

INTRODUCTION: Thousands of people die every day from infections acquired in the healthcare setting. So we must do everything possible to prevent the spread of infections in the healthcare setting.

THE SIX LINKS OF INFECTION TRANSMISSION: For infection to spread, six factors are essential.

1. Infectious agent - Some infectious agents, such as *Streptococcus pyogenes*, are prime pathogens. Other agents, such as *Staphylococcus epidermidis*, are part of the normal flora that become pathogenic in special situations

2. Reservoir - A reservoir is a site where infectious agents live and multiply. Reservoirs may be living, such as the human body for *Staphylococcus aureus*. Reservoirs may be inanimate, such as a dilute solution of Dettol™ for *Pseudomonas aeruginosa*.

3. Portal of Exit - The portal is a way for the infectious agent to get out of the reservoir. Portals can be natural orifices such as the mouth, nose or urethra. Portals can be traumatic or artificial, such as bleeding lesions or IV lines

4. Mode of Transmission - This is the way the infectious agent travels from the portal of exit in the reservoir to the portal of entry in the susceptible host. It may be by direct or indirect contact. It may be through fresh respiratory droplets. It may be through dried up respiratory droplets called droplet nuclei. Or it can be through insects such as mosquitoes.

5. Portal of Entry - The portal of entry is the site in the susceptible host through which the infectious agent enters. These can be natural orifices such as the eyes, nose, mouth, or vagina. These can also be traumatic wounds such as cuts or scrapes, or iatrogenic wounds such as surgical wounds, or IV or drainage tube sites.

6. Susceptible host - The last link in the chain of infection is a host that is susceptible to infection.

All six links are essential in the chain of infection transmission. A chain is only as strong as its weakest link, so infection control is all about finding out the weakest link in the chain of infection transmission and breaking it. Infections differ in their weakest link and the preferred means of stopping their transmission varies accordingly. Some infections have more than one weak link in their chain of transmission.

To take an example, in case of Hepatitis B,

1. The **infectious agent**, Hepatitis B virus,
2. A **reservoir**, such as a chronic carrier,
3. A **portal of exit**, such as a bleeding wound,
4. **Mode of transmission**, such as direct contact with an infected person's blood, and
5. A **portal of entry**, such as the conjunctiva of the exposed host,
6. A **susceptible host**, i.e., a person who is not immune to Hepatitis B

The best way to prevent the transmission of Hepatitis B infection is to vaccinate people so that they become immune. One can also block the portal of entry by using personal protective equipment such as gloves, gowns, and eye protection.

To take another example, in case of Malaria,

1. The **infectious agent**, the malaria parasite
2. A **reservoir**, such as an infected person
3. A **portal of exit**, such as a mosquito bite,
4. **Mode of transmission**, such as a mosquito,
5. A **portal of entry**, such as the skin of a susceptible person, and
6. A **susceptible host**, such as another human being

the easiest way to stop the spread of infection in the hospital is to block the mode of transmission by keeping the patient inside a mosquito net.

To take yet another example, in case of *Pseudomonas aeruginosa* spreading in a surgical ward,

1. The **infectious agent**, *Pseudomonas aeruginosa*
2. A **reservoir**, a bottle of dilute Dettol solution in which the bacteria multiply
3. A **portal of exit**, a pair of Cheates forceps dipped in the Dettol solution,
4. **Mode of transmission**, a gauze dressing picked up with contaminated Cheates forceps,
5. A **portal of entry**, a surgical wound, and
6. A **susceptible host**, a patient

the easiest way to stop the spread of infection in the hospital is to eliminate the reservoir by throwing away the Dettol solution and storing Cheates forceps in an autoclaved and dry tray or bottle.

STANDARD PRECAUTIONS - INFECTION CONTROL MEASURES FOR ALL PATIENTS

Hand hygiene

Hand washing



- 1) Before touching the patient or patient environment, even if gloves will be worn
 - 2) Before performing an aseptic procedure
 - 3) After potential contact with blood / body fluids, even if gloves were worn
 - 4) After contact with the patient
 - 5) After contact with the patient's environment
- Wash hands if visibly dirty or contaminated with blood or other body fluids

Hand rub



Same indications as above, if the hands look clean and haven't touched body fluids

If your hands look dirty, wash with soap & water.

If your hands look clean, use EZ-Clean.

STANDARD PRECAUTIONS - INFECTION CONTROL MEASURES FOR ALL PATIENTS

Personal Protective Equipment

Gloves		For touching blood, body fluids, secretions, excretions, and contaminated items; For touching mucous membranes and non-intact skin
Gown		During procedures and patient-care activities when contact of clothing or exposed skin with blood or body fluids, secretions, and excretions is anticipated.
Surgical mask		For protecting the mucous membranes of the nose and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, and secretions, especially suctioning and endotracheal intubation
Eye protection		For protecting the eyes during activities that are likely to generate splashes or sprays of blood, body fluids, and secretions
Face shield		For protecting the mucous membranes of the eyes, nose and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, and secretions

STANDARD PRECAUTIONS - INFECTION CONTROL MEASURES FOR ALL PATIENTS

Careful handling of patient-care equipment after use



Handle in a manner that prevents transfer of microorganisms to others and to the environment

Wear gloves

Do hand hygiene after removing gloves

Environmental cleaning



Clean and disinfect environmental surfaces, especially frequently touched surfaces in patient-care areas.

Textiles and laundry



Handle textiles in a manner that prevents the transfer of microorganisms to others and to the environment

Needles and other sharps



Do not recap, bend, break, or hand-manipulate used needles;

If recapping is required, use a one-handed scoop technique only;

Use safety features when available;

Place used sharps in puncture-resistant container

Patient resuscitation



Use mouthpiece, resuscitation bag, or other ventilation devices to prevent contact with mouth and oral secretions

STANDARD PRECAUTIONS - INFECTION CONTROL MEASURES FOR ALL PATIENTS

<p>Patient placement</p>		<p>Prioritize for single-patient room if, Patient is more likely to transmit infection, Is likely to contaminate the environment, Does not maintain appropriate hygiene, or Is at increased risk of acquiring infection or developing adverse outcome following infection</p>
<p>Respiratory hygiene or cough etiquette for source containment of infectious respiratory secretions, beginning at the initial point of encounter with the patient, such as ER or the OPD clinic</p>		<p>Instruct symptomatic persons to cover mouth / nose with tissues when sneezing/coughing</p>
		<p>Dispose tissues in no-touch receptacle</p>
		<p>Observe hand hygiene after soiling of hands with respiratory secretions</p>
		<p>Wear surgical mask if tolerated</p>
		<p>Maintain spatial separation of >3 feet if possible</p>

EXPANDED PRECAUTIONS or TRANSMISSION-BASED PRECAUTIONS: These are additional infection control measures applied to certain infections depending on their mode of transmission. Some infections may be spread by more than one mode and more than one set of transmission-based precautions may be needed for these.

Contact Precautions: These are applied to infections that spread from person to person by direct contact or by indirect contact with the patient's environment. Examples of such infections are scabies or multi-drug resistant *Klebsiella*.

Caregivers should wear gloves and gowns while caring for patients.

Patients should ideally be kept in a separate room. If it is not possible, they may be kept in the same room with other patients but contact with others should be avoided.

Droplet Precautions: These are applied to infections that spread from person to person in droplets generated from the respiratory tract during coughing, sneezing and talking. The infectious agents do not survive after the respiratory droplet dries up, so they generally do not spread more than three feet from the patient. Examples are influenza or rhinovirus infection.

Caregivers should wear surgical masks after entering the patient's room

Patients should be kept in a separate room. The door may remain open if the patient wants.

Airborne Precautions: These are applied to infectious agents that can survive drying and can therefore spread in dried up respiratory droplets called droplet nuclei. Droplet nuclei can be carried for long distances in air currents. Examples include *Mycobacterium tuberculosis*, measles virus and Varicella Zoster virus.

Caregivers should wear respirators (N95 or higher grade) before entering the patient's room.

Patients must be kept in a separate room under negative-pressure ventilation.

Extra PPE may be required for special needs. For example, gloves should be worn if blood exposure is anticipated while caring for a tuberculosis patient.

SUMMARY OF EXPANDED PRECAUTIONS

	Contact	Droplet	Airborne
Mode of transmission	<p>Direct or indirect contact</p> 	<p>Particles larger than 5 μm</p> 	<p>Particles smaller than 5 μm</p> 
Room	Private room preferred	<p>Private room preferred.</p> <p>Door may remain open.</p> <p>If no private room, put beds more than three feet apart</p>	<p>Private room essential.</p> <p>Room should be under negative-pressure ventilation.</p> <p>Door must remain closed</p>
Equipment	<p>Disposable, single-use.</p> <p>Dedicate non-critical items to individual patients</p>	<p>Disposable, single-use.</p> <p>Dedicate non-critical items to individual patients</p>	<p>Disposable, single-use.</p> <p>Dedicate non-critical items to individual patients</p>
Hand hygiene	As for standard precautions	As for standard precautions	As for standard precautions
Gloves	<p>Wear gloves before entering room. Discard before leaving</p> 	As for standard precautions	As for standard precautions

SUMMARY OF EXPANDED PRECAUTIONS (continued)

	Contact	Droplet	Airborne
Gown	<p>Wear gown before entering room. Discard before leaving</p> 	<p>As for standard precautions</p>	<p>As for standard precautions</p>
Mask	<p>As for standard precautions</p>	<p>Surgical mask upon room entry</p> 	<p>N95 or higher grade respirator before room entry</p> 
Eye protection	<p>As for standard precautions</p>	<p>As for standard precautions</p>	<p>As for standard precautions</p>

HAND HYGIENE

Why hand hygiene?

Hands are the main pathway of germ transmission in the healthcare setting.

Hand hygiene is therefore the most important measure to avoid the transmission of harmful germs and prevent healthcare-associated infections.

Who does hand hygiene?

Any healthcare worker and any person involved in direct or indirect patient care needs to be concerned about hand hygiene and should be able to perform it correctly and at the right time.

When? The Five Moments of Hand Hygiene

- 1) Before touching the patient or patient environment, even if gloves will be worn
- 2) Before performing an aseptic procedure
- 3) After potential contact with blood / body fluids, even if gloves were worn
- 4) After contact with the patient
- 5) After contact with the patient's environment

Additional moments are, i) After removing gloves, ii) When moving from a more contaminated to a cleaner area of the patient's body, iii) After using the toilet,

Which type of hand hygiene is better?

Rub your hands with an alcohol-based formulation if the hands are not visibly soiled. It is faster, more effective, and better tolerated by your hands than washing with soap and water.

Wash your hands with soap and water when hands are visibly dirty, visibly soiled with blood or other body fluids, and after using the toilet.

If infection with spore-forming pathogens is suspected or proven, such as *Clostridium difficile* infection, hand washing with soap & water is the preferred means.

How to perform hand hygiene?

How to handrub? غسل

 Duration of the entire procedure: 20.

1a/1b

Apply a palmful of the product in a cupped hand and cover all surfaces.



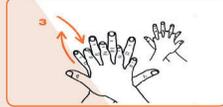
2

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

Back 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.



How to handwash? غسل

 Duration of the entire procedure

0,1

-Wet hands with water.
-Apply soap to cover all hand 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

Back 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

Rinse hands with water.



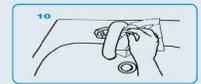
9

Dry thoroughly with a single use towel.



10

Use towel to turn off faucet.



11

And your hands are safe.



If hands look clean, do handrub If hands are soiled, wash with soap and water

Takes 20-30 seconds

Takes 40-60 seconds (twice as long as a handrub because you spend 20-30 seconds lathering up with soap, and another 20-30 seconds washing off the lather with water)

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Definition: Personal Protective Equipment is "specialized clothing or equipment worn by an employee for protection against infectious materials" (OSHA)

Types of PPE Used in Healthcare Settings:

- Gloves - protect hands
- Gowns/aprons - protect skin and/or clothing
- Masks and respirators- protect mouth/nose
- Goggles - protect eyes
- Face shields - protect face, mouth, nose, and eyes

Factors Influencing PPE Selection:

Type of exposure anticipated: For example, clean gloves are enough for performing venepuncture. However, for arterial puncture one should also use an impermeable apron and full face protection because of the risk of splashes or sprays of blood.

Category of isolation precautions:

For contact precautions, use gloves and gown.

For droplet precautions, use surgical mask. The Ministry of Health of the Kingdom of Saudi Arabia recommends N95 respirators for confirmed cases of H1N1 influenza.

For airborne precautions, use N95 respirator.

For all categories, extra PPE may be used depending on the type of exposure anticipated.

Durability and appropriateness for the task: For example, a cotton gown is normally enough for taking care of a patient under contact precautions. However if you anticipate exposure to large volumes of blood / body fluids, then a plastic apron will be more appropriate.

Fit: PPE must fit the individual user, and it is up to the employer to ensure that all PPE are available in sizes appropriate for the workforce that must be protected. For example, providing small (size 6) gloves to a six-foot tall physiotherapist is of no use.

PPE: Key Recommendations

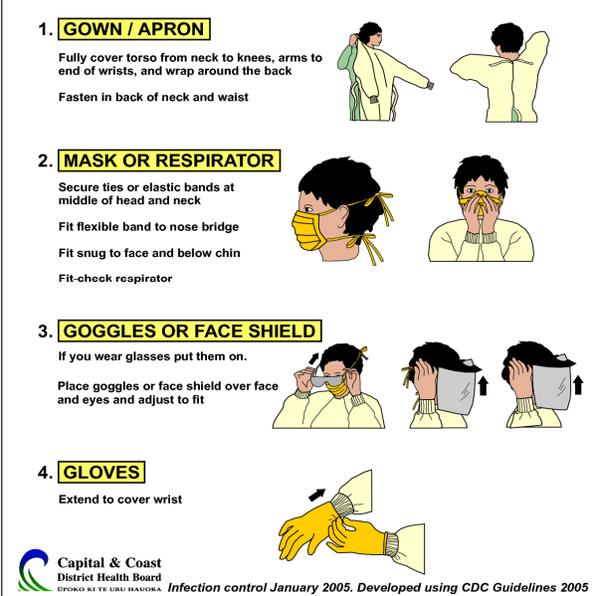
Remove and discard PPE before leaving the patient's room or area

Wear gloves for potential contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment. Do not wear the same pair of gloves for the care of more than one patient. Do not wash gloves for the purpose of reuse. Perform hand hygiene immediately after removing gloves

Wear a gown to protect skin and clothing during procedures or activities where contact with blood or body fluids is anticipated. Do not wear the same gown for the care of more than one patient.

Wear mouth, nose and eye protection during procedures that are likely to generate splashes or sprays of blood or other body fluids

Wear a surgical mask when placing a catheter or injecting material into the spinal canal or subdural space

CORRECT SEQUENCE FOR DONNING PERSONAL PROTECTIVE EQUIPMENT (PPE)	CORRECT SEQUENCE FOR REMOVING PERSONAL PROTECTIVE EQUIPMENT (PPE)
<p>The type of PPE used will vary based on the level of precautions required; e.g., Standard and Contact, Droplet or Airborne Infection Isolation.</p> <p>Remove hand jewellery and tie back hair.</p> <p>Clean and dry hands thoroughly.</p> <ol style="list-style-type: none">GOWN / APRON Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back Fasten in back of neck and waistMASK OR RESPIRATOR Secure ties or elastic bands at middle of head and neck Fit flexible band to nose bridge Fit snug to face and below chin Fit-check respiratorGOGGLES OR FACE SHIELD If you wear glasses put them on. Place goggles or face shield over face and eyes and adjust to fitGLOVES Extend to cover wrist  <p>Capital & Coast District Health Board EPOKŌ KI TE URU HEAOKA Infection control January 2005. Developed using CDC Guidelines 2005</p>	<ol style="list-style-type: none">GLOVES Outside of gloves are contaminated—DO NOT TOUCH! Grasp outside of glove with opposite gloved hand; peel off Hold removed glove in gloved hand Slide fingers of ungloved hand under remaining glove at wrist Peel glove off over first glove Discard gloves in waste container Clean and dry your hands thoroughlyGOGGLES OR FACE SHIELD Outside of goggles or face shield are contaminated—DO NOT TOUCH! To remove, handle by head band or ear pieces Place in designated receptacle for reprocessing or in waste container Clean and dry your hands thoroughlyGOWN / APRON Gown front and sleeves are contaminated—DO NOT TOUCH! Unfasten ties Pull away from neck and shoulders, touching inside of gown only Turn gown inside out Fold or roll into a bundle and discard Clean and dry your hands thoroughlyMASK OR RESPIRATOR Front of mask/respirator is contaminated—DO NOT TOUCH! Grasp bottom, then top ties or elastics and remove Discard in waste container Clean and dry your hands thoroughly 

If you need to put on only two or three items of PPE, for example only gloves and gown for contact precautions, follow the same sequence, i.e. wear the gown first, then the gloves. The same applies to taking PPE off.

INJECTION SAFETY: Injection safety includes practices intended to prevent transmission of infectious diseases between one patient and another, or between a patient and healthcare provider during preparation and administration of parenteral medications.

The most dangerous practices:

1. Use of a single syringe, with or without the same needle, to administer medication to multiple patients,
2. Reinsertion of a used syringe, with or without the same needle, into a medication vial or solution container (e.g., saline bag) to obtain additional medication and then using that vial or solution container for subsequent patients,
3. Preparation of medications in close proximity to contaminated supplies or equipment.

Key Recommendations:

1. Use aseptic technique when preparing and administering medications
2. Cleanse the access diaphragms of medication vials with 70% alcohol before inserting a device into the vial
3. Never administer medications from the same syringe to multiple patients, even if the needle is changed or the injection is administered through an intervening length of intravenous tubing
4. Do not reuse a syringe to enter a medication vial or solution
5. Do not administer medications from single-dose or single-use vials, ampoules, or bags or bottles of intravenous solution to more than one patient
6. Do not use fluid infusion or administration sets (e.g., intravenous tubing) for more than one patient
7. Dedicate multidose vials to a single patient whenever possible. If multidose vials will be used for more than one patient, they should be restricted to a centralized medication area and should not enter the immediate patient treatment area (e.g., operating room, patient room/cubicle)
8. Dispose of used syringes and needles at the point of use in a sharps container that is closable, puncture-resistant, and leak-proof.

WASTE DISPOSAL

Waste type	Example	Where to discard
<p>General waste Scrap paper, Paper/plastic wrappers & boxes Disposable cups & plates Soda cans, Empty bottles& caps, and Food waste.</p> <p>If the same items are contaminated with blood or other body fluids, they should be considered infectious waste</p>	 <p>WE040381 [RF] © www.visualphotos.com</p>	
<p>Infectious waste, non-sharp Empty IV fluid bottles, IV infusion tubing, Urinary catheter & collection bag Dressings contaminated with blood or body fluids, Used gloves and other PPE</p>		
<p>Sharp infectious waste Used needles and stylets, Surgical blades Broken glass</p> <p>Used syringe and needle go into the sharps bin as a unit. Do NOT try to re-cap needle or separate it from its syringe.</p>		

IMMUNIZATION:

Immunize all healthcare workers against Hepatitis B with three intramuscular doses (in the deltoid, not the glutei) of 1.0 mL (containing 10-20 mcg of HBsAg depending on the brand) on Day 0, 30 and 180.

Test levels of anti-HBs one month after the third dose of vaccine. Desired level of anti-HBs antibody is 10 mIU / mL or more.

Repeat the course of immunization for HCW who do not have protective levels of anti-HBs one month after the third dose.

HCW who do not develop protective levels of anti-HBs even after the second course of vaccination should be counseled to take up work in a area where they are not exposed to blood and other body fluids.