

## Current Practice

# Health care associated infection (HCAI)

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Health care associated infection (HCAI), also known as nosocomial infection or hospital infection, is an infection occurring in a patient during the process of care in a hospital or other health care facility which was not present or incubating at the time of admission<sup>1</sup>. This includes infection acquired in the health care facility but appearing after discharge and also *occupational infections among health care workers of the facility*<sup>1</sup>.

### **HCAI can cause:**

- More serious illness
- Prolongation of hospital stay
- Long term disability
- Increased mortality
- High financial burden to the health care system.
- High personal cost to patients and their families.

Eight to twelve percent of patients in acute care hospitals in developed countries acquire some form of infection from the hospital<sup>2</sup>. The risk is higher in critical care, estimated to be about 30%, and the mortality may reach 44%<sup>3</sup>. Less data is available from developing countries but it is thought that the risk is 2-20 times higher, and that the proportion of affected patients can exceed 25%<sup>3</sup>. It is a serious problem prevailing in every health facility irrespective of the country, level of facilities or system. In the USA it is among the 10 top leading causes of death and the economic impact in year 2004 was 6.5 billion US dollars<sup>2</sup>.

### **Clean care is safe care<sup>4</sup>**

The first global patient safety challenge “Clean Care is Safer Care” was launched by the World Health Organisation (WHO) in 2005 to tackle HCAI.

### **There are 5 components:**

1. Clean practices: surgical / emergency / routine
2. Clear products: blood and blood products, intravenous fluids etc.

3. Clean environment: water, sanitation, waste
4. Clean equipment
5. Clean hands.

### **HCAI and the paediatrician**

HCAI is a major challenge to all sections of the health field, but particularly to the paediatricians, due to a number of reasons:

- Immature / developing immune system in children
- Poor cutaneous barriers
- More handling / therapeutic interventions
- Less signs and symptoms
- Over cautious treatment with antibiotics thus increasing the tendency to develop resistance
- Ideal environment for bacteria to grow e.g. umbilical cord in newborns

### **Burden of infections in maternal and newborn fields according to WHO are:<sup>5</sup>**

- Over half a million avoidable maternal deaths occur per year from complications related to pregnancy and child birth.
- 20 times more suffer injury, diseases or infection.
- 15% of maternal deaths are from infections.
- 4 million babies die within the first 28 days of their life due to various causes.
- 26% of them die due to infections.

### **Most frequent sites of HCAI & their risk factors<sup>3</sup>**

1. Urinary tract infections (UTI): 34%.
  - Urinary catheters
  - Urinary invasive procedures
2. Surgical site infections: 17%.
  - Incorrect skin preparation
  - Inadequate antibiotic prophylaxis
  - Inappropriate wound care
3. Lower respiratory tract infections: 13%.
  - Mechanical ventilation
  - Aspiration
  - Nasogastric tubes

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4. Blood infections: 14%.

- Vascular catheter
- Critical care
- Neonates

**How can we minimize HCAI?**

- Standard precautions
- Clinical guidelines for units
- Skin to skin (STS) contact
- Initiate breast feeding within first hour after delivery
- Feeding colostrum in delivery rooms and special care baby unit (SCBU)
- Follow routine procedures for cleaning
- Antibiotic policy accepted and practised by all units in the hospital
- Adequate staffing and spacing especially in high dependency units (HDUs), intensive care units (ICUs), & SCBU
- Audits, surveillance and feedback especially on hand hygiene and clinical guidelines in the units.

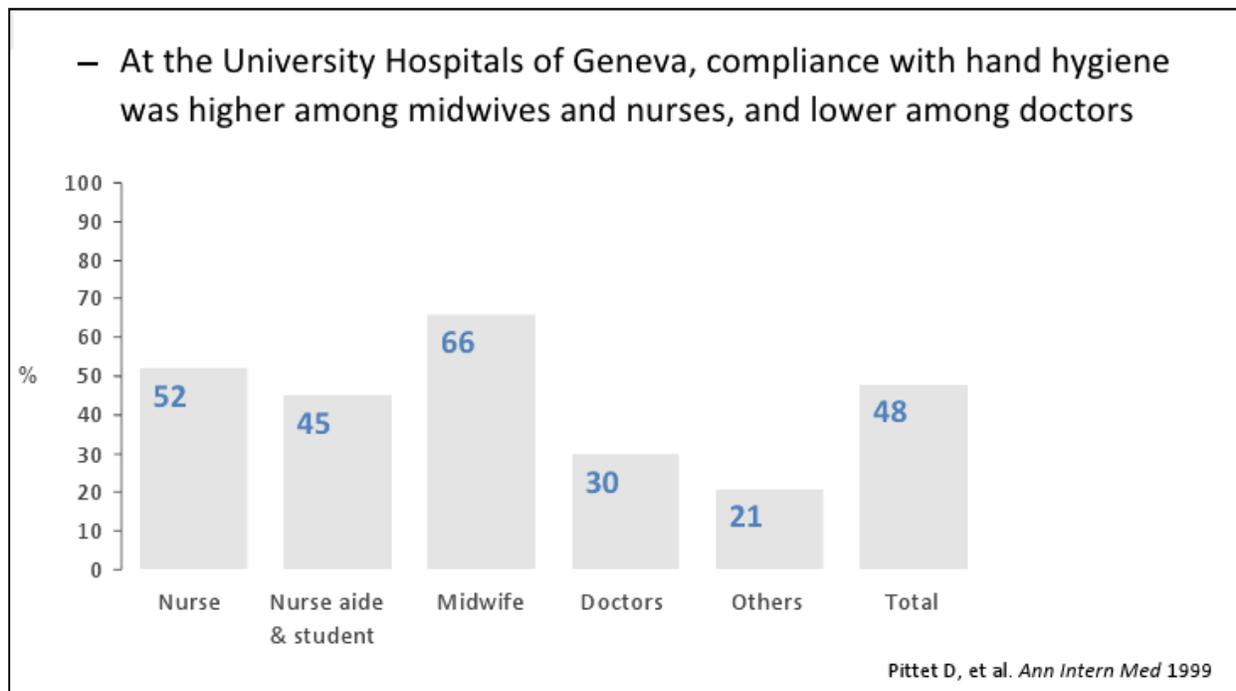
**Standard precautions**

By definition, standard precautions are a series of procedures and guidelines which are followed / practised in health care setting to prevent HCAI<sup>6</sup>.

This includes:

- Hand washing (hygiene) (Figure 1)
- Wearing gowns, gloves, goggles
- Protection from blood and other body fluids
- Safe sharp disposal
- Safe waste disposal
- Dealing with contaminated laundry
- Sterilizing and cleaning of contaminated equipment
- Cleaning, disinfecting and sterilizing gloves
- Environmental cleaning.

Hands are the most common vehicle to transmit HCAI. At least 50% HCAI are preventable using simple, non resource demanding measures which can be implemented in developed, transitional and developing countries<sup>3</sup>.



**Figure 1 - Compliance with Hand Washing among Healthcare staff**

Simple evidence has shown that hand hygiene in the single most effective measure to reduce HCAI<sup>1</sup>.

**Hand hygiene can be performed in 2 ways:**

1. Wash with soap and water (Figure 2)
2. Use of alcohol hand rub (Figure 3)



Figure 2: Wash with soap and water

Time constraint is thought to be a major obstacle for hand hygiene. However, adequate hand hygiene with soap and water needs only **40-60 seconds** but average

time usually adopted by health care workers in **<10 seconds<sup>3</sup>**.

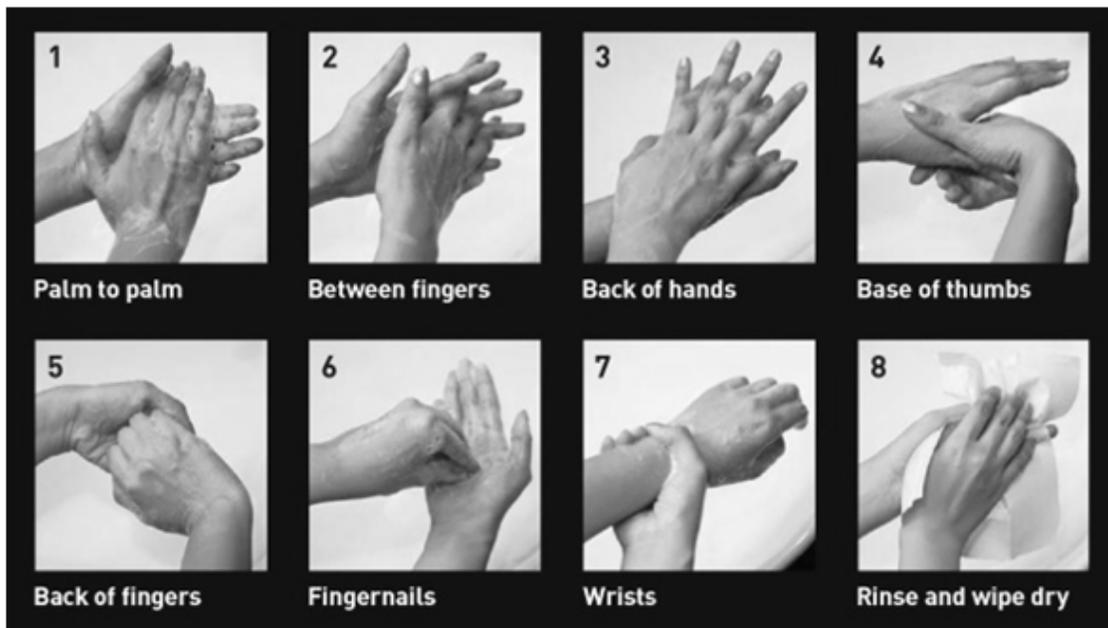


Figure 3: Use of alcohol hand rub

Hand hygiene with alcohol hand rub requires 20-30 seconds<sup>3</sup>.

**Ways of transmission of organisms by hands<sup>7</sup>**

5 steps have been described in the process of transmission of organisms by hands:

**1. Hand transmission: Step I (Figure 4)**

Organisms like staphylococcus aureus, proteus mirabilis, klebsiella species and acinetobacter species (100-1,000,000 colony forming units (CFU) /cm<sup>2</sup>) are present on intact areas of some patients<sup>7</sup>. Rarely, one million skin squames containing viable germs are shed daily from the normal skin and patients' immediate surroundings become contaminated by these organisms (especially staphylococcus aureus and enterococci)<sup>7</sup>.



**Figure 4: Hand transmission Step I**

**2. Hand Transmission: Step II (Figure 5)**

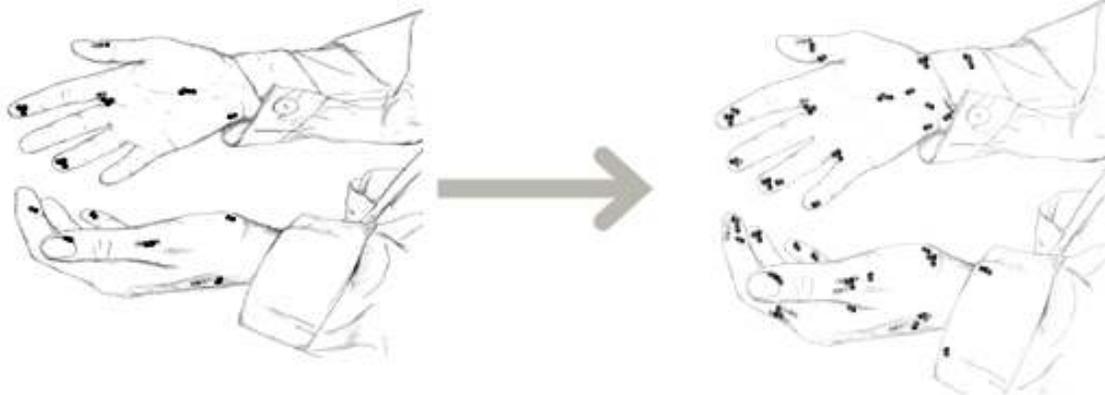
By direct and indirect contact patient's germs contaminate the health care workers' hands. Nurses could contaminate their hands with 100-1000 CFU of species during 'clean activities' (checking pulse, blood pressure (BP), turning and lifting patients). Fifteen percent of nurses working in an isolation unit carried a median of 10,000 CFU of staphylococcus aureus in their hands<sup>7</sup>. In a general health care facility 29% of nurses carried staphylococcus aureus on their hands (median 3800 CFU) and 17-30% carried gram negative bacilli (median 3400 – 38000 CFU)<sup>7</sup>.



**Figure 5: Hand transmission Step II**

**3. Hand transmission: Step III (Figure 6)**

Organisms survive on health care workers' hands for differing lengths of time (2-60min)<sup>3</sup>. In the absence of hand hygiene action, the longer the duration of care, the higher the degree of contamination and more and more colonies of organisms will be formed.

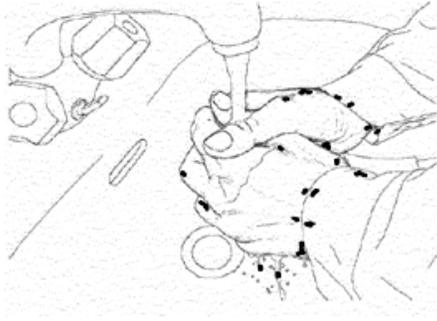


**Figure 6: Hand transmission Step III**

**4. Hand transmission: Step IV (Figure 7)**

Insufficient duration of hand hygiene / incorrect method / insufficient amount of product will lead

to poor hand decontamination and transient microorganism will remains on the hands.



**Figure 7: Hand transmission Step IV**

5. *Hand transmission: Step V* (Figure 8)  
Manipulation of invasive devices with contaminated hands leads to transmission of patients' germs to sites at risk of infection e.g. long lines, umbilical catheters.



**Figure 8: Hand transmission Step V**

Therefore particular attention must be paid for *Hand Hygiene* which can be done in two ways as described earlier.

Washing the hands with *soap and water* must be performed in the following instances:

- When hands are visibly dirty / soiled with body fluids or when you feel your hands are dirty.
- After going to the toilet / before entering the unit.
- If there is exposure to potential spore forming pathogens e.g. *clostridium difficile* outbreaks

*Alcohol Hand Rub* can be used in other instances to clean the hands.

WHO has recommended *alcohol based hand rub* due to the following factors<sup>8</sup>:

- Evidence based, fast acting and broad spectrum
- Better compliance
- Economic benefits
- Minimal side effects

### **Zonal distribution in a healthcare setting**

Focusing on a single patient, the health care setting is divided into 2 virtual geographical areas:

1. Patient care zone
2. Health care zone

*Patient care zone* includes a patient and his or her surroundings. This includes patient's skin, devices attached to patient, all inanimate surfaces around him or her which are touched by or in direct physical contact with the patient viz. bed, monitors, infusion tubes, knobs, buttons, bed linen etc

*Health care zone* includes all surfaces in the health care setting outside the patient care zone. It includes other patients and their health care zones and the environment of health care facility.

### **Hygiene at the point of care**

There should be 3 elements coming into play for a point of care in relation to a clinical setup:

1. Patient
2. Health care worker
3. Care / treatment

Concept is to perform hand hygiene at the moment when care is given. Hand hygiene products / facilities should be easily accessible and as close as possible for this to be successful. This can be achieved by keeping the hand rub in small pocket bottles, containers fixed to the patients bed, bedside cupboards / lockers, medicine trolleys, dressing trolleys, incubators or mounted on dispensers fixed to the wall.

Availability of alcohol hand rub at the point of care helps the health worker to fulfill the "*5 moments for hand hygiene*"<sup>1</sup>

### **My 5 moments of hand hygiene (Figure 9)**



Sax H, Allegranzi B, Uckay I, Larson E, Boyce J, Pittet D. J Hosp Infect 2007;67:9-21

**Figure 9: Five moments of hand hygiene**

The following **BEFORE** indications are to protect the patient from infections whereas **AFTER** indications are to protect the healthcare worker/healthcare environment and other patients.

1. **Before** touching a patient e.g. checking pulse, BP, adjusting oxygen mask, patting/stroking the head, helping a patient to sit up/turn, helping to clean/wash
2. **Before** clean/aseptic procedure e.g. brushing teeth, instilling eye drops, wound care, insertion of catheter, preparation of food, injections
3. **After** body fluid exposure risk e.g. after instilling eye drops, suction of secretions, drawing blood samples, manipulation of drains/catheters, cleaning urine/faeces/vomit, handling waste bandages/napkins/bed pans
4. **After** touching a patient e.g. stroking head/patting, helping patient to turn/sit up, checking pulse/ BP, examination of abdomen, taking ECG, applying oxygen mask
5. After touching the patient's surroundings e.g. changing bed linen with the patient out of bed, adjusting infusion lines, holding bed rail, cleaning bedside table

**Poor compliance with hand hygiene can be due to:**

- Lack of knowledge
- Lack of running water
- Lack of soap
- Lack of towels
- Lack of sinks

**Types of organisms which can spread due to poor hand hygiene<sup>9</sup>**

- Staphylococcus aureus (including MRSA)
- Streptococcus pyogenes (group A)
- Vancomycin resistant enterococcus
- Klebsiella species
- Escherichia coli
- Enterobacter species
- Pseudomonas
- Clostridium difficile
- Candida
- Rotavirus
- Adenovirus
- Hepatitis A
- Norovirus

Wounds, perineum are heavily loaded with microbes. Armpits, trunk and hands harbour huge numbers of

microbes. Intact skin has 100-1,000,000 microbes/cu mm<sup>7</sup>.

Note that the clostridium difficile spores are resistant to agents used in hand hygiene<sup>3</sup>

**Hand hygiene in clostridium out breaks include**

1. Hand washing with soap and water following correct steps
2. Additionally using Alcohol hand rub and allowing to dry
3. Usage of sterile gloves afterwards.

**Alcohol Hand Rub**

It is a preparation with alcohol, glycerin and hydrogen peroxide. If locally prepared, up to 50 litres can be prepared at a time but this can be increased depending on the demand. Shelf life is about 2 years and 80% ethanol V/V or 75% isopropyl alcohol V/V is used as the main component. Up to now there has not been any risk of developing resistance. It must be stored away from hot/fire places. Prepared alcohol hand rub can be stored in plastic or glass containers. If large volumes (50 L) are prepared, use plastic containers made up of polypropylene which is translucent enough to see the level. Stainless steel tanks are another option. Alcohol hand rub can be used again and again after initial hand washing. Glycerin is added to improve acceptability of the product and hydrogen peroxide to destroy the spores. If gloves are to be worn, hands must be dried after using alcohol hand rub. Containers/tanks must have levels marked outside. Hydrogen peroxide and glycerin are added with a measuring cylinder and rinsed with distilled water.

**There are 2 formulations recommended by the WHO to prepare hand rub<sup>1</sup>**

The first formulation contains:

- Ethanol 96% V/V: 833.3ml
- Hydrogen peroxide 3%: 41.7ml
- Glycerol 98%: 14.5ml

Pour into 1000 ml graduated flask, top up with distilled water / boiled cooled water, shake and mix. Final product has ethanol 80% V/V, glycerol 1.45% V/V and hydrogen peroxide 0.125% V/V.

The second formulation contains:

- Isopropyl alcohol (purity of 99.8%) 75% V/V: 751.5ml
- Hydrogen peroxide 3%: 41.7 ml
- Glycerol 98%: 14.5ml

Pour into 1000 ml graduated flask, top up with distilled water / boiled cooled water, shake and mix.

Final product has isopropyl alcohol 75% V/V, glycerol 1.45% V/V and hydrogen peroxide 0.125% V/V.

#### ***Recommendations on use of gloves***

- It does not replace / modify the indications for hand hygiene
- It does not replace hand washing
- Gloves are indicated when it is likely to come in contact with body fluids
- Remove gloves after caring for the patient before going to the next patient.
- Remove / change gloves when moving from a contaminated site to another site of the same patient.
- Rinsing of gloves after processing / decontamination is not recommended.
- Gloves on:
  - Before sterile procedures
  - If contact with body fluids is anticipated
  - If contact with non intact skin is anticipated
  - If contact with mucous membranes is anticipated
  - If contact precautions are indicated e.g. Hep B, HIV
- Gloves off:
  - If damaged
  - If any contact with body fluids
  - Contact with a patient/contaminated site has ended
  - When hand hygiene is indicated.

#### ***Following terminologies are used in Standard Precautions<sup>6</sup>***

***Detergents:*** These agents will remove oil and dirt, but will not remove micro-organisms e.g. general purpose detergents like soap.

***Antiseptics:*** These agents are used only in living tissues to remove micro-organisms e.g. 70% alcohol, Savlon, Dettol, Iodine and Hibiscrub.

***Decontamination:*** Process of removing or destroying micro-organisms to a certain extent.

***Disinfection:*** Process of destroying micro-organisms on inanimate objects. Spores would not be destroyed e.g. Hypochlorite, TCL, Cidex.

***Sterilization:*** Removing all microorganisms including virus, fungi, parasites and spores from inanimate objects and equipment.

#### **Pregnancy and HCAI**

##### ***Obstetric procedures which increase the risk of infection during pregnancy, labour and delivery:***

- Amniocentesis
- Artificial rupture of membranes
- Vaginal examination
- Episiotomy
- Routine shaving of perineum
- Urinary catheterization
- Application of fetal scalp electrode

##### ***Measures which can be taken in the Labour Room to reduce HCAI***

- Leave the baby on mothers' chest to provide good skin to skin contact. This has many advantages in addition to colonization of maternal flora.
- Encourage early breast feeding particularly feeding of colostrum.
- Correct disposal of contaminated items, blood spills.
- Do not keep newborn babies touching each other to avoid cross colonization.
- Keep the baby and mother together whenever possible.
- Follow instructions for routine cleaning of walls, floor, equipment, etc. "Labour Room Guidelines" is a useful book published by the Family Health Bureau on this issue. This book has been distributed to almost all the maternity units in the country.
- Have unit disciplines laid down for the staff to follow e.g. policy on episiotomy, number of vaginal examinations, prophylactic antibiotics etc.
- Instructions on exposure management and immunization. This can be done with the co-operation of hospital infection control unit e.g. Hepatitis B vaccine

#### **Clinical guidelines<sup>6,10</sup>**

##### ***Clinical guidelines in the units for various commonly performed procedures are important. Some examples for procedures are:***

- Skin preparation for routine urgent invasive procedures
- Prevention of infections related to IV/ long lines
- Urinary catheterization
- Tracheal suction
- Wound care
- Surgical drains

### ***Skin preparation for blood culture and lumbar puncture***

- Follow correct hand washing techniques and drying.
- Clean the skin with 70% alcohol followed by 10% povidone-iodine (If allergic to iodine use 2% chlorhexidine).
- Hand wash, dry with sterile towel, put on sterile gloves (Sterile gowns, mask drapers SOS).
- Perform the procedure.
- Dress the site.

### ***Skin preparation for venepuncture***

- Use 70% alcohol to clean the skin and let it dry.
- Other steps as above.

### ***How to manage spilled blood or body fluids***

- Use heavy duty gloves.
- Soak up with wadding / paper towels.
- Pour 1% hypochlorite till it is well soaked.
- Leave for 10 minutes.
- Remove and discard absorbent material as clinical waste.
- Clean area with General Purpose Detergent (GPD) & let it dry.
- Discard gloves and wash hands.

### ***Instructions on arterial catheters and central venous lines***

- Hand wash and clean with antiseptic (alcohol hand rub or 2% chlorhexidine) let it dry and put on sterile gloves.
- Cap, mask, sterile gown.
- Should be done in a designated area theatre / ICU.
- Clean the site with 70% alcohol followed by 10% povidone-iodine.
- After insertion, secure with a sterile dressing and record the date.
- Have minimal number of ports.
- Disinfect the port before and after injections.
- Before removal of line, clean the surroundings with 2% chlorhexidine or 10% povidone-iodine.
- If culture is planned, avoid the top of the catheter touching anywhere using a sterile scissor at a length of about 5cm and place in a sterile container and send to the microbiology laboratory.
- Send a peripheral sample of blood for culture.
- Cover the site with a sterile dressing and wash hands.

### ***Precautions about IV cannula / long lines once inserted***

- Cover with a sterile dressing after securing preferably with transparent plasters.
- Date of insertion recorded on BHT
- Inspect daily and re-site at first sign of inflammation
- If gauze is used for dressing, change gauze every 48-72 hours or earlier if damp or soiled.
- Remove long lines as soon as a peripheral line is secured unless there are special indications.
- Remove the peripheral lines as soon as medications are changed over to oral.
- Cover the puncture site with a sterile dressing.

### ***Steps of urinary catheterization***

- Clean the vulval area after separating labia / meatus with a normal saline swab.
- Wash hands and wear sterile gloves.
- Lubricate and insert the catheter gently.
- If unsuccessful, use a new catheter.
- Record the date of insertion in case of an indwelling catheter.
- Maintain a closed system.
- Perform daily meatal / perineal care with a normal saline swab
- Keep the urine bag at a lower level but never allow it to touch the floor.
- Foley's catheters (later) can be kept up to 28 days if necessary.

### ***Suction of trachea / throat***

- Do only if clinically indicated
- Wash hands, wear clean gloves
- Gown / splash proof mask if indicated.
- Sterile suction catheter, single use only
- Connect to suction machine while rest of the tube is inside the pack.
- Take out the rest of the catheter with gloved hand just before suction.
- Remove gloves and wash hands.

### ***Waste Disposal***

- Clinical waste, e.g. dead tissues, must be collected into a separate bag and buried or incinerated.
- Sharps – collect into sharp bins
- Send for incineration when the bin is 2/3<sup>rd</sup> full
- Contaminated equipment / linen with body fluids must be washed first with soap before sending for sterilization.

### ***Equipment and Medications***

- Stethoscopes – ICU's and neonatal units must have separate stethoscopes for individual patients. In general wards, clean if stethoscope comes in contact with infectious conditions. Use a 70% alcohol swabs for cleaning.
- Thermometer – clean with a 70% alcohol swab in between patients.
- Baby weighing scale – clean with general purpose detergents.
- N-G tubes and syringes used in feeding can be used up to 24 hours for individual baby.
- Burette sets – use up to 24 hours.
- Multi-dose antibiotics and other drugs – keep at the appropriate storing temperature according to manufactures.  
Close the cap / lid and keep. When re used, clean the lid with 70% alcohol swab before putting the needle in.
- Prepared IV fluids – discard after 24 hours.
- Nebulizer masks – change between patients. Change if contaminated or clean with GPD followed by 70% alcohol.

### **Environmental cleaning**

These are mainly for HDUs, ICUs, SCBU, delivery rooms etc.

#### ***Environment***

- Floors: Mop with GPD twice/day with 0.1% hypochlorite if there in an outbreak of infection.
- Separate mop for each cubicle and wash mop with 0.1% hypochlorite weekly.
- Walls: Damp dust with GPD weekly.
- Horizontal surfaces: Damp dust with GPD twice daily and in between patients.
- Sinks and taps: Wash with GPD twice daily
- Bathrooms: Damp dust twice daily with GPD (including door knobs and taps).

#### ***Furniture (Cots/beds/bedside cupboards)***

- Damp dust daily with GPD.
- Clean with GPD and 2% chlorhexidine. If baby is septic leave chlorhexidine for 2-3 minutes until dry and wash with water.

#### ***Mattresses***

- Cover with impermeable material.
- Wipe with GPD and dry in between patients.
- If baby is septic as above with GPD and 2% chlorhexidine.

Cleaning of equipment, instruments linen etc. must be done according to the guidelines of the unit.

Further instructions can be obtained from labour room guidelines.

### **Rational use of antibiotics**

#### ***Why is it important?***

- To have better outcome.
- Minimize antibiotic resistance.
- Minimize cost of drugs and patient care.
- To have less side effects.
- Importantly there are no new antibiotics coming up the pipeline in the near future.

#### ***General rules on use of antibiotics***

- Use only when indicated.
- Start with the spectrum and step up if necessary
- Use in adequate dose and duration
- Be aware about interactions and pharmacokinetics
- Send appropriate specimens before starting treatment
- Select the appropriate antibiotic for the condition
- Use the appropriate route
- Step down according to the antibiotic sensitivity tests
- Switch on to oral as soon as possible.
- Supportive care is important e.g. draining
- Minimize the duration of the antibiotic course
- Consider the cost
- If for prophylactic purposes, limit to a single dose if possible.

#### **Summary**

HCAI is a serious escalating problem in the medical field. At least 50% of it is preventable with simple measures. Awareness of the gravity of the problem, following simple measures and guidelines is a responsibility of all health personnel.

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