




Basic microbiology

Infection Prevention & Control: Foundation Course for
Residential Care Settings
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You send a CSU from Mary to the microbiology laboratory.

If bacteria are reported to be present in the microbiology result, does that mean Mary has a UTI?



What does a Clinical Microbiologist do?

- **THE SCIENCE BIT....**
- **Biology of microbes: bacteria, viruses, fungi, parasites**
- **Benefit and harm of microbes to humans**
- **Understand how microbes become resistant to antimicrobial agents**



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What does a Clinical Microbiologist do?

- **THE MEDICAL BIT...**
- Clinical and laboratory diagnosis of infection
- Treatment of infection – **right drug for the right bug**
- Understand antimicrobial resistance and how to reduce it – **avoid unnecessary antimicrobial use = also called 'antimicrobial stewardship'**
- Infection prevention & control – integral to **patient safety**
- Surveillance and feedback – **information for action**
- Education



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Microorganisms - Bacteria



- Bacteria / Bugs / Germs
- Invisible to the naked eye
- Different shapes under the microscope
- Different names/types
- Can live in and on the human body without causing any harm – “normal flora” / “bystanders” / “colonisers”
 - Important to our survival
 - Protect us from infection with *C. difficile*



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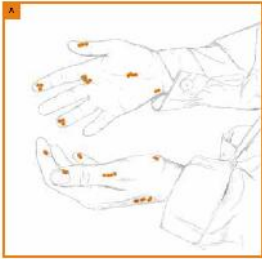
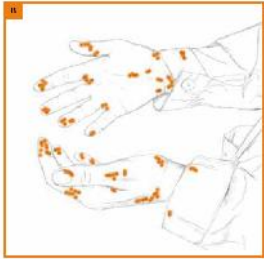


Resident Flora = x10 more bugs in or on us than cells belonging to us



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Transient Flora

Organism survival on HCWs' hands*



WHO Guidelines for Hand Hygiene in Healthcare 2009



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Bacteria

- Bacteria divide every 20 minutes



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Microbes are useful

- Protect against infection
- Digestion of food
- Food industry
- Agriculture
- Source of antibiotics – penicillin, aminoglycosides



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Back to Basics

- We are protected from infection by our immune system
 - Normal skin barrier
 - Normal bowel lining
 - Properly functioning immune cells: white blood cells
- Defective immune system predisposes a person to developing infection

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Skin Barrier

Normal skin barrier

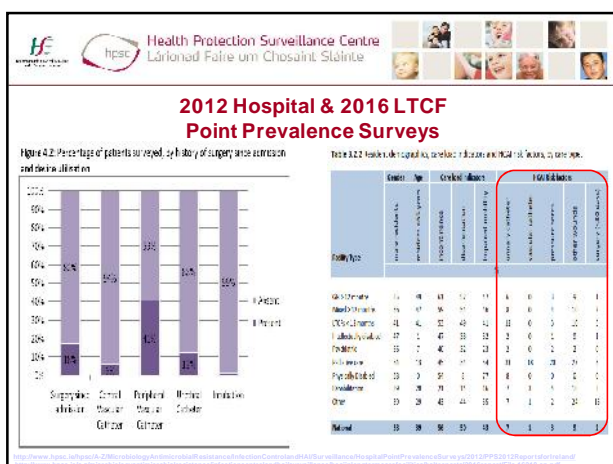
Stratum corneum


Epidermis

Dermis


Subcutaneous tissue

Healthcare increases a patient's risk of developing infection





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Host immunity

- What causes a weakened immune system?
 - Damage to the skin barrier: wounds, pressure sores, ulcers
 - Malnutrition
 - Diabetes
 - Advancing age
 - Major illness: trauma, sepsis, surgery
 - Cancer: leukaemia
 - Chemotherapy: attacks cancer cells and good cells
 - Medications that suppress over-active immune systems: affect normal cells also
 - Abuse of drugs or alcohol
 - Infections: HIV



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Host versus pathogen

- Bacteria will take any opportunity to invade the body and cause infection
- Severity of infection depends on the level of immune function of the patient
- Outcome of infection depends on many factors:
 - Ability to fight infection
 - Virulence or strength of the bacteria causing infection
 - Early recognition of infection
 - Giving the correct antibiotics that will work against the bacteria causing the infection
 - Giving the correct supportive treatments



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Host versus Pathogen



- How can harmful bacteria be destroyed?
 - Normally functioning white blood cells
 - “munch” on harmful bacteria: phagocytosis



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How do we detect bacteria in the microbiology laboratory?

- Firstly, you need to take the right specimen(s) from the resident with suspected infection **AND** get them to the laboratory quickly
- Use the laboratory manual for advice on the optimal specimen type and instructions on specimen collection



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How do we detect bacteria in the microbiology laboratory?

- Gram stain
- Culture
- Molecular methods: PCR
- Antimicrobial susceptibility testing – is the bacteria susceptible or resistant to common antimicrobials?
- Bacterial typing in investigation of suspected outbreaks



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Specimen arrives in lab




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Examine it under the microscope

- Urine microscopy
 - Bacteria
 - White blood cells/pus cells
 - Red blood cells
 - Epithelial cells
 - Casts
- Gram stain





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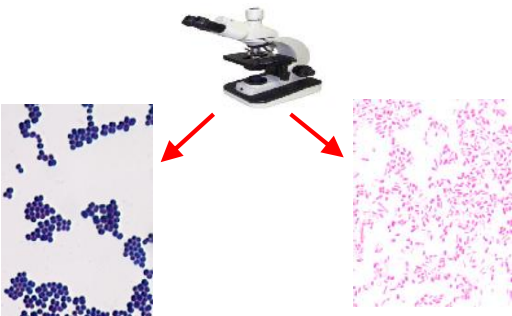
Bacteria

- Initial identification based on Gram stain

1. **Colour:** Gram positive (purple) versus Gram negative (pink)
2. **Shape:** Rods/bacilli versus cocci



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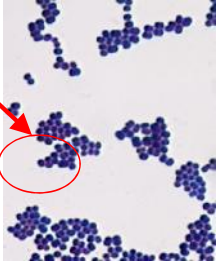
Gram positive

Gram negative

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Gram positive cocci


1. Staphylococci - clusters
2. Streptococci - chains
3. Enterococci - chains



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Gram negative bacilli

- E. coli
- Klebsiella
- Proteus
- Pseudomonas
- Salmonella
- Campylobacter



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Culture

- Grow bacteria in culture media – agars/broths give nutrition needed for bacterial growth
- Identify the bacteria – E. coli, S. aureus
- Need to know the name of the bacteria you're dealing with, so you can test it against the right antimicrobials

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Set up culture plate

Incubator

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Give the bug a name

MANUAL


AUTOMATED METHODS

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Perform susceptibility testing What antimicrobial will work?

MANUAL


AUTOMATED



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Provide a microbiology report


PATIENT NAME, ADDRESS, DATE OF BIRTH, CHART NUMBER, REFERRAL CLINICIAN	
SPECIMEN TYPE	SPECIMEN COLLECTION DATE
SPECIMEN NUMBER IN LAB	RELEVANT CLINICAL INFORMATION
MICROSCOPY RESULT: GRAM STAIN, PUS CELLS, EPITHELIAL CELLS	
CULTURE RESULT: MICROORGANISM NAME	
ANTIMICROBIAL SUSCEPTIBILITY RESULTS: SENSITIVE TO: X, Y, Z RESISTANT TO: A, B, C	
RESULT INTERPRETATION NAME AND REGISTRATION OF PERSON AUTHORISING THE REPORT AND DATE OF AUTHORISATION	



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You send a CSU from Mary to the microbiology laboratory.



If bacteria are reported to be present in the microbiology result, does that mean Mary has a UTI?

IF YOU'RE GOING TO SEND A TEST, YOU NEED TO BE ABLE TO INTERPRET THE SIGNIFICANCE OF THE RESULT



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Other techniques for picking up microorganisms: PCR

- Molecular technique
- Directly detects genetic material of bacteria or viruses in a specimen – DNA or RNA
- Don't have to wait for culture results
- Good for slow-growing bacteria – *C. difficile*, *M. tuberculosis*
- Good for viruses, as these are difficult to culture – norovirus, influenza virus, hepatitis B etc
- Can tell you how much virus is present – viral load tests for hepatitis and HIV



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Serology



- Some microorganisms do not grow in culture or they are slow-growing – e.g., viruses
- Antigens are expressed on the surface of microorganisms – like a birthmark or a name badge
- Specific antibodies are produced by immune system in response to antigens 'memory'
- Serology = Detection of specific antibody or antigen in the blood – indicates current infection (antigen) or past exposure (antibody) to a pathogen OR vaccination – rubella, varicella, hepatitis B



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How do bacteria cause infection?

- Stick to or enter human cells
- Destroy tissue
- Produce toxins:
 - Streptococcal toxic shock syndrome
 - *C. difficile* toxin
 - Botulinum toxin





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How do bacterial infections declare themselves?

Non-specific symptoms

- High temperature or low temperature
- Generally unwell
- Confusion
- High WCC

Symptoms localised to site of infection



- Dysuria – pain on urination
- Diarrhoea – loose stools out of the normal character for the resident
- Cough
- Redness or pus at a wound site



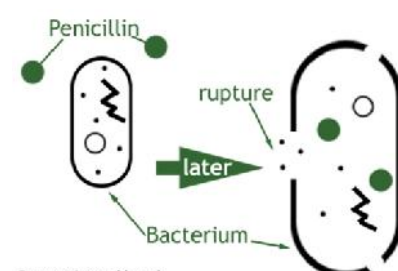
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How can harmful bacteria be destroyed?



- Sometimes the immune system can't control infection on it's own:
 - **ANTIMICROBIALS** are needed to help destroy bacteria and overcome infection



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How do antimicrobials work?

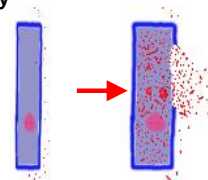



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Viruses

- Can only multiply within a living cell
- Turn host cell into 'virus factory'
- Host cell is then killed







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Common viral infections

- Norovirus - Gastroenteritis
- Hepatitis A & E virus
- Influenza - 'flu' virus
- Rhinovirus - common cold virus
- Herpes simplex - cold sore virus
- Varicella zoster - chicken pox and shingles virus
- Blood borne viruses: Hepatitis B, C, HIV

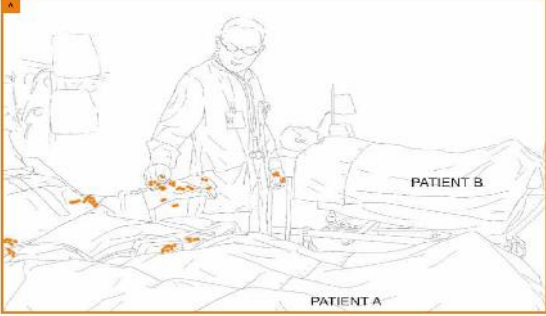


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How do microorganisms get around?

1. Contact/Touch
 - Direct - contact with people who are ill or colonised
 - Indirect - contact with contaminated equipment or environment
2. Inhalation of contaminated droplets or aerosols
3. Ingestion (food or water or contaminated droplets or aerosols)
4. Blood-borne
5. Vertical (via placenta): mother-to-child
6. Sexual transmission
7. Insects
8. Animals

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Full on the evidence base for the following: patient in case: 'asymptomatic'?



WHO Guidelines for Hand Hygiene in Healthcare 2009

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The chain of infection







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Influenza

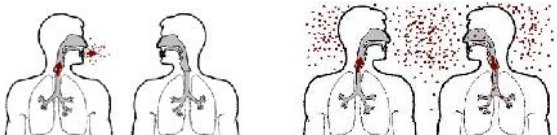
- People with 'flu' infection may cough and sneeze
- Produce large moist droplets which travel a short distance until gravity forces them to land on nearest surface
- Close contact – droplets may land on mouth, nose, eyes
- Touching contaminated surfaces causes contamination of hands – touching face/mouth/eyes introduces virus



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TB

- **Inhalation of aerosols - smaller particles that are suspended in the air and travel further**





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Norovirus gastroenteritis

- Infected person may have projectile vomit
- Contaminated droplets and aerosols travel in air and land on surfaces
- Touching contaminated surfaces causes contamination of hands – touching face/mouth introduces virus
- Or infection via ingestion of contaminated food or water






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Impetigo

- Direct skin-to-skin contact
- Staphylococcal skin infection






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Stop infection - break the chain



SAVE LIVES
Clean **Your** Hands

HAND HYGIENE:
THE SINGLE MOST IMPORTANT MEASURE TO PREVENT SPREAD OF INFECTION



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Thank you for your attention

Take your opportunity for the WHO

Your 5 Moments for Hand Hygiene