COMMONWEALTH OF AUSTRALIA

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Infection prevention and control including sterilisation and disinfection

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Outline

• Transmission of micro-organisms
• Prevention of transmission of micro-organisms
• Standard and additional precautions
• Hand hygiene
• Sterilisation and disinfection
• Cleaning
• Aseptic technique
Why are HAIs important?

• Approximately 200,000 HAIs in Australia each year
  – 2 million bed days
  – Increased length of stay by 2.5x

• HAI cause
  – 37 000 attributable deaths in Europe
  – 99 000 deaths in USA

• Costs
  – €7 billion in Europe
  – US$ 6.5 billion in the USA
Healthcare associated infection

• Traditionally occurring >48 after hospital admission (“hospital acquired”, “nosocomial”)
• But patients in the community receive healthcare
  • Dialysis, long term central venous catheters, chemotherapy, long term care facilities, day care, early discharge
• Multiresistant organisms occurring in community in patients with no risk factors
  – Community acquired MRSA, multi-resistant Gram negatives
• Many are preventable
Prevention of healthcare associated infections

• Prevent development of antibiotic resistance
  – Prudent antimicrobial use, antimicrobial stewardship

• Prevention of transmission
  – Isolation precautions
  – Hand hygiene
  – Decolonisation
  – Sterilisation and disinfection
  – Environmental cleaning

• Prevention of infection in individual patient
  – Aseptic technique
  – Decolonisation
  – Bundles of care
  – Antibiotic prophylaxis
  – Vaccination of staff and patients
Transmission of (nosocomial) pathogens

Requirements
- Source
- Mode of transmission
- Susceptible host
Source

• Animate
  – Healthcare worker
  – Patient
  – Visitor

• Inanimate
  – Fomite
  – Environment
Mode of transmission

• Contact transmission
  – Direct – person-to-person
    • Eg scabies, herpes simplex
  – Indirect – via contaminated intermediate object (fomite or environment) or person (healthcare worker)
    • Bacteria eg MRSA, VRE, CPE
    • Viruses eg influenza, norovirus
Modes of transmission

• Droplet
  – >5 μm
  – Generated by coughing, sneezing
  – Drop to ground by about 1m

• Eg
  – influenza
  – pertussis
  – MERS-CoV/SARS
  – Neisseria meningitidis
  – rhinovirus
Modes of transmission

• Airborne
  – <5 μm
  – Stay suspended in the air
  – Dispersed widely by air currents
  – May be inhaled by susceptible hosts over long distances

• Eg
  – TB
  – Measles
  – Varicella
  – ?influenza/SARS/MERS-CoV
Isolation precautions

• Standard precautions

• Transmission based precautions
  – Contact precautions
  – Droplet precautions
  – Airborne precautions

• May use more than one at a time

• Choose according to:
  – organism eg VRE
  – syndrome eg diarrhoea
Standard precautions

• Used for all patients at all times, regardless of patient diagnosis or presumed infectious status

• Protect healthcare workers and patients from contact with infectious agents in recognised and unrecognised sources of infection

• Apply to
  – Blood
  – All body fluids, secretions and excretions except sweat, regardless of whether visible blood is present
  – Non-intact skin
  – Mucous membranes

• Use of gloves, eye protection +/-gowns, masks
Contact precautions

• Reduce risk of transmission of microorganisms via direct or indirect contact with patient or environment
• Use gowns and gloves for all patient contact
• Single room
• Use for patients with e.g.
  – Diarrhoea
  – Excessive wound drainage
  – Multidrug resistant organisms
  – Respiratory viruses
Droplet precautions

• Reduce risk of droplet transmission of infectious agents from close respiratory or mucous membrane contact
• Use surgical masks
• Single room
• Use for patients with e.g.
  – Pertussis
  – Meningococcus
  – Respiratory viruses
Airborne precautions

• Use negative pressure ventilation, N95 mask
• Single room with door closed
• Use for
  – TB
  – Chicken pox
  – Measles
  – ?Pandemic influenza
  – ?MERS-CoV/SARS
  – ?Ebola
Hand hygiene

• Refers to
  – Hand washing
    • plain soap
    • antimicrobial soap
  – Waterless, alcohol based product (gel, foam, rub)

• Hand washing
  – Effective
  – Time consuming
  – Inconvenient
  – May be drying on skin
Alcohol based products

• Convenient
• Very effective
• Act rapidly
• Better for skin condition
• Use in all situations
  – Except if hands visibly soiled
  – Patient has norovirus (or *Clostridium difficile*)
WHO 5 Moments in Hand Hygiene

REMEMBER
• Before and after touching a patient
• Before a procedure
• After a procedure or body fluid exposure risk
• After touching the patient’s surroundings even if you don’t touch the patient
How to handrub?

RUB HANDS FOR HAND HYGIENE! WASH HANDS ONLY WHEN VISIBLY SOILED!

Duration of the entire procedure: 20-30 sec.

1. Apply a palmful of the product in a cupped hand, covering all surfaces.
2. Rub hands palm to palm,
3. Right palm over left dorsum with interlaced fingers and vice versa,
4. Palm to palm with fingers interlaced, 
5. Backs of fingers to opposing palms with fingers interlocked,
6. Rotational rubbing of left thumb clasped in right palm and vice versa,
7. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa,
8. Once dry, your hands are safe.

- Must cover all surfaces of the hands
- Rubbing should take 20-30 seconds
- Hands should be dry
- If washing, should lather for 20 seconds
  - Sing “Happy Birthday”
Using gloves

• Use only as part of standard or contact precautions
• Need to disinfect (or wash) before putting on (make sure hands are dry) and after taking off
• Need to change between patients and when you would disinfect hands eg if about to do a procedure in a patient in contact precautions
• *Never* wash or disinfect gloves
• Using gloves *does not* substitute for hand hygiene — Still need to follow WHO 5 Moments
Sterilisation and disinfection

- Each year in the US: ~46,500,000 surgical procedures, including >5 million GI endoscopies
  - Involves contact by a medical device or surgical instrument with a patient’s sterile tissue or mucous membranes
  - Major risk of introduction of infection
  - Failure to properly disinfect or sterilise equipment risks person-to-person transmission (e.g., hepatitis B virus) and transmission of environmental pathogens (e.g., Pseudomonas aeruginosa)
  - Failure to comply with guidelines has led to numerous outbreaks of infectious organisms
Sterilisation and disinfection

• Sterilisation:
  – The process of killing or removing all viable organisms, including viruses, bacteria, fungi and spores

• Disinfection:
  – The process that eliminates many or all-pathogenic microorganisms on inanimate objects with the exception of bacterial spores

• Cleaning:
  – The removal of visible soil (e.g., organic and inorganic material) from objects and surfaces
    • Essential prior to sterilisation and disinfection
Spaulding classification

• How an object will be disinfected depends on its intended use

  – CRITICAL
    • objects which enter normally sterile tissue should be sterile

  – SEMICRITICAL
    • objects that touch mucous membranes or skin that is not intact require a disinfection process (high-level disinfection) that kills all microorganisms except for high numbers of bacterial spores

  – NONCRITICAL
    • objects that touch only intact skin require low-level disinfection
Processing “Critical” Patient Care Objects

• Classification: Enter normally sterile tissue
• Object: Sterility
• Level germicidal action: Kill all microorganisms, including bacterial spores
• Examples: Surgical instruments and devices, cardiac catheters, implants
• Method:
  – Purchase sterile
  – Steam for most objects
  – For heat sensitive objects: gas, hydrogen peroxide plasma, vaporized hydrogen peroxide, ozone or chemical sterilisation
Processing “Semi-critical” Patient Care Objects

• Classification: Come in contact with mucous membranes or non-intact skin
• Object: Free of all microorganisms except high numbers of bacterial spores
• Level germicidal action: Kills all microorganisms except high numbers of bacterial spores
• Examples: Respiratory therapy and anaesthesia equipment, GI endoscopes, endocavitary probes
• Method: High-level disinfection using chemical disinfectants
  – Glutaraldehyde, hydrogen peroxide, ortho-phthalaldehyde, peracetic acid with hydrogen peroxide
Processing “Noncritical” Patient Care Objects

- Classification: Do not come in contact with mucous membranes or non-intact skin
- Object: Can be expected to be contaminated with some microorganisms
- Level germicidal action: Kill vegetative bacteria, fungi and lipid viruses
- Examples: Bedpans, crutches, bed rails, ECG leads, bedside tables, walls, floors and furniture
- Method: Low-level disinfection (or detergent for housekeeping surfaces)
  - Ethyl or isopropyl alcohol (70-90%), sodium hypochlorite (household bleach), phenolic germicidal detergent solution, iodophor germicidal detergent solution, quaternary ammonium germicidal detergent solution
Cleaning of reusable devices

- Cleaning is the removal of foreign material (e.g., soil and organic material) from objects using detergent solution.
- Cleaning to remove organic material **must always** precede high-level disinfection and sterilisation of critical and semi-critical instruments and devices.
  - Residual proteinaceous material reduces the effectiveness of the disinfection and sterilisation processes.
  - If an item cannot be cleaned, it cannot be disinfected or sterilised.
- Instruments should be cleaned as soon as practical after use (i.e., preferably at the point of use) before soiled materials become dried onto the instruments.
  - Dried or baked materials on the instrument make the removal process more difficult and the disinfection or sterilisation process less effective or ineffective.
Sterilisation and disinfection

• Single use medical devices should not be reused
• Make sure items are adequately cleaned before sterilisation and disinfection
  – Organic debris can inhibit adequate S&D
• Only sterilising services that meet the minimum requirements are able to undertake sterilisation
• Make sure item is appropriately processed prior to use
• Know what is required for equipment that you use
Environmental Cleaning

• Previously, environment not thought to be important in transmission of micro-organisms
  – Cleaning was not a priority

• Recent evidence shows that:
  – Surfaces can be heavily contaminated with organisms
  – The environment may facilitate transmission of important health care-associated pathogens, including VRE, *Clostridium difficile*, MRSA, multi-resistant Gram negatives and norovirus
    • Improved cleaning associated with reduced transmission
  – Risk of acquiring these organisms is increased if a new admission is placed in a room previously occupied by a patient known to be colonised or infected with one of these pathogens
Survival of organisms in the environment

### TABLE 1 Survival times and infectious doses retrieved or extrapolated from published studies

<table>
<thead>
<tr>
<th>Organism</th>
<th>Survival time</th>
<th>Infectious dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
<td>7 days--&gt;7 mo</td>
<td>4 CFU</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>3 days--&gt;5 mo</td>
<td>250 CFU</td>
</tr>
<tr>
<td>Clostridium difficile</td>
<td>&gt;5 mo</td>
<td>5 spores</td>
</tr>
<tr>
<td>Vancomycin-resistant <em>Enterococcus</em></td>
<td>5 days--&gt;4 mo</td>
<td>&lt;10³ CFU</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>2 h–16 mo</td>
<td>10²–10⁵ CFU</td>
</tr>
<tr>
<td><em>Klebsiella</em></td>
<td>2 h–&gt;30 mo</td>
<td>10² CFU</td>
</tr>
<tr>
<td>Norovirus</td>
<td>8 h–7 days</td>
<td>&lt;20 virions</td>
</tr>
</tbody>
</table>

*Survival times and infectious doses of a range of pathogens according to, or extrapolated from, original studies, some of which involved animal-based research.*

Cleaning

• Visual assessment of “cleanliness” does not correlate with microbiological contamination
• High touch areas important
• Move away from concentration on floors and walls to daily cleaning of high touch areas
• Need to clean shared equipment that has touched patients (eg stethoscopes) after use
Aseptic technique and ANTT

• Aseptic technique
  – Protects patients during invasive clinical procedures by employing infection control measures that minimise, as far as practicably possible, the presence of pathogenic microorganisms
  – Aims for asepsis

• Aseptic non-touch technique (ANTT)
  – Framework for aseptic practice ie how to “do” asepsis in a standardised way
Definitions

• Sterile
  – *Free from micro-organisms*
    • Due to the natural multitude of organisms in the atmosphere it is not possible to achieve a sterile technique in a typical healthcare setting

• Asepsis
  – *Free from infection or infectious material*
    • *Aseptic technique* aims to prevent pathogenic organisms, in sufficient quantity to cause infection, from being introduced to susceptible sites by hands, surfaces and equipment
    • Unlike sterile techniques, aseptic techniques are possible and can be achieved in typical hospital and community settings

• Clean
  – *Free from dirt, marks or stains*
ANTT

- A technique used to prevent contamination of equipment (e.g., needles, surgical wounds) and skin breaches (e.g., surgical wound, IV insertion site) by microorganisms that could cause infection.

Key parts

Key sites
ANTT procedure

1. Assess the difficulty in maintaining asepsis of your procedural equipment depending on the complexity of the procedure e.g. cannulation vs CVAD insertion

2. Environment management e.g. work surfaces disinfected prior to use

3. HH and appropriate PPE used along with procedure site decontamination eg appropriate skin prep

4. Aseptic field is appropriate for procedure

5. Non-touch technique used to avoid contamination where possible

6. Appropriate decontamination of equipment and proceduralist ie cleaning procedure trolley and HH
ANTT

• Asepsis is ensured by identifying and then protecting key parts and key sites by:
  – Hand hygiene
  – Gloves
    • Sterile if touching key parts or key sites
    • Non-sterile otherwise
  – Appropriate PPE
    • Standard precautions at all times (inc. eye protection)
  – Non-touch technique
  – Using new sterilised equipment and/or cleaning existing key parts to a standard that renders them aseptic prior to use
Insertion of therapeutic devices

• Include catheters inserted for
  – Drainage (eg urinary catheter)
  – For intravascular access (eg central and peripheral venous lines)
  – For mechanical ventilation (eg intubation)

• Indwelling devices
  – Provide a route for infectious agents to enter the body
  – Aseptic insertion and careful maintenance of devices is critical to reducing infection risk

• Therapeutic medical devices
  – A common source of HAIs in intensive care units
  – Pneumonia, urinary tract infections and bloodstream infection account for around 70% of intensive care unit HAIs
    • most of these associated with invasive devices
Therapeutic devices – minimise infection risk

• Consider the infection risk
• Ensure device is absolutely necessary
• Ensure you are adequately trained and competent in the skills required for safe insertion and maintenance of the device
• Use standard precautions at all times including appropriate personal protective equipment
• Use aseptic non-touch technique appropriately
• Choose the most appropriate device for the patient
• Minimise the period of time a device remains in a patient
• Regularly monitor patients for any signs and symptoms of infection
• Provide patient education on the infection risk associated with the insertion of devices and the importance of proper maintenance
Skin preparation for invasive procedures

• Thorough cleaning of the skin prior to invasive procedures can reduce the incidence of healthcare associated infection

• Choice of agent depends on the type of procedure and patient factors

• Skin disinfection will remove transient bacteria and reduce resident bacteria through a combination of mechanical friction and chemical killing
Types of skin preps

- **Chlorhexidine gluconate**
  - Kills a range of Gram positive and Gram negative bacteria, viruses and fungi, and binds to the top layer of the skin, which results in persistent activity
  - Not inactivated in the presence of organic material

- **Povidone iodine**
  - Kills a range of Gram positive and Gram negative bacteria, viruses and fungi
  - Kills bacteria quickly but does not have a residual effect
  - Inactivated by organic material so should be applied only to clean skin

- **Alcohol**
  - Kills a range of Gram positive and Gram negative bacteria and many viruses and fungi
  - Kills more quickly than chlorhexidine gluconate and povidone iodine
  - Has little residual effect
Skin prep – what to use

• Skin preps for surgery/insertion of IV lines usually a combination of alcohol and chlorhexidine or alcohol and iodine

• For patients with a history of chlorhexidine sensitivity, use 5% alcohol-based povidone-iodine solution

• Do not use chlorhexidine around mucous membranes, eyes, ears, traumatic wounds
Summary

• Prevent your patients from acquiring infections by:
  – Use hand hygiene & standard precautions at all times
  – Use additional precautions when indicated
  – Use appropriate aseptic technique
  – Know about cleaning, sterilisation and disinfection of equipment that you are using
  – Make sure you are competent to insert and manage devices that you are using
  – Avoid use of unnecessary indwelling devices
  – Remove devices when no longer necessary
  – Ensure shared equipment is cleaned appropriately

• Infection control is everybody’s business