Management of common infections

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Overview

- General overview about microbiology
- Interpreting microbiology results
- General principles about antibiotics
- Management of common infections
  - Respiratory tract infections
  - Urinary tract infections
  - Skin infections - cellulitis
General overview of microbiology
Commensal vs Pathogen

• Microorganisms live throughout our body (eg gut, skin)

• Commensal
  • An organism participating in a symbiotic relationship in which one species derives some benefit while the other is unaffected
  • Do not cause disease

• Pathogen
  • An agent that causes disease, especially a living micro-organism such as a bacterium, virus, or fungus
  • Eg E.coli UTI, Staph cellulitis
  • Some sites are normally sterile eg blood, brain, bladder
Identifying bacteria

- Organisms identified and grouped according to:
  - Oxygen requirement: aerobic vs anaerobic
  - Gram stain: Gram positive (purple) vs gram neg (pink)
  - Cell shape
    - Cocci are circular
    - Bacilli are rod-shaped
    - Cocco-bacilli are capsule-shaped

- Final identification can take 3 days
- Usually, the only info available in the first 2 days are gram stain and shape (but this is still useful!)
Identifying bacteria

• Susceptibilities
  – Determine the antibiotics the organism is susceptible to
  – Sensitive (S), Intermediate (I), Resistant (R)
  – Some labs will withhold results to certain antibiotics (e.g. broad spectrum)

• MALDI-TOF: increasingly used, faster identification
Gram positive

Cocci

Staphylococcus
  - *Staph aureus* (coagulase +)
  - *Staph epidermidis* (coagulase –)

Streptococcus
  - *Strep pneumoniae*
  - *Strep pyogenes*
  - *Strep agalactae*

Enterococcus
  - *E. faecalis*
  - *E. faecium*

Bacilli

- Clostridium
- Listeria
- Corynebacterium
- Bacillus
Gram positive

Cocci

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- \textit{Bacillus}
Gram positive

Cocci

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Enterococcus
- E. faecalis
- E. faecium

Bacilli
- Clostridium
- Listeria
- Corynebacterium
- Bacillus
Gram negative

Bacilli
- Klebsiella
- E.Coli
- Enterobacter
- Citrobacter
- Serratia

Cocci
- Pseudomonas
- Proteus
- Salmonella

Coccobacilli
- Haemophilus influenzae
- Bordetella pertussis
- Legionella

(Neisseria spp)
- Neisseria meningitidis
- Neisseria gonorrhoea
Gram negative

Bacilli
- E.Coli
- Klebsiella
- Enterobacter
- Citrobacter
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- Pseudomonas
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(Neisseria spp)
Gram negative

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- Enterobacter
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- Salmonella

Pseudomonas
- Proteus
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Pseudomonas
- Proteus
- Salmonella

Cocci
- Haemophilus influenzae
- Bordetella pertussis
- Legionella

Coccobacilli
- Neisseria meningitidis
- Neisseria gonorrhoea

Neisseria spp
Interpreting micro results
Layout of a micro report

- **Differs** depending on the type of specimen and the lab

- Status of the report (final, interim)
- Specimen description
- Gram stain (semi-quantitative)
- Culture (semi-quantitative)
- Susceptibilities/sensitivities
  - *Sensitive*, *Intermediate*, *Resistant*
- Sometimes text commentary
What to think through

1. From which site was the sample taken?
   – Sterile site: blood, CSF, bone, joint
   – Non-sterile site: sputum, skin, urine*

2. Don’t just go straight to the susceptibility results
   – Look at the quality of the sample and what else is there
   – The most appropriate antibiotic may not be the one with “S” next to it
     • Side effects, drug interactions, site of infection
Common types of samples

- Urine
- Sputum
- Skin
Urine

- Bladder/urine are supposed to be sterile
- **But**, the method of collection means contamination is possible → MSU
- Look at the leukocyte count (WBC)
  - If leukocytes <100, any organism is probably a contaminant and does not require treatment
- Look at the epithelial cell count
  - High numbers indicate skin contamination
- Look at the concentration of the organisms
  - Generally >$10^6$ suggests infection but depends on other factors
  - The mere presence of bacteria above a certain limit (even with leukocytes) does not by itself indicate UTI
Examples

FINAL Urine M/C/S Murine - Tests: Urin (Urine M & C)

**SPECIMEN**
- Specimen Type: Urine Midstream

**CHEMISTRY**
- pH: 6.5
- Protein: +
- Specific Grav.: 1.007
- Blood: ++
- Glucose: NEGATIVE
- Leucocytes: +++

**MICROSCOPY**
- Leucocytes: 311 x10^6/L ( <2x10^6/L )
- Red Blood Cells: 53 x10^6/L ( <15x10^6/L )
- Squamous Epithelial Cells: ++

**STANDARD BACTERIAL CULTURE**
- 1. Escherichia coli: >10^9 cfu/L

**SENSITIVITIES:**
- Ampicillin: I
- Augmentin: S
- Cefazolin: S
- Ceftriaxone: S
- Ciprofloxacin: S
- Cotrimoxazole: S
- Gentamicin: S
- Nitrofurantoin: S
- Tazocin: S
- Trimethoprim: S

Lab No

FINAL Urine M/C/S Murine - Tests: Urin (Urine M & C)

**SPECIMEN**
- Specimen Type: Urine Type Not Stated

**CHEMISTRY**
- pH: 7.0
- Protein: TRACE
- Specific Grav.: 1.020
- Blood: NEGATIVE
- Glucose: NEGATIVE
- Leucocytes: NEGATIVE

**MICROSCOPY**
- Leucocytes: 7 x10^6/L ( <2x10^6/L )
- Red Blood Cells: 8 x10^6/L ( <15x10^6/L )
- Squamous Epithelial Cells: Mil

**STANDARD BACTERIAL CULTURE**
- 1. Pseudomonas aeruginosa: 10^7 cfu/L

**SENSITIVITIES:**
- Ceftazidime: S
- Ciprofloxacin: S
- Gentamicin: S
- Meropenem: S
- Tazocin: S
- Timentin: S
Asymptomatic bacteriuria

- Bacteria are often present in significant numbers in the urine in the absence of symptoms of UTI
- Rates of asymptomatic bacteriuria can be:
  - 100% in long-term indwelling catheters
  - 25-50% in female nursing home residents
  - 1-5% in healthy, premenopausal women
- Treatment of asymptomatic bacteriuria provides **no benefit** and may lead to development of **resistance**
- Some exceptions are: pregnant women and prior to TURP procedure
- Where the prevalence of asymptomatic bacteriuria is high:
  - the use of urine microscopy and culture to determine the presence of UTI can be misleading
Urinary catheters

• Would normally expect to see bacteria and WCC in a non-infected patient
• Culture results often unreliable unless taken through a newly inserted catheter
• Cultures (and treatment) should only occur if:
  – Patient is symptomatic
  – Have certain risk factors e.g. immunosuppressed, pregnancy
  – Undergoing a urological procedure
Urinary dipsticks

- Controversial, may be useful in some settings
- **Leukocyte esterase** – indicates presence of WCC in urine
- **Nitrate** – indicates presence of some bacteria
- Issues with accuracy
  - False negatives and false positives
- Not recommended as ‘screening’ in asymptomatic patients
- Routine use in aged care facilities a concern
Sputum

- Non-sterile site
- Common contamination through oropharyngeal tract
- Gram stain is very important
  - Useful for ‘screening’ the sample
  - High numbers of epithelial cells suggests contamination by oral secretions (i.e. a bad sample)
    - Labs may reject these specimens and not culture them
  - Presence of white cells (polymorphs) indicative of real infection
  - If organism seen on gram stain, indicates higher likelihood of real infection
  - Amount of growth is important – “light/moderate/heavy” or “+/++/+++”
Sputum

• Culture
  – Need to correlate this with what was seen on the gram stain
  – For an organism to be deemed significant, it should predominate on both the gram stain and the culture and be a recognised respiratory pathogen
    o e.g. *Streptococcus pneumoniae, Haemophilus influenzae*
  - Other organisms require caution
    o *Staphylococcus aureus* – usually colonisation of the airway
    o *Escherichia coli, Pseudomonas spp.* – often colonisers (especially in hospitals)
  - BUT, clinical judgement is always required
Skin swab

- Non-sterile site
- The decision to treat a skin infection should always be based on **clinical grounds**, not purely on the basis of a wound swab
- Look at the Gram stain:
  - Are there white cells present?
- Pure growth of a single organism increases the likelihood that it is pathogenic
- But, known pathogens are always reported even if there is mixed growth
  - E.g. *Staphylococcus aureus*, *Streptococcus pyogenes*, *Clostridium perfringens*
General principles about antibiotics
Learning about antibiotics…

• … is very difficult!
  – Bacteria names sound the same
  – Antibiotic names sound the same
  – Lots of bacteria can cause lost of different conditions
  – Antibiotic spectra overlap
    • … and is constantly evolving

• DIFFERENT to other medications
  – Destroy a pathogen but minimising toxicity to the host
Terminology

• Antimicrobial
  – Anything that kills (or prevents growth) any microbe
  – Bacteria, viruses, fungi, parasites

• Antibiotic
  – An agent that kills bacteria
  – Ineffective against viruses and fungi
  – Some also have anti-parasitic activity
Empiric vs targeted therapy

- **Empiric therapy**
  - Treating an infection without knowing the causative pathogen
  - Relying on experience and precedent

- **Prophylaxis**
  - Prevention of disease

- **Targeted therapy**
  - Antibiotic regimen determined by identity and antibiotic sensitivities
  - More refined and specific compared to empiric therapy

Both rely on:
- Knowledge of location of disease in the body
- Local epidemiology
Bactericidal vs bacteriostatic

- Bactericidal – kills the organism (eg cell wall rupture)
- Bacteriostatic – stops the growth of the organism (eg prevent protein synthesis)
  - Allows body’s immune system to fight infection
  - Not ideal for immunosuppressed patients
Time vs concentration dependent kill

- Time dependent kill
  - The ability to kill organisms depends on the time above MIC
    → Very important that antibiotics are given on time!
  - Giving higher doses do not necessarily correlate with increased effectiveness (unless protected site)
  - Penicillins, cephalosporins, meropenem, vancomycin
Time vs concentration dependent kill

- Concentration dependent kill
  - Ability to eradicate organisms depends on the concentration above MIC
  - Higher concentration = better activity, BUT increased toxicity
  - Generally want peak concentration to be 8-10 x MIC
  - eg Gentamicin and ciprofloxacin
Patient considerations

**Eye**
- Abx need to cross BBB
- Sometimes give intravitreal injections

**CNS**
- Does this antibiotic penetrate the CNS?
- Need high doses

**Food effects**
- Affect absorption of oral antibiotics
- Enteral feeds
- Nausea, vomiting, diarrhoea

**Fluid load**
- Infusion fluid
- Salt content of certain antibiotics

**Body habitus**
- Patient size (weight, height)
- Obese patients may require higher doses
  - Actual body weight
  - Ideal body weight
  - Adjusted body weight

**Renal failure**
- Dosage adjustments
- Also consider haemodialysis, peritoneal dialysis, CRRT

**Liver failure**
- May need dose adjustment, or
- Avoid drug altogether
Other considerations

• Drug-drug interactions
  – Azoles eg. fluconazole, voriconazole, posaconazole
  – Rifampicin
  – QT prolongation
    • Ciprofloxacin, moxifloxacin, azithromycin

• Food-drug interactions
  – Rifampicin

• Supplement-drug interactions (calcium, iron, magnesium)
  – Tetracyclines eg. doxycycline, minocycline
  – Fluoroquinolones eg. ciprofloxacin, norfloxacxin, moxifloxacin
The antibiotics
Common antibiotics

**Beta lactams**
- Penicillins
  - Benzylpenicillin
  - Flucloxacillin/dicloxacillin
  - Amoxicillin/ampicillin
  - Amoxicillin-clavulanate (Augmentin®)
  - Piperacillin-tazobactam (Tazocin®)
- Cephalosporins
  - Cefazolin
  - Ceftriaxone
- Carbapenems
  - Meropenem

**Other antibiotics**
- Clindamycin
- Ciprofloxacin
- Trimethoprim
- Trimethoprim-sulfamethoxazole (Bactrim®)
- Metronidazole
- Moxifloxacin
- Vancomycin
- Gentamicin
- Rifampicin
What is a beta-lactam?

Beta-lactamase enzyme

Beta-lactam ring

Penicillin

Cephalosporin

Carbapenem
Streptococci
Enterococci
Staphylococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Benzylpenicillin

Anaerobes

Increasing resistance

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

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Enterococci
Streptococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Staphylococci
Enterococci

Benzylpenicillin
Flucloxacillin

Anaerobes

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

MRSA
VRE

National Centre for Antimicrobial Stewardship
Enterococci
Streptococci
E. coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Staphylococci
Benzylpenicillin
Flucloxacillin
Amoxycillin/ampicillin

Increasing resistance

Anaerobes

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

MRSA
VRE

Gram negatives
Enterococci
Streptococci
Staphylococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

Anaerobes

Amoxycillin-clavulanate (Augmentin®)
Amoxycillin/ ampicillin
Piperacillin-tazobactam (Tazocin®)

MRSA VRE

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Penicillin allergies

- Depends on beta-lactam ring and side chains
- Generally 3 types of allergies
  - Immediate hypersensitivity – avoid all beta-lactams
    - Anaphylaxis, angioedema
  - Delayed hypersensitivity – other beta-lactams usually OK
    - Rash
  - Severe delayed hypersensitivity – avoid all beta-lactams
    - DRESS, SJS
- Penicillin ↔ cephalosporins: 1-10% cross reactivity
- Thought to be less for penicillin ↔ carbapenems
- Other allergies – avoid all beta-lactams
  - Interstitial nephritis
  - Haematological abnormalities
Cephalosporins

- Similar structure to penicillins
- Side effects
  - Hypersensitivity (less than penicillins)
  - Cross reactivity with penicillins in studies suggest 1-10%
  - Other side effects similar to penicillins
- 1\textsuperscript{st} \rightarrow 2\textsuperscript{nd} \rightarrow 3\textsuperscript{rd} \rightarrow 4\textsuperscript{th} generation
  - Increase gram negative cover
  - Lose gram positive cover
Streptococci
Staphylococci
Enterococci
E.coli
Klebsiella
Proteus
Haemophilus
Pseudomonas

 Gram positives

Anaerobes

Increasing resistance

1st generation
- Cephazolin
- (Cephalexin)

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

MRSA
VRE

National Centre for Antimicrobial Stewardship
Streptococci
Staphylococci
Enterococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Anaerobes

Gram negatives

1st generation
- Cephazolin
- (Cephalexin)

3rd generation
- Ceftriaxone

Resistant Gram negs:
- Enterobacter
- Citrobiacter
- Serratia

Increasing resistance

MRSA
VRE
Streptococci
Staphylococci
Enterococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Meropenem

Gram positives

Increasing resistance

Anaerobes

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

MRSA
VRE

Gram negatives

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Enterococci
Streptococci
Staphylococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Clindamycin

MRSA

VRE

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

Anaerobes

Gram negatives
Enterococci
Streptococci
Staphylococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Anaerobes

E.coli

Gram negatives

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia

Vancomycin
MRSA
VRE
Enterococcus faecalis
Streptococci
Staphylococci
E.coli
Klebsiella
Haemophilus
Proteus
Pseudomonas

Gram positives

Anaerobes

Moxifloxacin

Ciprofloxacin

MRSA
VRE

Resistant Gram negs:
- Enterobacter
- Citrobacter
- Serratia
Too many antibiotics to cover

• For a great video presentation on principles of antibiotic pharmacotherapy; go to the Australian Commission website

Some useful resources

- **Therapeutic Guidelines: Antibiotic, Version 15**
  - Note that some recommendations are in the Dermatology, Gastrointestinal, Oral and Dental books

- **Australian Medicines Handbook**
  - Anti-infectives chapter has a useful table of antibiotic susceptibilities to common organisms

- **MIMS**
  - Detailed information on PK/PD, microbiology and administration
  - **Caution** with dosing information
Management of common infections
Antibiotic therapy

- Remember – empiric vs directed therapy
- The following treatment options largely discuss EMPIRIC therapy
  - Know common pathogens that cause infection
  - Know your local epidemiology
- Antibiotic treatment should be **guided** by microbiology results
Management of Respiratory Tract Infections (RTIs)
RTIs – what to consider

- Upper vs lower respiratory tract infections
- Exacerbation of airways disease – eg. COPD, asthma
- Influenza
- Pneumonia
  - Community acquired
    - From home
    - From high level care nursing home
  - Hospital acquired
    - Risk of multi-drug resistant pathogen
- Severity of infection
- Allergies
- Is the patient immunocompromised?
- Other medications
Community acquired pneumonia – usual suspects

- *Streptococcus pneumoniae*
- *Haemophilus influenzae*
- *Mycoplasma pneumoniae*
- *Chlamydia pneumoniae*
- *Legionella* spp.
- Viruses!

- High level care NH
  - *Streptococcus pneumoniae*
  - Gram negative bacilli eg. *E. coli*, *Klebsiella*, *Pseudomonas*

- Other
  - *Staphylococcus aureus*
  - *Pneumocystis jiroveci*
  - Fungal
Empiric antibiotic management for CAP

• Outpatient setting
  – Amoxicillin 1g orally TDS OR doxycycline 100mg orally BD
  – Consider amoxycillin-clavulanate for aspiration
  – Cefuroxime 500mg orally BD for mild penicillin allergy

• Hospital setting
  – Benzylpenicillin 1.2g IV QID PLUS doxycycline* 100mg orally BD
  – Ceftriaxone 1g IV daily PLUS doxycycline* 100mg orally BD
  – Ceftriaxone 1g IV daily PLUS azithromycin* 500mg IV daily
  – Moxifloxacin 400mg IV daily

• Consider allergies, clinical history and microbiology results
  *May not require atypical cover if from HLC; history is important!
Empiric HAP antibiotic management

- Depends on risk factors for multi-drug resistance
  - Amoxicillin-clavulanate 875mg-125mg orally BD
  - Ceftriaxone 1g IV daily
  - Piperacillin-tazobactam 4.5g IV QID
  - Moxifloxacin 400mg orally/IV daily
  - +/- Vancomycin according to weight and levels
Management of Urinary Tract Infections
UTIs – what to consider

• Symptoms
  – Asymptomatic bacteriuria
  – Cystitis
  – Pyelonephritis
• Presence of urinary catheter
• Male vs female
  – Prostatitis
• Uncomplicated vs complicated UTI
• Recent travel
• Renal function
• Prophylaxis or recent antibiotic exposure
UTI - Usual suspects

• Uncomplicated UTI
  – *Escherichia coli*, *Staphylococcus saprophyticus*

• Complicated UTI
  – *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Streptococcus agalactiae* (Group B Strep), enterococci

• Recent travel or recent antibiotic exposure
  – Consider drug-resistant isolates
  – Extended spectrum beta lactamase producing organisms
Antibiotic management

• Obtain microbiology where possible
• Acute cystitis
  – Trimethoprim 300mg orally daily
  – Cephalexin 500mg orally BD
  – Amoxycillin-clavulanate 500/125mg orally BD
  – Nitrofurantoin 100mg orally BD
  – Norfloxacin 400mg orally BD
• Complicated UTI/pyelonephritis
  – Gentamicin (dose according to IBW) IV daily PLUS
    ampicillin/amoxicillin 2g IV QID
  – Ceftriaxone 1g IV daily
  – Meropenem 1g IV TDS
Management of Skin Infections
Skin Infections – what to consider and likely culprits

- **Cellulitis**
  - *Staphylococcus aureus*
  - *Streptococcus pyogenes*
  - Other Streptococci

- **Wound infections**
  - Surgical wounds
  - Non-surgical wounds
    - Contaminated vs non-contaminated
Antibiotic management

- Empirical management of cellulitis
  - Flucloxacillin 500mg orally QID
  - Dicloxacillin 500mg orally QID
  - Cephalexin 500mg orally QID
  - Clindamycin 450mg orally TDS
  - Flucloxacillin 2g IV QID
  - Cephazolin 2g IV TDS
  - Clindamycin
  - Vancomycin IV, dose dependent on weight, renal function and levels
Summary

• It’s not easy!
• Antibiotics are a difficult class of drugs to understand
• Certain bacteria and antibiotics that you should be familiar with
• Ask if not sure!
Clinical Care Standard for AMS
What role do you play?

Nine statements describing best practice for managing a patient who has, or is suspected of having a bacterial infection, regardless of setting.

• **For consumers:** describes the care they can expect to receive

• **For clinicians:** provides support in the delivery of care the patient is expecting

• **For health services:** systems are in place to support clinicians in providing the care that is expected by the patient

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Thankyou!

• Questions?

THE UNUSUAL SUSPECTS

Stop The Resistance. Prescribe Wisely.

• Email: sonia.koning@easternhealth.org.au
**FINAL Respiratory M/C/S Mresp - Tests: Sp (Sputum MC&S)**

**SPECIMEN**
Specimen Type: Sputum

**MICROSCOPY**

**GRAM STAIN**

- Macroscopic Description: Mucoaid
- Pus:Epithelial Cell Ratio: >25:10
- Pus Cells: +++
- Squamous Epithelial Cells: +
- Gram negative bacilli: +++
- Mixed upper respiratory tract flora: ++

**CULTURE**

- Standard culture: +++ Haemophilus influenzae
- ++ Candida krusei
- +++ Mixed upper respiratory tract flora

**SENSITIVITIES**

- Amoxicillin: S
- Augmentin: S
- Ceftriaxone: S

**FINAL Respiratory M/C/S Mresp - Tests: Sp (Sputum MC&S)**

**SPECIMEN**
Specimen Type: Sputum

**MICROSCOPY**

**GRAM STAIN**

- Macroscopic Description: Saliva
- Pus:Epithelial Cell Ratio: <25:10
- Pus Cells: +
- Squamous Epithelial Cells: ++
- Gram positive cocci: +++

The ratio of <25:10 pus to epithelial cells seen in the Gram stain suggests salivary contamination

**CULTURE**

- Standard culture: ++ Mixed upper respiratory tract flora
**Skin swab**

**FINAL Wounds/Tips/Ent/Eye Mpus - Tests: Wound (Wounds & Other M&C)**

**SPECIMEN**
Specimen Type : Swab
Description : Skin Craft Site L. Leg

**GRAM STAIN**
- Leucocytes : +++
- Epithelial Cells : +++
- Gram positive cocci : ++

**CULTURE**
- + Enterobacter cloacae complex
- + Staphylococcus haemolyticus

Final report to follow

**FINAL Wounds/Tips/Ent/Eye Mpus - Tests: Wound (Wounds & Other M&C)**

**SPECIMEN**
Specimen Type : Wound Swab
Description : Left groin

**GRAM STAIN**
- Leucocytes : NOT Detected
- No organisms seen

**CULTURE**
- ++ Mixed Coagulase Negative Staphylococci including Corynebacterium species and Enterococcus faecalis.

**COMMENT**
Final report to follow

**SENSITIVITIES 1**
- Clindamycin : S
- Cotrimoxazole : S
- Erythromycin : S
- Fusidic Acid : S
- Oxacillin : R
- Penicillin : R
- Rifampicin : S
- Vancomycin : S
FINAL Urine M/C/S Murine - Tests: Urin (Urine M & C)

**SPECIMEN**

**Specimen Type:** Urine Type Not Stated

**CHEMISTRY**

- **pH:** 5.5
- **Protein:** +
- **Specific Grav.:** 1.021
- **Blood:** +++
- **Glucose:** NEGATIVE
- **Leucocytes:** +++

**MICROSCOPY**

- **Leucocytes:** 1274 \( \times 10^6 / L \) (\(<2 \times 10^6 / L\))
- **Red Blood Cells:** 391 \( \times 10^6 / L \) (\(<13 \times 10^6 / L\))
- **Squamous Epithelial Cells:** Nil

**STANDARD BACTERIAL CULTURE**

1. *Escherichia coli* ESBL +ve \( >10^9 \text{ cfu/L} \)

**SENSITIVITIES:**

1. Ciprofloxacin
2. Cotrimoxazole
3. Gentamicin
4. Meropenem
5. Nitrofurantoin
6. Trimethoprim

**ORGANISM 1:** This extended spectrum beta-lactamase producing organism will be resistant to cephalosporins, aminoglycosides and all penicillins including augmentin, tazocin and timentin.

FINAL Urine M/C/S Murine - Tests: Urin (Urine M & C)

**SPECIMEN**

**Specimen Type:** Urine Catheter Specimen

**CHEMISTRY**

- **pH:** 7.0
- **Protein:** NEGATIVE
- **Specific Grav.:** 1.011
- **Blood:** NEGATIVE
- **Glucose:** NEGATIVE
- **Leucocytes:** NEGATIVE

**MICROSCOPY**

- **Leucocytes:** 9 \( \times 10^6 / L \) (\(<2 \times 10^6 / L\))
- **Red Blood Cells:** 4 \( \times 10^6 / L \) (\(<13 \times 10^6 / L\))
- **Squamous Epithelial Cells:** Nil

**STANDARD BACTERIAL CULTURE**

1. *Enterococcus faecalis* \( 3 \times 10^7 \text{ cfu/L} \)

**SENSITIVITIES:**

1. Amoxicillin
2. Nitrofurantoin
3. Vancomycin

**STANDARD BACTERIAL CULTURE**

1. *Escherichia coli* ESBL +ve

**SENSITIVITIES:**

1. Ciprofloxacin
2. Cotrimoxazole
3. Gentamicin
4. Meropenem
5. Nitrofurantoin
6. Trimethoprim

**ORGANISM 1:** This extended spectrum beta-lactamase producing organism will be resistant to cephalosporins, aminoglycosides and all penicillins including augmentin, tazocin and timentin.