Probable group drug of choice for extrarenal infections but not useful for urinary infection if GFR &lt; 20 mL/min.</td>
</tr>
</tbody>
</table>

sulfamethoxazole-trimethoprim (COTM)
<table>
<thead>
<tr>
<th>Drug</th>
<th>Primary Route</th>
<th>Half-life</th>
<th>Overdosage</th>
<th>Interval</th>
<th>Serum Level</th>
<th>Group Remarks</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minocycline</strong></td>
<td>Hepatic</td>
<td>12-15</td>
<td>75</td>
<td>0.12-0.14</td>
<td>1</td>
<td>12</td>
<td>18-24</td>
</tr>
<tr>
<td><strong>Vancomycin</strong></td>
<td>Renal</td>
<td>6-8</td>
<td>200-250</td>
<td>&lt;10</td>
<td>0.47-0.84</td>
<td>1</td>
<td>24-72</td>
</tr>
</tbody>
</table>

* Abbreviations used in Table: T½ = biological half-life; ESRD = end-stage renal disease; BUN = blood urea nitrogen; GFR = glomerular filtration rate. I = interval extension method of dosage adjustment[data units are hours between maintenance doses]; D = dose reduction method of dosage adjustment[data units are percentage of usual maintenance dose]; H = hemodialysis; P = peritoneal dialysis; d = days.
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MEDICAL LITANY

From the inability to leave well alone
From too much zeal for what is new
and contempt for what is old.
From putting knowledge before wisdom,
Science before art, cleverness before common sense;
From treating patients as cases; and from
making the cure of disease more grievous
than its endurance,
Lord God deliver us.

SIR ROBERT HUTCHINSON
(1871 - 1960)