

**Infection Control Tool Kit on
Emerging Infectious Disease Outbreaks**

ACKNOWLEDGEMENTS

This tool kit was developed with the contributions of the team members of the Infectious Disease Centre @ Princess Margaret Hospital of Hong Kong on behalf of the Western Pacific Region of World Health Organisation.

The centre was built by the Hong Kong government under the Hospital Authority to provide infectious disease (ID) service for the community and to address ID surge capacity after SARS outbreak in 2003. One third of the SARS patients in HK were treated at Princess Margaret Hospital and left the team with valuable experience in the management of infectious diseases. The HAIDC is built for the management of major outbreaks of both emerging and re-emerging infectious diseases and to ensure that the public and staff will be offered the best possible protection.

The comprehensive chapters on epidemiological and infection control principles were developed by the authors of the Course Book (Basic Module) of the Hospital Authority Infectious Disease Simulation Training Center (Version 1.1, 2009) :

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Introduction

There is no arguing that Infection Control has an integral role in the provision of a safe health care environment for both patients and health care workers, in particular when there is outbreak of lethal emerging or re-emerging infectious diseases. Lack of adherence to safe practice or inadvertent exposure to pathogens, including bacteria and viruses, in the health care environment can lead to significant morbidity and mortality in patients and health care workers alike.

Objectives

This infection control tool kit is designed for use in low-resource countries and in particular health facility level with emphasis on the preparedness and “know how” skills in handling emerging and re-emerging infectious disease outbreaks. It aims to provide tools for application as practice guide and monitoring framework which are user friendly, practical and evidence-based.

Use of the toolkit

The tool kit is developed in 2 sections :

Section A - Best Defense Strategy – Good Practice of Basics Infection Control Measures;

Section B – Specific Response to Selected Situation

with “Preparedness” and “Response” as the respective philosophical underpinnings to life-threatening emerging and re-emerging infectious disease outbreaks. Major epidemiological and infection control principles are provided under each key area of focus on top of checklists, photo guides and posters. For checklist, it consists of groups of questions easily answered by yes/no/NA responses. The checklist can be used as preparedness exercise (i.e. drills or simulation training) or performance monitoring tool with its intended design to highlight all important and vital steps to ensure patient and staff safety and public health protection. Completing the checklist helps identify areas in which existing practices or resources are generally satisfactory or where there are issues and weaknesses that should be addressed and corrected with immediate attention.

The strategies outlined in the tool kit by no means are the only way of managing emerging infectious diseases and outbreaks. Users are advised to refer to their own context and make appropriate modifications whilst confronting problems like resources limitations. Although the content of the tool kit is believed to be accurate at time of release, users are advised to check updates in relation to emerging infectious disease threats or changes in practice or research.

SECTION A

Best Defense Strategy – Good Basic Infection Control Practice

1. Pathogenicity and host defense mechanisms

Pathogen

A pathogen is a microbe that has the ability to cause host tissue injury. The host damage can be as a result of direct microbial activity or arise from the host immune response. This definition encompasses **classical pathogens** and **opportunistic pathogens**. Opportunistic pathogens form part of a group that target susceptible groups in the general population, e.g., old people and people with immune function disorders.

Pathogenicity

The pathogenicity of an organism is defined as the *ability to cause host damage*. **Virulence** is defined as the level of pathogenicity. Thus, a pathogen has greater virulence if its capacity to cause host damage is high.

Sources and causes of virulence:

- **Adhesins:** Bacteria possess special abilities to adhere to linings so that any flushing of the system will not cause their excretion. For example: E coli bacteria have special adhesins as part of its fimbriae (pili) so they can adhere to the bladder epithelium even though bladder emptying flushes out the system.
- **Toxins:** Toxins are released by bacterial that can directly harm the host tissue or trigger destructive host tissue mechanisms. There are only a few toxins:
 - A-B toxins
 - pore-forming toxins (form pores in host cells therefore lysis of cell occurs)
 - proteolytic toxins (breakdown proteins)
- **Invasiveness:** Microorganisms can invade the body in several ways and this is a complex mechanism
- **Intracellular survival:** Pathogens can survive within the host cell with only a few mechanisms.
- **Evasion of the immune response:** The longer the pathogen stays inside a host, the more damage it can cause. Evading the immune response is the most important factor in terms of determining the virulence of the microorganism. Pathogens can vary their antigenicity, or evade complement activation by masking themselves, or degrade the immune components by enzyme release. Another example is the development of a capsule around the bacterial cell wall, so that phagocytosis cannot occur.

General principles of microbial pathogenesis

Pathogenic organisms typically interact directly with the host, and if they are capable of finding a niche, invading skin or mucous membranes, disseminating and evading host defenses and then changes in host physiology result that translates into symptoms.

Colonization (Table 1): Ligand-specific adherence to host receptors

→ **Invasion:** Penetration of skin, mucosa or other epithelial membranes to reach the circulation or specific target organ or cell type

→ *Multiplication*: Depends on preferred niche of the organism and its growth rate; slow or rapid; intracellular or extracellular

→ *Dissemination*: Spread locally or disseminate widely

There are exceptions with some micro-organisms, e.g. *S aureus*, Group A streptococci, producing toxins or even super antigens which have a profound effect on the immune system.

Table 1. Bacteria commonly found on the surfaces of the human body

Bacterium	Skin	Conjunctiva	Nose	Pharynx	Mouth	Lower GI	Anterior urethra	Vagina
<i>Staphylococcus epidermidis</i> and other coagulase-negative staphylococci	++	+	++	++	++	+	++	++
<i>Staphylococcus aureus</i>	+	+/-	+	+	+	++	+/-	+
<i>Streptococcus mitis</i> , <i>S. salivarius</i> , <i>S. mutans</i> (viridans group)				++	++	+/-	+	+
Enterococci				+/-	+	++	+	+
<i>Streptococcus pneumoniae</i>		+/-	+/-	+	+			+/-
<i>Streptococcus pyogenes</i> (group A)	+/-	+/-		+	+	+/-		+/-
<i>Neisseria spp.</i>		+	+	++	+		+	+
<i>Neisseria meningitidis</i>			+	++	+			+
Enterobacteriaceae (coliform)		+/-	+/-	+/-	+	++	+	+
<i>Pseudomonas aeruginosa</i>				+/-	+/-	+	+/-	
<i>Haemophilus influenzae</i>		+/-	+	+	+			
<i>Bacteroides spp.</i>						++	+	+/-
<i>Lactobacillus spp.</i>				+	++	++		++
<i>Clostridium spp.</i>					+/-	++		
Corynebacteria (Diphtheroid)	++	+	++	+	+	+	+	+
Mycobacteria	+		+/-	+/-		+	+	
Actinomycetes				+	+			
Spirochetes except <i>Treponema pallidum</i> (syphilis)				+	++	++		
Mycoplasma				+	+	+	+/-	+

First line of defense

External and mechanical barriers and associated predisposing risk factors to infections (primary infections at the portal of entry can result in bacteraemia and/or secondary infections at the other body sites by haematogenous or contiguous spread):

- Skin → skin and soft tissue infection
 - Trauma and burns
 - Surgery
 - Dryness
 - Underlying skin problems, e.g. dermatitis, eczema, psoriasis
 - Intravascular catheter insertion
 - Drainage tube insertion
- Mucous membranes → mucositis
 - Nasogastric tubes
 - Nasotracheal tubes
 - Endotracheal tubes
- Cilia → pneumonia
 - Smoking
 - Preceding infections by certain viruses and bacteria
- Normal flora (microbial antagonism) → gastroenteritis, selection for *Clostridium difficile* and multi-drug resistant organism (MDRO)
 - Previous administration of broad spectrum antibiotics
- Gag and cough reflexes → pneumonia
 - Unconsciousness
- Gastrointestinal tract peristalsis → pneumonia
 - Peritonitis and other intraabdominal infections causing ileus
- Secretions (saliva, sweat, GI secretions, including gastric acid, and vaginal secretions, interferon) → pneumonia, gastroenteritis
 - Gastrectomy
 - Antacids

Second line of defense

Non-specific inflammatory response: phagocytosis (neutrophils, monocytes)

Specific immune responses: two subdivisions exist

- Cell-mediated
 - Lymphokines enhance the function of macrophages
 - Cytotoxic T cells directly kill viral infected cells
- Humoral
 - Antibodies by B lymphocytes in conjunction with helper T cells
 - Act as an opsonin to enhance phagocytic process
 - Prevention of adherence factors
 - Neutralize the toxins produced by the invading bacteria

- Induce complement activation and the inflammatory response
- Cause cell lysis
- Inhibit motility
- Inhibit metabolic pathways and growth of the microorganism

Risk factors:

- Malnutrition
- Extremes of age
- Inherited and acquired immunodeficiencies
- Chronic disease
- Immunosuppressive therapy
- Surgery
- Inadequate immunization

Table 2. Selected pathogens associated with immunodeficiency diseases

Pathogen	History	Host defense affected	Clinical examples
<i>Pneumocystis carinii</i> , <i>Cryptococcus neoformans</i> , herpesviruses	Disseminated infections, opportunistic infections, persistent viral infections	T cells	Severe combined immunodeficiency, AIDS
<i>Haemophilus influenzae</i> , <i>Streptococcus pneumoniae</i> , <i>Giardia lamblia</i> , <i>Campylobacter</i> <i>spp.</i> enteroviruses	Recurrent respiratory infections with encapsulated organisms, chronic diarrhoea, aseptic meningitis	B cells	Common variable immunodeficiency, X-linked agammaglobulinaemia
<i>Staphylococcus aureus</i> , <i>Burkholderia cepacia</i> , <i>Serratia</i> <i>marcescens</i> , <i>Aspergillus spp.</i> <i>Nocardia spp.</i>	Gingivitis, aphthous ulcers, recurrent pyogenic infections, delayed umbilical stump separation	Phagocytes	Chronic granulomatous disease, Chédiak-Higashi syndrome, leukocyte adhesion deficiency
<i>Neisseria spp.</i>	Recurrent bacteraemia, recurrent meningitis	Complement	Late complement component deficiency
<i>Staphylococcus aureus</i> , <i>H.</i> <i>influenzae</i> , <i>S. pneumoniae</i> , <i>Candida albicans</i>	Eczema, kyphoscoliosis, pathologic fractures, pulmonary and cutaneous infections, mucocutaneous candidiasis	T cells, phagocytes	Hyperimmunoglobulin E-recurrent infections (Job's syndrome)

Signs and symptoms of infections (may overlap with those of inflammation due to other causes e.g. autoimmune disease):

- Systemic
 - Fever
 - Chills
 - Myalgia
 - Headache
 - Anorexia
- Peripheral
 - Redness
 - Heat
 - Pain
 - Swelling
 - Loss of function
- Consequences
 - Refractory hypotension
 - Multi-organ failure

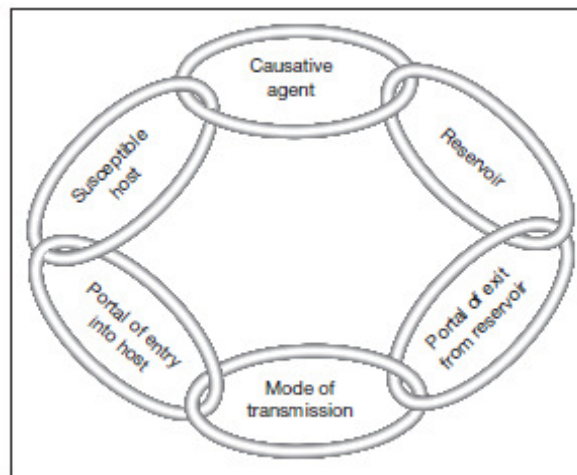
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2. Transmission of infection in health care setting

Patients are at higher risk of developing infection in hospital because of underlying medical diseases, invasive procedures and medical devices, surgical operations, immunosuppressive therapy, or they may be related to transplantation procedures. These lower the defense mechanism against invasion of not only virulent pathogens but also low-grade pathogens such as coagulase negative staphylococcus in implant infection and catheter related blood stream infection. Nosocomial infection prolongs length of stay and increases morbidity and mortality. To control and prevent hospital acquired infection, it is important to understand the transmission of pathogens which result in colonization and infection of patients.

Chain of transmission



There are 6 essential components in the chain that result in infection: causative agent, reservoir, portal of exit, mode of transmission, portal of entry and susceptible host.

1. **Agents:** causing infection includes viruses, bacteria, fungi, parasites and even unconventional agents - prions. They can be part of the patient's own flora causing endogenous infection or may be acquired from other sources leading to exogenous infection.
2. **Reservoir:** human subjects, animals, inanimate environment, contaminated equipment and device and solution can serve as the reservoir where the agents survive and even multiply e.g. chronic hepatitis B in infected or carrier patients. Pseudomonas and Legionella persist in tap water, sink and cooling tower systems. Asymptomatic carriers may pose a risk of transmission because they often are not recognized by staff to take precautionary action.

The survival of some pathogens in the environment is listed in the following tables

Table 1. Persistence of clinically relevant bacteria on dry inanimate surfaces.

Type of bacteria	Duration of persistence (range)
<i>Acinetobacter</i> spp	3 days – 5 months
<i>Bordetella pertussis</i>	3 – 5 days
<i>Campylobacter jejuni</i>	Up to 6 days
<i>Clostridium difficile</i> (spores)	5 months
<i>Chlamydia pneumoniae</i>	≤ 30 hours
<i>Chlamydia psittaci</i>	15 days
<i>Corynebacterium diphtheriae</i>	7 days – 6 months
<i>Corynebacterium pseudotuberculosis</i>	1 – 8 days
<i>Escherichia coli</i>	1.5 hours – 16 months
<i>Enterococcus</i> spp. including VRE and VSE	5 days – 4 months
<i>Haemophilus influenzae</i>	12 days
<i>Helicobacter pylori</i>	≤ 90 minutes
<i>Klebsiella</i> spp	2 hours – > 30 months
<i>Listeria</i> spp	1 day - months
<i>Mycobacterium bovis</i>	> 2 months
<i>Mycobacterium tuberculosis</i>	1 day to 4 months
<i>Neisseria gonorrhoeae</i>	1-3 days
<i>Proteus vulgaris</i>	1-2 days
<i>Pseudomonas aeruginosa</i>	6 hours – 16 months
<i>Salmonella typhi</i>	6 hours – 4 weeks
<i>Salmonella typhimurium</i>	10 days – 4.2 years
<i>Salmonella</i> spp	1 day
<i>Serratia marcescens</i>	3 days – 2 months
<i>Shigella</i> spp	2 days – 5 months
<i>Staphylococcus aureus</i> , including MRSA	7 days – 7 months
<i>Streptococcus pneumoniae</i>	1 – 20 days
<i>Streptococcus pyogenes</i>	3 days – 6.5 months
<i>Vibrio cholerae</i>	1 – 7 days

Table 2. Persistence of clinically relevant fungi on dry inanimate surfaces.

Type of fungus	Duration of persistence (range)
Candida albicans	1-120 days
Candida parapsilosis	14 days
Torulopsis glabrata	102-150 days

Table 3. Persistence of clinically relevant viruses on dry inanimate surfaces.

Type of virus	Duration of persistence (range)
Adenovirus	7 days – 3 months
Astrovirus	7 – 90 days
Coronavirus	3 hours
SARS associated virus	72 – 96 hours
Coxsackie virus	> 2 weeks
Cytomegalovirus	8 hours
Echovirus	7 days
HAV	2 hours – 60 days
HBV	> 1 week
HIV	> 7 days
Herpes simplex virus, type 1 and 2	4.5 hours – 8 weeks
Influenza virus	1 – 2 days
Norovirus and feline calici virus	8 hours – 7 days
Papillomavirus	> 7 days
Papovavirus	8 days
Parvovirus	> 1 year
Poliovirus type 1	4 hours - < 8 days
Poliovirus type 2	1 day – 8 weeks
Pseudorabies virus	≥ 7 days
Respiratory syncytial virus	Up to 6 hours
Rhinovirus	2 hours – 7 days
Rotavirus	6 – 60 days
Vacciniavirus	3 weeks - > 20 weeks

3. Port of exit: Common portals of exit associated with human reservoirs include the respiratory, genitourinary, and gastrointestinal tracts, the skin and mucous membranes and the placenta (transmission from mother to fetus).

4. Mode of transmission: The microorganism can be acquired by inhalation (through respiratory tract), ingestion (through gastrointestinal tract), inoculation (through accidental sharp injury or bites), contact (during sexual intercourse) and transplacental transmission (microbes may cross placenta from the mother to fetus). Some can spread by using

more than one transmission route.

- **Contact transmission:** Contact is the most common mode of transmission of infection in the health care settings. It may be subdivided into direct contact and indirect contact

Direct contact. Refers to person-to-person spread of organisms through actual physical contact. It occurs in many daily healthcare activities either by 'clean' tasks such as bathing, temperature taking, patient lifting, dressing change, insertion and changing of drip sets or by dirty tasks such as handling patient excreta, suction through contaminated hands of health care workers.

Hand hygiene is the most effective way to prevent transmission by the contact route as promoted by WHO at 5 critical moments



Indirect contact: Occurs when a susceptible person comes in contact with a contaminated object e.g. endoscopes, respiratory equipment. Thorough cleaning, disinfection, and sterilization are essential in the health care setting to prevent nosocomial infection acquired from contaminated items and equipment.

- **Droplet transmission:** Results from contact with contaminated respiratory secretions. A person with a droplet-spread infection coughs, sneezes, or talks, releasing infected secretions that spread through the air to the oral or nasal mucous membranes of a person nearby. Microbes in droplet nuclei (mucus droplets) can travel up to 3 feet (1 meter). Droplet transmission differs from airborne transmission in that the droplets don't remain suspended in the air but settle on surfaces. Examples of diseases spread by droplets include respiratory viral infection e.g. influenza, parainfluenza, RSV and bacterial e.g. whooping cough, meningococcal infection.
 - **Airborne transmission:** Airborne transmission occurs when fine microbial particles or dust particles containing pathogens remain suspended in the air for a prolonged period, and then are spread widely by air currents and inhaled. The tiny particles remain suspended in the air for several hours and may cause infection when a susceptible person inhales them. Examples of diseases spread by the airborne include pulmonary tuberculosis, varicella, and measles.
 - **Direct inoculation and transplacental transmission:** Sharps injury and placental transmission may result in transmission and congenital infection respectively with blood borne pathogens such as HIV, HBV, and HCV. Contaminated intravenous infusions have caused outbreaks of iatrogenic bacteraemia.
5. **Portal of entry.** The portal of entry is the path by which an infectious agent invades a susceptible host. Usually, this path is the same as the portal of exit. In addition, each invasive device, e.g. intravenous line, creates an additional portal of entry into a patient's body thus increasing the chance of developing an infection and contaminated neurosurgical instruments in CJD diseases.
6. **Susceptible host.** The final link in the chain of infection is the susceptible host. The human body has many defense mechanisms for resisting the entry and multiplication of pathogens. Examples include an intact skin, an active coughing reflex, appropriate stomach acidity, innate defense mechanisms composed of white blood cells, macrophages, and complement and finally an adaptive immune response involving humoral and cellular immune responses. When these defense mechanisms are weakened and interrupted due to invasive devices, procedures, surgery, trauma, malignancy, chemotherapy in immunocompromised persons and in persons at extreme of age, infective agents of even low virulence are likely to invade the body and cause an infection.

Further reading

1. WHO Guidelines on Hand Hygiene in Health Care 2009
http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf
2. How long do nosocomial pathogens persist on the inanimate surfaces? A systemic review
<http://www.biomedcentral.com/1471-2334/6/130>

3. Isolation of the patient

Isolation

Refers to the precautions that are taken in the hospital to prevent the spread of an infectious agent from an infected or colonized patient to susceptible persons, based on our current understanding of the way infections can transmit.

There are two tiers of isolation precautions:

- Standard Precautions – applied to the care of all patients in all health care settings, regardless of the suspected or confirmed presence of an infectious agent.
- Transmission-Based Precautions – applied to patients who are known or suspected to be infected or colonized with infectious agents, including certain epidemiologically important pathogens, which require additional control measures to effectively prevent transmission.

There are three categories of Transmission-Based Precautions: **Contact Precautions, Droplet Precautions and Airborne Precautions**. They are used when the route(s) of transmission is (are) not completely interrupted using Standard Precautions alone. For some diseases that have multiple routes of transmission (e.g. SARS, HSI), more than one Transmission-Based Precautions category may be used. When used either singly or in combination, they are always used in addition to Standard Precautions.

Patient placement

Appropriate patient placement is a significant component of isolation precautions. A single room is important to prevent direct- or indirect-contact transmission when the source patient has poor personal hygiene, contaminates the environment or cannot be expected to assist in maintaining infection control precautions to limit transmission of microorganism.

It is very important to consider the epidemiology and mode of transmission of the infecting pathogen and the patient population being served in determining patient placement.

1. Contact Precautions

- In acute care hospitals, place patients in a single-patient room when available.
- When single-patient rooms are in short supply, apply the following principles for making decisions on patient placement
 - Prioritize patients with conditions that may facilitate transmission (e.g. uncontained drainage, stool incontinence) for single-patient room placement.
 - Cohort patients who are infected or colonized with the same pathogen and are suitable roommates
 - If it becomes necessary to place a patient who requires Contact Precautions in a room with a patient who is not infected or colonized with the same infectious agent;
 - Avoid placing patients on Contact Precautions in the same room with patients who have conditions that may increase the risk of adverse outcome from infection or that may facilitate transmission (e.g. patients who are immunocompromised or have open wounds).
 - Ensure that patients are physically separated (> 3 feet apart) from each other. Draw the privacy curtain between beds to minimize opportunities for direct contact.
 - Change protective attire and perform hand hygiene between contact with patients in the same room,

regardless of whether one or both patients are on Contact Precautions.

2. Droplet Precautions

- In acute care hospitals, place patients in a single-patient room when available.
- When single-patient rooms are in short supply, apply the following principles for making decisions on patient placement
 - Prioritize patients who have excessive cough and sputum production for single-room placement.
 - Cohort patients who are infected with the same pathogen and are suitable roommates.
 - If it becomes necessary to place a patient who requires Droplet Precautions in a room with a patient who does not have the same infection.
 - Avoid placing patients on Droplet Precautions in the same room with patients who have conditions that may increase the risk of adverse outcome from infection or that may facilitate transmission (e.g. those who are immunocompromised, have or have anticipated prolonged length of stay).
 - Ensure that patients are physically separated (> 3 feet apart) from each other. Draw the privacy curtain between beds to minimize opportunities for close contact.
 - Change protective attire and perform hand hygiene after contact with patients in the same room, regardless of whether one or both patients are on Droplet Precautions.

3. Airborne Precautions

- In acute care hospitals and long-term care settings, place patients who require Airborne Precautions in an Airborne Infection Isolation Room (AIIR) that has been constructed in accordance with current guidelines.
 - Provide at least 6 (existing facility) or 12 (new construction/renovation) air changes per hour.
 - Direct exhaust of air to the outside. If it is not possible to exhaust air from an AIIR directly to the outside, the air may be returned to the air-handling system or adjacent spaces if all air is directed through HEPA filters
 - Whenever an AIIR is in use for a patient on Airborne Precautions, monitor air pressure daily with visual indicators (e.g. smoke tubes, flutter strips), regardless of the presence of differential pressure sensing devices (e.g. manometers)
 - Keep the AIIR door closed when not required for entry and exit.
- When an AIIR is not available, transfer the patient to a facility that has an available AIIR.
- In the event of an outbreak or exposure involving large numbers of patients who require Airborne Precautions:
 - Consult infection control professionals before patient placement to determine the safety of an alternative room that does not meet engineering requirements for an AIIR.
 - Cohort patients who are presumed to have the same infection in areas of the facility that are away from other patients, especially patients who are at increased risk for infection (e.g. immunocompromised patients).
 - Use temporary portable solutions (e.g. exhaust fan) to create a negative pressure environment in the converted area of the facility. Discharge air directly to the outside, away from people and air intakes, or direct all the air through HEPA filters before it is introduced to other air spaces.

Protective Environments (PE) for Immunocompromised Patients

Patients who have congenital primary immune deficiencies or acquired diseases are at increased risk for numerous types of infection. Guidelines for preventing infections in certain groups of immunocompromised patient have been published. Evidence supports placing allogeneic hematopoietic stem cell transplant (HSCT) patients in a Protective Environment.

A **Protective Environment** is designed to minimize fungal spore counts in air by maintaining:

- filtration of incoming air by using central or point-of-use HEPA filters
- directed room air flow
- positive room air pressure of 2.5 kPa relative to the corridor
- well-sealed rooms
- 12 ACH

Patients should be maintained in a PE room except for required diagnostic or therapeutic procedures that cannot be performed in the room, e.g. radiology, operating theatre. Respiratory protection e.g. N95 respirator should be provided for the patient when leaving PE during periods of construction.

Psychological Effect of Isolation

When isolation of patients is necessary, efforts must be made to counteract possible adverse effects on patients, such as anxiety, depression and other mood disturbances, perceptions of stigma, reduced contact with clinical staff and increases in preventable adverse events; in order to improve acceptance by the patients and adherence by health care providers.

Psychological support for the patient in isolation comes in many forms, such as allowing an individual to express feelings about the constraints of isolation and providing information about the purpose of isolation.

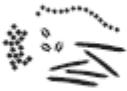
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4. CDC. Guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients. Recommendations of CDC, the Infectious Disease Society of America, and the American Society of Blood and Marrow Transplantation. MMWR 2000; 49(RR10);1-125.

4. Disinfection and sterilization

Each year many surgical procedures and invasive medical procedures are performed that involve contact of instruments and devices with patient's sterile tissue or mucous membranes. There is risk of person to person transmission of pathogens via contaminated devices if they are not properly disinfected or sterilised e.g. tuberculosis via contaminated bronchoscopes. In recent years it has been acknowledged that a contaminated inanimate environment may play a role in the outbreak and persistence of multi-drug resistant bacteria e.g. MRSA, VRE and clostridium difficile. Hand hygiene with alcohol hand rub as promoted by the WHO is an important measure in breaking the chain of transmission in hospitals.

Microorganisms vary in their resistance to disinfection process with prions being resistant to all routine disinfection/sterilisation process as shown below:

MICROORGANISMS		EXAMPLES	LEVEL OF DISINFECTION
PRIONS		Agents for Creutzfeld-Jakob disease.	PRION REPROCESSING
BACTERIAL SPORES		<i>Bacillus subtilis</i> , <i>Clostridium sporogenes</i> , <i>Clostridium difficile</i> , etc.	STERILIZATION
COCCIDIA		<i>Cryptosporidium</i>	
MYCOBACTERIA		<i>Mycobacterium tuberculosis</i>	HIGH LEVEL DISINFECTION
NONLIPID OR SMALL VIRUSES		Poliovirus, Coxsackie virus, Rhinovirus, etc.	INTERMEDIATE LEVEL DISINFECTION
FUNGI		<i>Trichophyton</i> spp., <i>Cryptococcus</i> spp., <i>Candida</i> spp., etc.	
VEGETATIVE BACTERIA		<i>Pseudomonas aeruginosa</i> , <i>E. coli</i> , <i>Staph. aureus</i> , <i>Salmonella</i> spp., <i>Neisseria meningitidis</i> , <i>Enterococci</i> , etc.	LOW LEVEL DISINFECTION
LIPID OR MEDIUM-SIZED VIRUSES		Herpes simplex, Cytomegalovirus, Respiratory syncytial, Hepatitis B, Human Immunodeficiency Virus (HIV), etc.	

Definition of terms

- **Sterilization** describes a process that destroys or eliminates all forms of microbial life and is carried out in health-care facilities by physical or chemical methods
- **Disinfection** describes a process that eliminates many pathogenic microorganism except bacterial spores on inanimate objects
 - *High-level disinfectants* - will kill all microorganisms except large numbers of bacterial spores
 - *Intermediate-level disinfectants* - might be cidal for mycobacteria, vegetative bacteria, most viruses, and most fungi but do not necessarily kill bacterial spores
 - *Low-level disinfectants* - can kill most vegetative bacteria, some fungi, and some viruses in a practical period of time (≤ 10 minutes)
- **Antiseptics**
 - *Disinfectant that can be applied to living tissues to destroy transient and permanent skin flora.*
 - *Hand hygiene (alcohol hand rub of visibly clean hands or hand washing with antiseptic soap after dirty procedure or visiting toilet) is probably the most important infection control measure as promoted by WHO*
 - *Commonly used sterilization / high level disinfectant and antiseptics are listed in tables 1-4*
- **Decontamination removes pathogenic microorganisms from objects so they are safe to handle, use, or discard.**
- **Cleaning is the removal of visible soil (e.g. organic and inorganic material) from objects and surfaces and normally is accomplished manually or mechanically using water with detergents or enzymatic products. It is essential before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes**
 - *Disinfection can be achieved using physical or chemical method.*
 - *Moist heat is the most effective and controllable method for heat tolerable items*

	Temperature °C	Time
Sterilization by steam	134	3 mins
	121	15 mins
Instrument boiler	100	10 mins
Automated washer disinfectant	71	3 mins
	80	1 min
	90	12 secs
Linen	65	10 mins
	71	3 mins

Factors that affect the efficacy of both disinfection and sterilization include prior cleaning of the object; organic and inorganic load present; type and level of microbial contamination; concentration of and exposure time to the germicide; physical nature of the object (e.g. crevices, hinges, and lumens); presence of biofilms; temperature and pH of the disinfection process; and in some cases, relative humidity of the sterilization process.

Spauling has devised a rational approach to the disinfection and sterilization of patient care items and equipment which are classified into 3 risk categories

1. **Critical items**

Those that enter the sterile tissue or vascular systems should be sterile because of high risk of infection if such items are contaminated by any microorganism including spores. They include surgical instruments like cardiac and urinary catheters, implants and ultrasound probes. They should be purchased as **sterile** or be **sterilized** by steam sterilization if possible, or if heat sensitive, by ethylene oxide or hydrogen peroxide plasma or liquid chemical sterilant if other methods are unsuitable.

2. **Semi-critical items**

Those that come in contact with mucous membranes or non-intact skin. Respiratory therapy and anaesthetic equipment, some endoscopes, laryngoscope blades, oesophageal manometry probes, vaginal and rectal probes. They should be free from all microorganisms; however, small numbers of bacterial spores are permissible. Intact mucous membranes generally are resistant to infection by common bacterial spores but susceptible to other organisms, such as bacteria, mycobacteria, and viruses.

They minimally require **high-level disinfection** using chemical disinfectants e.g. glutaraldehyde, ortho-phthalaldehyde, peracetic acid with hydrogen peroxide using concentration and contact time as recommended by the manufacturer.

Endoscopes should be rinsed and flushed using sterile water after high-level disinfection to prevent contamination with organisms in tap water e.g. nontuberculous mycobacteria, *Legionella*, or *Pseudomonas*. Alternatively, filtered water (0.2µ filter) rinse should be followed by an alcohol rinse and forced air-drying.

3. **Non-critical items**

Those that come in contact with intact skin but not mucous membrane. Intact skin is the effective barrier to most microorganisms. Sterility of items in contact with skin is not critical. Examples of noncritical items are bedpans, blood pressure cuffs, bed rails linen, furniture and floors. They may be decontaminated with **low level disinfectant** where they are used and do not need to be transported to central processing area. Nevertheless if they are contaminated, they could potentially contribute to secondary transmission by contaminating the hands of healthcare workers and medical equipment. Recent data have revived the discussion on the importance of environment contamination in the spread and persistence of hospital problem pathogens such as MRSA, VRE, clostridium difficile and acinetobacter.

Decontamination of equipment used on patients with Creutzfeldt-Jakob disease

These unconventional agents are extremely resistant to physical and chemical agents. It is advisable to use a single use instrument in high infectivity tissues such as brain, spinal cord, anterior eye surgery and in case of variant CJD procedure involving lymphoid tissue in patients with known or suspected CJD or related disorder and at-risk patients (those who are asymptomatic but have a clinical or family history that place them at risk). Instruments used on at-risk patients that involve low/no infectivity tissue should be thoroughly cleaned and sterilized or disinfected using physical or chemical process e.g. 134 °C for 18 minutes, immersion in 20,000 ppm sodium hypochlorite for 1 hour or 2M sodium hydroxide for 1 hour, and for histological specimen's immersion in 96% formic acid for 1 hour).

Table 1. Characteristics of selected chemicals used as high-level disinfectants or chemical sterilants

	HP (7.5%)	PA (0.2%)	Glut (≥2.0%)	OPA (0.55%)	HP/PA (7.35%/0.23%)
HLD Claim	30m @ 20°C	NA	20-90m @ 20°-25°C	15m @ 20°C, 5m @ 25°C in AER	15m @ 20°C
Sterilization claim	6h @ 20°C	12m @ 50-56°C	10h @ 20°-25°C	None	3h @ 20°C
Activation	No	No	Yes	No	No
Reuse life ¹	21 d	Single use	14-30 d	14 d	14 d
Shelf life stability ²	2 y	6 mo	2 y	2 y	2 y
Disposal restrictions	None	None	Local ³	Local ³	None
Materials compatibility	Good	Good	Excellent	Excellent	No data
Monitor MEC ⁴	Yes (6%)	No	Yes (1.5% or higher)	Yes (0.3% OPA)	No
Safety	Serious eye damage (eye glasses)	Serious eye and skin damage (conc soln) ⁵	Respiratory	Eye irritant, stains skin	Eye damage
Processing	Manual or automated	Automated	Manual or automated	Manual or automated	Automated
Organic material resistance	Yes	Yes	Yes	Yes	Yes
OSHA exposure limit	1 ppm TWA	None	None ⁶	None	HP-1 ppm TWA
Cost profile (per cycle) ⁷	+ (manual) ++ (automated)	+++ (automated)	+ (manual) ++ (automated)	++ (manual)	++ (manual)

Abbreviations: HLD = high level disinfectant; HP = hydrogen peroxide; PA = peracetic acid; OPA = ortho-phthalaldehyde; m = minutes; h = hours; NA = not applicable; TWA = time weighted average.

¹ Number of days a product can be reused as determined by re-use protocol

² time a product can remain in storage (unused)

³ MEC=minimum effective concentration is the lowest concentration of active ingredients at which the product is effective

Table 2. Comparison of various method of sterilization

Sterilization method	Advantages	Disadvantages
Steam	Nontoxic to patient Cycle easy to control and monitor Rapidly microcidal Least affected by organic/inorganic soils among sterilization processes listed Rapid cycle time Penetrates medical packing, device lumens	Deleterious for heat sensitive instruments Microsurgical instruments damaged by repeated exposure May leave instruments wet, causing them to rust Potential for burns
Hydrogen peroxide gas plasma	Safe for environment Leaves no toxic residuals Cycle time is 28-75 minutes and no aeration necessary Use for heat and moisture sensitive items since process temperature < 50°C Simple to operate, install and monitor Compatible with most medical devices Only requires electrical outlet	Cellulose (paper), linens and liquids cannot be processed Sterilization chamber size large Some endoscopes or medical devices with long or narrow lumens may not be able to be processed Requires synthetic packaging & special container tray Hydrogen peroxide may be toxic at levels > 1ppmTWA
100% Ethylene oxide (ETO)	Penetrates packaging materials, device lumens Single-dose cartridge and negative-pressure chamber minimizes the potential for gas leak and ETO exposure Simple to operate and monitor Compatible with most medical materials	Requires aeration time to remove ETO residue Sterilization chamber size large ETO is toxic, a carcinogen, and flammable ETO cartridges cannot be stored in flammable liquid storage cabinet Lengthy cycle/aeration time
ETO Mixtures	Penetrates medical packing and many plastics Compatible with most medical materials Cycle easy to control and monitor	Potential hazards to staff and patients Lengthy cycle/aeration time ETO is toxic, a carcinogen, and flammable
Peracetic acid	Rapid cycle time (30-45 minutes) Low temperature (50-55°C liquid immersion sterilization) Environmental friendly by-products Sterilant flows through endoscope which facilitates salt, protein and microbe removal	Point-of-use system, no sterile storage Biological indicator may not be suitable for routine monitoring Use of immersible instruments only Some material incompatibility Small number or single instruments processed in a cycle Potential for serious eye and skin damage (conc solution) with contact

Table 3. Antimicrobial activities and summary of properties of disinfectants

Disinfectant	Antimicrobial activity					Other properties			
	Bacteria	Myco- bacteria	Spores	Viruses		Stability	Inactivation by organic matter	Corrosive/ damaging	Irritant/ sensitizing
				Enveloped	Non enveloped				
Alcohol 60-70%	+++	+++	-	++	++	Yes	Yes	Slight	No
Chlorine releasing agents (0.5-1.0%)	+++	+++	+++	+++	+++	No	Yes	Yes	Yes
Clear soluble phenolics (1-2%)	+++	++	-	++	+	Yes	No	Slight	Yes
Glutaral- dehyde (2%)	+++	+++	+++	+++	+++	Moderate	No	No	Yes
Peracetic acid (0.2-0.35%)	+++	+++	+++	+++	+++	No	No	Slight	Slight
Peroxygen compounds (3-6%)	+++	±	±	+++	±	Moderate	Yes	Slight	No

Table 4. Antimicrobial activities of antiseptics

Group	Gram positive bacteria	Gram negative bacteria	Mycobacteria	Fungi	Viruses	Speed of action
Alcohols	+++	+++	+++	+++	+++	Fast
Chlorhexidine (2% and 4% aq)	+++	+++	+	+	+++	Intermediate
Hexachlorophane (3% aq)	+++	++	+	+	+	Intermediate
Iodine compounds	+++	+++	+++	++	+++	Intermediate
Iodophors	+++	+++	+	++	++	Intermediate
Phenol derivatives	+++	+	+	+	+	Intermediate
Triclosan	+++	++	+	-	+++	Intermediate
Quaternary ammonium compounds	+	++	-	-	+	Slow

Further reading

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http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Disinfection_Nov_2008.pdf
2. Infection Control for Creutzfeldt-Jakob Disease (CJD) HA guideline
http://ha.home/visitor/view_content.asp?parent_id=8564&content_id=4673&language=ENG&visit_mode=
3. WHO guidelines on Hand hygiene in health care 2009
http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf

5. Environmental cleanliness

Environment surfaces have been considered as a source of pathogens that can cause hospital infection for many years. Many pathogens are able to survive on inanimate surfaces for weeks and up to months. Controlling and limiting the spread of hospital infection has become one of the most challenging aspects of health care epidemiology. Environmental cleaning on a regular basis has been recommended so as to prevent the spread of organisms. Further intense environmental cleaning should be implemented during an outbreak. A clean environment provides the right setting for good patient care and good infection control.

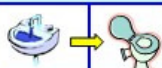
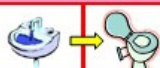
How to achieve hospital cleanliness

- Establish a system that meets appropriate standards of cleanliness
- Institute audit mechanisms

Practical steps

- **Develop a color code system** to differentiate clean and dirty areas in hospital. Separate cleansing of utensils and equipment so as to prevent cross contamination is recommended. The system can provide clarity for cleaning staff and reinforce the clean and dirty concept and emphasize a high standard of hygiene.
- Provide a well-written **cleaning manual** for cleaning staff. The manual should include the rules of cleaning, cleaning tasks, equipment required, safety factors and assessment and method. Staff should consistently follow the instructions to prepare and to perform the cleaning task. Contingency procedure such as the handling of the spillage of infectious material must be established. Regular drill should be run to train staff to recognize the importance of the procedure and the identification of lapses so as to promote a safe working environment. Nowadays, most cleaning services are contracted-out and as a result the cleaning service may face problems of high staff turnover, unstable quality of cleaning standard, and inflexibility of cleaning roles. These factors could all have a detrimental effect on the cleaning standard within a hospital. The standardized manual facilitates staff to cope with the change in their working location.
- CDC recommends that '**Wet-dust horizontal surfaces regularly** (e.g. daily, 3 times per week) using clean cloths wetted with disinfectant' as being adequate for cleaning surfaces. The first priority in the selection of material for cleaning should be that it is disposable or made of microfiber material. An increase in cleaning frequency is dictated by whether or not an area is a high touching area. The wipe method follows a figure of eight pattern to enhance the cleaning standards.
- **Subjective cleaning audit** utilizing criteria such as no visible dirt, no smell, and no stain. The 'Essence of Care-Benchmarks for Care Environment' published by the Department of Health includes indicators of best practice for a clean environment as a reference. A more scientific approach is to use adenosine triphosphate (ATP) bioluminescence swabbing as a detection tool for effective hospital cleaning. A presence of ATP after cleaning and disinfection is an indicator of poor cleaning.
- Regular assessment of the compliance to housekeeping procedures should be advocated. An audit tool and schedule with a multi-disciplinary team is highly recommended by NHS. Remedial work and education should focus on the weaknesses found in the audit report.

NHS proposed an action plan 'Towards cleaner hospitals and lower rates of infection' so as to focus on the challenges of a clean environment. A team is advocated with patient representatives to assess hospital cleanliness from a patient perspective. Patients expect a hospital to be clean as measured in star ratings, similar to a clean hotel. Patient satisfaction is a key indicator for evaluation. Change requires the efforts of patients, nurses and all health care workers to achieve success. A more aggressive approach to achieve a clean environment is to empower patients with more knowledge and to encourage them to demand the highest standards of hygiene. The external pressure of a high standard cleanliness within hospitals provides the momentum to change.

Utensils/ Location	Office/Nurse Station/ Other Non-clinical Areas	Pantry	Staff's Toilet/ Changing Room	Patient's Toilet/ Changing Room	Sluice Room	Patient Areas	Transmission Based Precaution
							Droplet Precaution
Disposable Gloves							
Cleansing Cloth							 Disposable Cloth or Immediate Laundry Treatment after use
Cleansing Mope							
Drying Mope							

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6. Specimen collection and handling

Key messages:

To know:

- What is the right kind of laboratory investigation
- What is the right way to order the test
- What is the right kind of specimen
- What is the right container
- What is the right time to collect the specimen
- What is the right way to collect the specimen
- What is the safe way to handle the specimen

Principles:

The right investigation

- Don't forget the importance of taking a relevant history, performing proper physical examination and interpreting non-specific lab results e.g. CXR, CBP, L/RFT in guiding the ordering of specific microbiological investigation.
- Consider that the syndrome or disease might not be related to infection, e.g. fever caused by autoimmune disease, malignancy, drug reaction, disturbance of body temperature regulation at the central nervous system.
- Know the indication of each test to be ordered which could differ greatly for particular syndrome. However, a standard battery of tests for a generic syndrome is not recommended as each patient's presentation could be very different. Overwhelming non-specific findings by extensive non-targeted investigation could be very confusing in making a diagnosis and cause a delay in proper treatment, or even mislead the physician to an incorrect diagnosis. Ask the microbiologist or Infectious Disease physician for any queries.
- Know the limitation of each test to be ordered, so that correct interpretation of the results can guide clinical management. Some investigations don't give a clear answer indicating an active infection but rather indicate past exposure. Again, ask the microbiologist or Infectious Disease physician for any queries.
- Know how each test result would affect clinical management. If it really makes no difference, don't order it. Don't do it for the sake of "completeness" or "convenience". It's not worth such waste of resources and time.
- Know the availability and turn around time of the test to be ordered. For some special tests, there may be specific charges to the department or the patient.

The right way to order

Most tests can now be ordered electronically, which also provides additional points-to-note and instructions for certain tests. Some require prior arrangement with the microbiologist or lab. The clinician can also consult the electronic copy of laboratory user guide at the CMS station. It is important to provide the following information with accuracy for accurate specimen processing and result interpretation:

- Patient's double identifiers
- Patient's location
- Relevant clinical information, including current antimicrobial consumption or any particular antibiotic for susceptibility testing
- Date and time of collection
- Nature of the specimen and the body site from which it is taken.

The right specimen

Know the best body site for a specimen to be collected for optimal yield with meaningful results. Some specimens are not fit for testing at all. Ask the laboratory or microbiologist, or consult the laboratory user guide for any queries.

The right container

The laboratory should specify the type of specimen container for each test which may be subject to different testing protocol and instrumentation. All specimens for culture require sterile containers to prevent overgrowth of contaminants affecting result interpretation.

The right time to collect

The time of collection could affect the yield depending on the body site sampled and time of clinical presentation. Always try to collect samples for culture before administration or change of any antimicrobial agents, especially if such treatment delay won't cause harm to the patient. Serological diagnosis often requires sampling of acute and convalescent clotted blood, 10-14 days or longer apart, to note any significant change of antibody titre since the presence of IgM might be a false positive. Do ask the microbiologist for any queries.

The right way to collect

Good technique, including aseptic technique, is vital to sample representative or clinically significant pathogens or their biomarkers, especially for culture of specimens taken from body sites which are easily contaminated from microflora (refer to Table 1 in the chapter "Host Defense Mechanisms"). This is important when cautious interpretation is required to differentiate colonization or contamination from infection or disease. Taking sufficient quantity of material is another rule of thumb for optimal yield.

The safe way to handle

Safety and decontamination procedures protect the specimen collector and colleagues, laboratory personnel, and the patient from risks associated with specimen collection. Standard precautions always apply for all patients and their specimens to reduce the risk of transmission from both recognized and unrecognized sources of infection. Transmission-based precautions must be used for patients known or suspected to be infected with highly transmissible or epidemiologically important pathogens which can spread by airborne or droplet transmission or by contact with dry skin or contaminated surfaces (please refer to the chapter “Isolation of Patient”). Points for specimen management are highlighted as below:

- Wear gloves, gowns, and where appropriate, masks and/or goggles or face shield when collecting specimens (use particulate respirator for aerosol-generating procedures, e.g. collecting nasopharyngeal aspirate, performing bronchoscopy).
- Collect the specimen in a watertight and leak-proof primary containers and transport the containers within a sealable, watertight secondary container (e.g. zip-lock plastic bag with a separate compartment for paperwork, large centrifuge tubes with screw caps), which is then put into an outer container or packaging box with biohazard warning label for transport. During transportation specific PPE is not necessary but good hand hygiene must be observed.
- Never transport syringes with needles to the lab. Instead, remove the needle with a protective device, recap the syringe, and place it in a sealable, leak-proof plastic bag.
- Do not transport leaking specimen containers to the lab.
- Disinfection of work areas and decontamination of spills of blood or infectious body fluids is generally achieved by 10,000 ppm of sodium hypochlorite or 1 in 5 dilution of household bleach such as Clorox after covering the spill with cloth or paper towels. Appropriate PPE (gloves, disposable gown, face and eye protection) should be worn by staff doing the clean-up procedure.

Table 1. Specimens usually required for microbiological investigation for specific syndromes

Acute syndrome	Possible diseases/pathogens (examples)	Specimens	Lab studies
Diarrhoea	<i>V. cholerae</i> , enterotoxigenic <i>E. coli</i> , <i>Giardia</i> , <i>Cryptosporidium</i> , <i>Shigella</i> , <i>Salmonella</i> , <i>Campylobacter</i> , amoeba, enterohaemorrhagic <i>E. coli</i> , <i>Clostridium difficile</i> , rotavirus, norovirus	Faeces, duodenal aspirate	Culture, <i>C. difficile</i> toxin, PCR, antigen detection, ova & cysts
Haemorrhagic fever	Dengue, yellow fever, Rift Valley, Crimean Congo, tick-borne flaviviruses, Lassa, arenaviruses, Ebola, Marburg, hantaviruses, malaria, relapsing fever	Blood (EDTA, clotted), post-mortem specimens	Viral culture, antigen detection, antibodies, PCR, malaria smear (thick & thin)
Jaundice	Yellow fever, hepatitis A-E, <i>Leptospira</i>	Blood (clotted, EDTA), liver biopsy	Antibodies, antigen detection, PCR, viral culture
Neurological	Poliomyelitis, GBS, HSV, VZV, measles, mumps, influenza, Japanese encephalitis, enterovirus, CMV, JC virus, LCMV, rabies, pneumococcus, meningococcus, <i>H. influenzae</i> , Group B streptococcus, <i>E. coli</i> , <i>Listeria</i> , <i>Leptospira</i> , syphilis, <i>Nocardia</i> , TB, <i>Cryptococcus</i> , <i>Aspergillus</i> , zygomycetes, <i>Strongyloides</i> , <i>Angiostrongylus</i> , <i>Toxoplasma</i> , neurocysticercosis, amoeba, malaria	CSF, blood (EDTA, clotted, smear, culture), throat swab, faeces, post-mortem specimens	Gram stain, Indian ink, bacterial antigen, cryptococcal antigen, galactomannan, bacterial, fungal & viral culture, PCR/nucleic acid amplification, antibodies, microscopy
Respiratory	Bacterial pneumonia including TB and Legionnaires' disease, respiratory viruses, pertussis, hantavirus, diphtheria, streptococcal pharyngitis, anthrax, plague, dimorphic fungi, aspergillosis, PCP	Sputum, blood (culture, clotted), urine, nasopharyngeal aspirate / swab, throat swab	Gram stain, acid-fast stain, bacterial, fungal and viral culture, urine antigen, PCR/nucleic acid amplification, antibodies, galactomannan, cytology
Dermatological	VZV, enteroviruses, measles, rubella, parvovirus B19, dengue, typhus, typhoid, Scarlet fever, meningococcus, gonococcus, syphilis, <i>Candida</i> , <i>Penicillium marneffe</i> , anthrax	Vesicular fluid, blood (clotted, culture), lesion swab	Gram stain, bacterial, fungal culture, antigen detection (DIF), antibodies, PCR, galactomannan
Ophthalmological	<i>Chlamydia trachomatis</i> , adenovirus, HSV, gonococcus, amoeba, <i>Fusarium</i> and other mould	Conjunctival swab, blood (clotted), throat swab, contact lens case & fluid	Gram stain, antigen (DIF) & antibody detection, nucleic acid amplification, viral, fungal, amoebic culture

Specimen collection for specific disease (please refer to the corresponding documents in the References for detailed practical guidance):

- Respiratory disease outbreak of unknown aetiology
 - Nasopharyngeal swab / aspirate, sputum, tracheal aspirate, broncho-alveolar lavage fluid, pleural fluid
 - Acute and convalescent sera
 - Whole blood for culture
 - Whole blood plasma for PCR
 - Fixed tissues from all major organs, non-fixed tissues from lung and upper airway
 - Urine, stool
- Avian influenza A (H5N1)
 - Throat swab, lower respiratory samples
 - Acute and convalescent sera
- Anthrax
 - Blood
 - Serum
 - Skin lesion exudates (vesicular fluid under the eschar is better than a piece of the eschar)
 - Stool, rectal swab
 - Sputum, nasal swab, pleural fluid
 - CSF
- Botulism
 - Stool, enema, gastric aspirate, vomitus
 - Serum
 - Tissue
- Plague
 - Bubo fluid, tissue
 - Blood
 - Serum
 - Bronchial wash, sputum, throat swab
 - CSF
- Smallpox
 - Lesion fluid or crusts
 - Respiratory secretions
 - Blood
 - Tissue

Points-to-note for collecting certain specimens:

- Blood culture
 - Aseptic technique is mandatory
 - perform hand hygiene
 - wear sterile gloves
 - prepare sterile set
 - disinfect blood taking site with antiseptics e.g. 2% chlorhexidine gluconate in 70% alcohol (according to your hospital guideline)
 - disinfect the stopper of culture bottle with 70% alcohol
 - Choose antecubital fossa instead of femoral site for blood taking
 - Take at least 5 ml of blood
 - Avoid recapping needles. Discard needles into an approved sharps container. Use vacuum blood collection system to prevent sharps injury.
- CSF
 - Don't refrigerate
 - Don't need transport medium for virology
- Faecal
 - Rectal swab is not recommended for virology
 - Don't send formed stool for diagnosis (not screening of known pathogen) of acute diarrhoea
- Respiratory tract
 - Don't try to take throat or pharyngeal specimens for patients with suspected acute epiglottitis. The procedure may precipitate respiratory obstruction.
 - Saliva-like specimens are useless for ordinary bacterial culture. You may wish to ask a physiotherapist for help to collect a better sample.
 - Early morning sputum may give a better yield for AFB smear but should not be waited for if a suspected patient is newly admitted.
 - Expecterated sputum has much lower yield than BAL +/- biopsy or induced sputum for PCP.
- Abscess
 - Send pus rather than swab from the advancing edge for better yield.
 - Don't send drainage tube for culture.
- Urine
 - Wash the external genitalia with soap and water or normal saline for hospitalized or debilitated patients to reduce risk of contamination.
 - If the patient has a urinary catheter, collect the specimen from the designated sampling sleeve on the tubing with a sterile needle and syringe. Don't collect from the urinary bag. Don't send urinary catheter tip for culture.

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7. Handling of infectious diarrhoea

Diarrhoeal disease accounts for approximately 2 million deaths annually in children under the age of five years. Disease and death caused by diarrhoea is a global problem but is especially prevalent in developing countries where parents often fail to recognize the danger signs and children simply die through rapid loss of fluids and undernourishment through lack of food.

Definition

Diarrhoea is the passage of loose or liquid stools more frequently than is normal for the individual. It is usually a symptom of gastrointestinal infection. Depending on the type of infection, the diarrhoea may be watery (e.g. in cholera) or passed with blood (e.g. in dysentery).

Aetiology

As a symptom of infection, diarrhoea is caused by bacterial, viral, parasitic organisms.

- Bacterial: Salmonella, Shigella, Campylobacter, and Escherichia Coli, Vibrio parahaemolyticus, Vibrio cholera, Clostridium difficile and cholera. Contaminated food and water can result in several types of infectious diarrhoea.
- Viral: Norovirus, Rotavirus, enteric Adenoviruses and Hepatitis A/E. Rotavirus is the most significant viral pathogen causing diarrhoea, particularly in children.
- Parasites: Giardia lamblia, Entamoeba histolytica and Cryptosporidium. Parasites enter the body through food and water and take up residence in the digestive system.

Clinical presentation

Most are self-limiting and besides acute diarrhoea, symptoms may include nausea and vomiting, loss of appetite, and abdominal pain. As dehydration worsens, symptoms progress from thirst, restlessness, decreased skin turgor and sunken eyes to decreased consciousness, rapid and feeble pulse and low or undetectable pulse. **Dehydration and hypovolemic shock** are the primary causes of death.

The outcome will be fatal in some susceptible hosts such as infants, elderly people and the immunocompromised. It is often a coinfection with other diseases, such as malaria and HIV, and is frequently a comorbidity factor in deaths resulting from these diseases.

Treatment

Replacement of fluids and electrolytes is the cornerstone of supportive care for patients with diarrhoea and greatly reduces mortality due to dehydration. While rehydration counters fluid loss it neither stops the symptoms nor kills the pathogens responsible for the illness. There are very few treatments for specific diarrhoeal pathogens. Antibiotics, which are commonly prescribed, are ineffective against many pathogens and indiscriminate use contributes to the development of resistant organisms.

Laboratory confirmation

Most cases of acute diarrhoea never need diagnosis. The most useful diagnostic tool is stool culture and examination for parasites. The earlier cultures are performed, the greater the chance of obtaining a positive result. For viral gastroenteritis, the diagnostic methods are electron microscopy, enzyme immunoassay, polymerase chain reaction and serology.

Mode of transmission

Transmission of an infectious agent resulting in diarrhoea is usually directly or indirectly from an infected or colonized person to a susceptible host often on the hands.

- Predominantly fecal-oral route. It may be spread from
 - Person to person, aggravated by poor personal hygiene.
 - Contracted from contaminated foods if prepared or stored in unhygienic conditions. Water may contaminate food during irrigation and fish and seafood from polluted water may contribute to the disease.
 - Water contaminated with human faeces. Animal faeces also contain microorganisms that can cause diarrhoea.
- Pathogen with low infective doses, long shedding period and prolonged survival in the environment enhance the infectiveness of the illness accounting for outbreak.
- Person to person transmission is a major determinant of transmission in hospital and institutional outbreaks.
- Preventative measures include
 - Contaminated food and water sources should be identified and eliminated
 - Food hygiene should be maintained e.g. shellfish should be cooked thoroughly
 - Contact precautions should be instituted to reduce the transmission of organisms from an infected or colonized host through direct or indirect contact. This involves:
 - Patient placement - isolation of suspected cases.
 - Gloving – change gloves after contact with infective material. Remove gloves before leaving the isolation room.
 - Hand washing – with an antibacterial agent or an alcohol based hand rub after removing gloves. Do not touch potentially contaminated surfaces or items before leaving the room.
 - Gowns and protective apparel – use a clean, nonsterile disposable gown. Remove before leaving the room. Do not touch potentially contaminated surfaces or items before leaving the room.
 - Patient transport – limited to essential transport.
 - Patient care equipment – reserve non-critical patient care equipment. Clean and disinfect equipment regularly.
 - Care of the diaper host
 - Handle infective diarrhoea with contact precautions
 - Clean up vomitus immediately with contact precautions
 - Prevent further contaminated areas by cleansing with an effective disinfectant
 - Environmental hygiene. Good hygienic housekeeping and pest control.
 - Carriers e.g. food handlers should be educated regarding personal hygiene i.e. hand hygiene should be reinforced, to prevent spread.

Clinical practice on handling of diapers

- Adopt a clean to dirty conceptual framework
- Dispose of used diapers in a proper and timely fashion
- Observe hand hygiene after removal of gloves
- Monitor personal hygiene and self-discipline among staff and visitors
- Staff should discard excreta via bedpan macerators to avoid further contamination or spillage incidents

References

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3	Swan-neck sealing method for clinical waste	P	49

Remarks : C = Checklist , G = Guideline, L = Leaflet , P = Poster , PG = Photo Guide

Respiratory Hygiene and Cough Etiquette



- Cover the nose/mouth when coughing or sneezing



- Perform hand hygiene if contact respiratory secretions and contaminated objects



- Use tissue paper to contain respiratory secretions and dispose in the waste receptacle



- Put on a surgical mask if there is respiratory symptoms





HAND HYGIENE When and How

WORLD ALLIANCE
for PATIENT SAFETY

WHO acknowledges the Hôpitaux Universitaires de Genève (HUG), in particular the members of the Infection Control Programme, for their active participation in developing this material.



World Health
Organization

October 2008, version 1.

How to handrub?

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

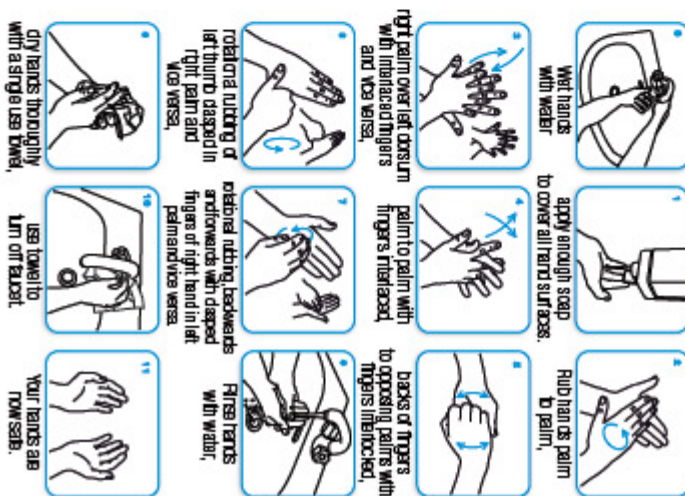
Duration of the entire procedure: 20-30 sec.



How to handwash?

WASH HANDS ONLY WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB!

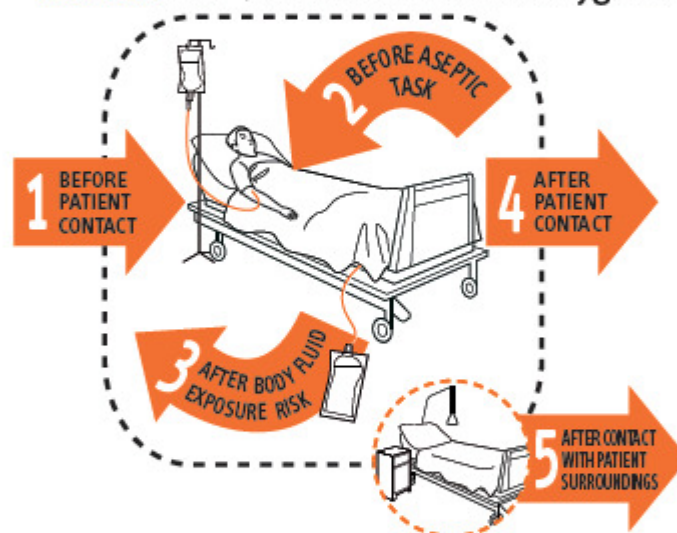
Duration of the entire procedure: 40-60 sec.



Design: mandelaght research



WHEN? Your 5 moments for hand hygiene



1 BEFORE PATIENT CONTACT	WHEN? Clean your hands before touching a patient when approaching him/her EXAMPLES: shaking hands, helping a patient to move around, clinical examination
2 BEFORE AN ASEPTIC TASK	WHEN? Clean your hands immediately before any aseptic task EXAMPLES: oral/dental care, secretion aspiration, wound dressing, catheter insertion, preparation of food, medications
3 AFTER BODY FLUID EXPOSURE RISK	WHEN? Clean your hands immediately after an exposure risk to body fluids (and after glove removal) EXAMPLES: oral/dental care, secretion aspiration, drawing and manipulating blood, clearing up urine, faeces, handling waste
4 AFTER PATIENT CONTACT	WHEN? Clean your hands after touching a patient and her/his immediate surroundings, when leaving the patient's side EXAMPLES: shaking hands, helping a patient to move around, clinical examination
5 AFTER CONTACT WITH PATIENT SURROUNDINGS	WHEN? Clean your hands after touching any object or furniture in the patient's immediate surroundings, when leaving - even if the patient has not been touched EXAMPLES: changing bed linen, perfusion speed adjustment

PREVENT NOSOCOMIAL INFECTION PLEASE WASH YOUR HANDS!

①



Palm to palm

②



Palm to palm, fingers interlaced

③



Palm rubs over dorsum
(vice versa)

④



Rotate clasped fingers in
palm (vice versa)

⑤



Rotate thumb in clasped palm
(vice versa)

⑥



Fingers interlocked, rub
backs of fingers to opposing
palms (vice versa)

⑦



Rotational rub wrist with palm
(vice versa) (**Optional**)

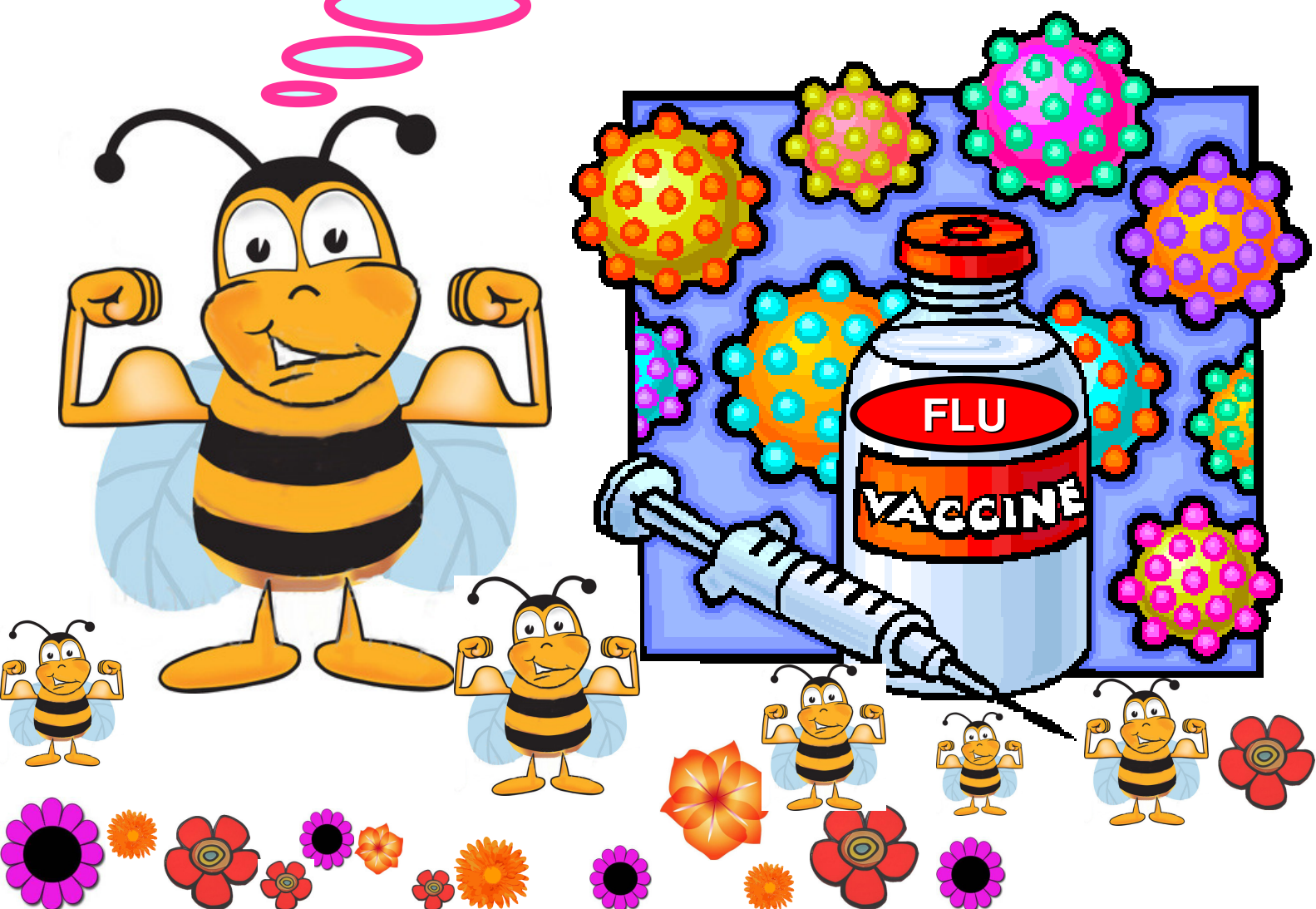
**Care Your
Family**

**Safeguard
Patient**

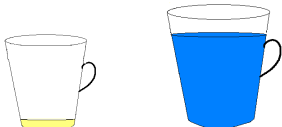
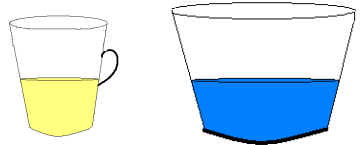
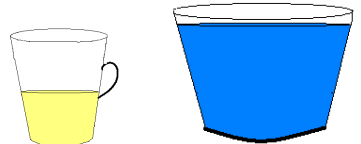
Protect Yourself

Please take action now

Have you vaccinated yet ?



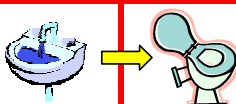
Dilution of Hypochloride commonly used in clinical area

Ratio	Dilution	Photo Guide	Applications	Time (Mins.)	Effective ppm
1:9	1part of hypochloride in 9 parts of clean water ----- e.g. 30 ml hypochloride in 270ml clean water	 30ml hypochloride 270ml clean water	- Accidental splash of blood, leaking of body fluid - Mop with dry cloth, then covered with hypochloride soaked cloth or absorbent - Clear up ultimately	Soak for 5 Mins	5000ppm
1:49	1part of hypochloride in 49 parts of clean water ----- e.g. 100ml hypochloride in 4900ml clean water	 100ml hypochloride 4900ml clean water	- Bed frame, chair, mattress, wheel chair, stretcher - Vomit: Immediate clear up, then disinfect - Mop	Soak for 30 Mins	1000ppm
1:99	1part of hypochloride in 99 parts of clean water ----- e.g. 100ml hypochloride in 9900ml clean water	 100ml hypochloride 9900ml clean water	- Bed pan 、 Urinal	Soak for 10 Mins	500ppm
1:249	1part of hypochloride in 249 parts of clean water ----- e.g. 16ml hypochloride in 3984ml clean water	 16ml hypochloride 3984ml clean water	- Medication Cup 、 Toys	Soak for 10 Mins	200ppm

* Choice of Hypochloride - Clorox/Hypo 6

ppm = parts per million

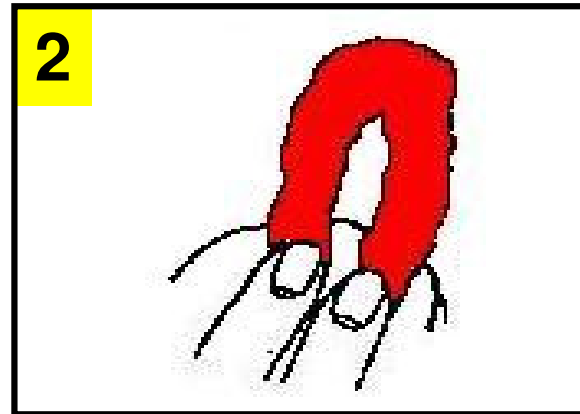
Cleansing Utensils Color Code System

Utensils/ Location	Office/Nurse Station/ Other Non-clinical Areas	Pantry	Staff's Toilet/ Changing Room		Patient's Toilet/ Changing Room	Sluice Room	Patient Areas	Transmission Based Precaution
								Droplet Precaution
Disposable Gloves								
Cleansing Cloth								 Disposable Cloth or Immediate Laundry Treatment after use
Cleansing Mope								
Drying Mope								

紅色醫療廢物袋的「鵝頸結」封口方法
“Swan-neck” method of sealing red bag for clinical waste



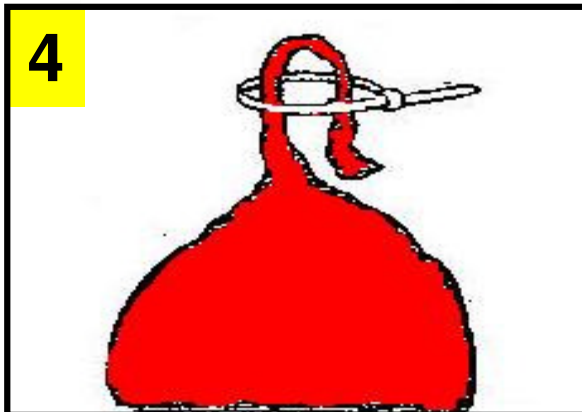
紅色廢物袋在3/4滿時就要封妥
Seal clinical waste red bag when no more than 75% full



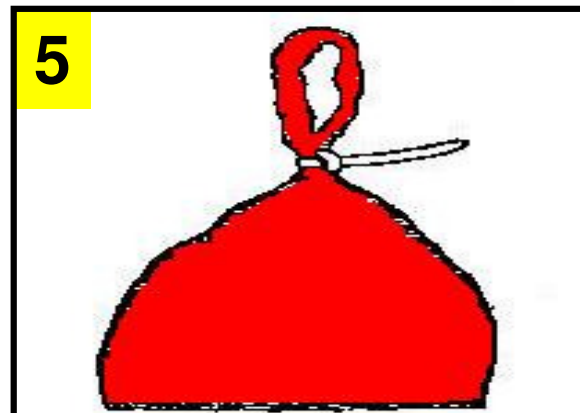
中間扭曲後對摺
Twist firmly then double over



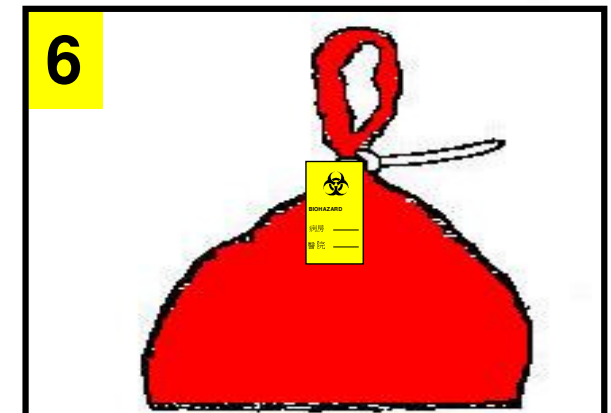
緊握著已扭曲的部份
Hold the twist firmly



把索膠帶套著紅色廢物袋的頸部
Pass the “gun tie” over neck of the Red Bag



把索膠帶拉緊形成有效的封口
Tighten the seal manually to create an effective seal



將廢物標籤緊緊繫於紅色袋的封口上
The Medical waste label should be tied securely to the neck of the red bag

SECTION B – Specific Response to selected situations

In this section, instead of adopting a disease model which can be non-exhaustive and unpredictable with new emergence of novel infectious disease, based on the unique experience of the tool kit development team and the intention to bring about enlightenment to handle other unknown situations, only SARS and Avian Influenza H5N1 were selected as exemplars to demonstrate comprehensive approach that should be adopted for “Preparedness” and “Response” to specific outbreak situations.

However, tool kit was developed so as to cover every detail practical areas as far as possible so as to reduce risk accordingly. In dealing with other situations, the principles of transmission-based precautions shall always be applied appropriately. There are three categories of Transmission-Based Precautions: **Contact Precautions, Droplet Precautions and Airborne Precautions**. They are used when the route(s) of transmission is (are) not completely interrupted using Standard Precautions alone. For some diseases that have multiple routes of transmission (e.g. SARS, HSI), more than one Transmission-Based Precautions category may be used. When used either singly or in combination, they are always used in addition to Standard Precautions.

Once again, the strategies outlined in the tool kit by no means are the only way of managing emerging infectious diseases and outbreaks. Users are advised to refer to their own context and make appropriate modifications whilst confronting problems like resources limitations. Although the content of the tool kit is believed to be accurate at time of release, users are advised to check updates in relation to emerging infectious disease threats or changes in practice or research.

1. Severe Acute Respiratory Syndrome

Introduction

Severe acute respiratory syndrome (SARS) is a serious form of respiratory failure, caused by a coronavirus, (SARS-associated coronavirus (SARS-CoV)) which was first isolated in 2003. Infection with the SARS virus resulted in acute respiratory distress (severe breathing difficulty) and sometimes death. The world was unprepared for the emergence of SARS and the lack of preparedness resulted in considerable confusion, heightened public concern and increased transmission rates. It was a dramatic example of how quickly world travel can spread a disease but also an example of how quickly a networked health system can respond to an emerging threat.

Background information

This contagious respiratory infection was first described on February 26, 2003 and was identified as a new disease by World Health Organization (WHO) physician, Dr. Carlo Urbani. He diagnosed it in a 48-year-old businessman who had traveled from the Guangdong province of China, through Hong Kong, to Hanoi, Vietnam. The businessman died from the illness as did Dr. Urbani on March 29, 2003, at the age of 46.

In the meantime, SARS was spreading, and within 6 weeks of its discovery, it had travelled throughout many parts of Asia, North America and Europe. According to the World Health Organization (WHO), a total of 8,098 people worldwide became sick with SARS during the 2003 outbreak. The heaviest burden of illness was felt in China, Hong Kong, Taiwan, Singapore, Canada and Vietnam.^{1,2}

The morbidity, mortality and speed and ease of transmission associated with SARS led to the WHO declaring SARS as a global health threat, resulting in the issuance of an unprecedented travel advisory. Daily WHO updates tracked the spread of SARS as it was not clear whether it would become a global pandemic, or would settle into a less aggressive pattern. By June 2003, the epidemic had subsided but even as the number of new cases dwindled, and travel advisories began to be lifted, the sober truth remained: every new case had the potential to spark another outbreak.

Clinical experience

Approximately 23% to 32% of patients with SARS became critically ill.^{3, 4, 5, 6} Acute Lung Injury (ALI) was the most common severe organ dysfunction and occurred in 16% of all patients with SARS and 80% of critically ill patients with SARS. Virtually all patients with ALI required mechanical ventilation. The case fatality rate worldwide was 9.6% but among those with a SARS-related critical illness 50% died.^{5, 6} Mortality was highest amongst elderly patients especially those with co morbidities while children were relatively protected from the illness.⁴ There was no vertical transmission documented in pregnant women.⁷

Symptoms

The hallmark symptoms were fever greater than 38.0 degrees C^{4, 8} and cough, difficulty breathing, or other respiratory symptoms. Symptoms in the order of how commonly they appeared include:

- Fever
- Chills and shaking
- Muscle aches
- Cough
- Headache

Less common symptoms include (also in order):

- Dizziness
- Productive cough (sputum)
- Sore throat
- Runny nose
- Nausea and vomiting
- Diarrhoea

Lower respiratory symptoms usually began 2 to 7 days after symptom onset but these could be the initial presenting symptoms in up to 30% of patients. Gastrointestinal symptoms occurred with variable frequency but included nausea, diarrhoea and vomiting. Tachycardia and tachypnoea were also extremely common. The median time from exposure to symptom onset was approximately one week (1,4).

Two thirds of patients had pulmonary infiltrates on their initial chest X-ray and virtually all had infiltrates by one week. Laboratory abnormalities^{4, 9} included

- Blood clotting tests
- Blood chemistries
 - ALT and CPK were sometimes elevated

- Elevated lactate dehydrogenase
- Sodium and potassium were sometimes low
- Chest X-ray or chest CT scan
- Complete blood count (CBC)
 - Low white blood cell (WBC) count
 - Moderate lymphopenia
- Low platelet count

Confirmatory laboratory testing involved viral serology and/or detection of viral RNA by nucleic acid amplification from samples of serum, nasopharyngeal secretions, urine or stool. Specific tests included the PCR test for SARS virus, antibody tests for SARS, and direct SARS virus isolation. All current tests have some limitations. Negative test results could not reliably exclude the SARS virus until more than 28 days after symptom onset.

Nosocomial transmission from patients to health care workers was a prominent and worrisome feature of the SARS outbreaks. In Hong Kong, almost 25% of the total number of SARS cases comprised health care workers.¹⁰ While in Singapore and Toronto health care workers accounted for approximately half the cases, 20% of whom became critically ill.^{4,6} There were concerns that airway management and mechanical ventilation strategies may have contributed to the high nosocomial transmission rate.

Lung pathology in SARS

Diffuse alveolar damage with varying degrees of organisation was the predominant pathology in the lungs of SARS patients.¹¹ Several phases have been recognized

- **Acute phase:** evidence of hyaline membranes, interstitial and alveolar oedema, mild interstitial infiltrates of inflammatory cells and vascular congestion.
- **Organizing phase:** evidence of interstitial and airspace fibroblast proliferation, and type II cell hyperplasia.

Specific treatment for SARS

Antiviral agents for SARS

During the outbreak in 2003 many different interventions were used in management, including antivirals, like ribavirin, IFN and protease inhibitors, as well as immunomodulatory agents, especially systemic corticosteroids. The uncertain natural history of untreated SARS and the uncontrolled nature of these interventions meant that no drug intervention was of proven benefit or prophylactic value. Despite progress in the search for new antivirals there is still a need for effective antiviral drugs to prevent and treat SARS. Predictive correlations between *in vitro* activity and antiviral effects have not been validated either in animal models or humans infected with SARS.

Community acquired pneumonia and SARS

During the SARS epidemic patients with new lung infiltrates were initially treated with antibiotics consistent with published current guidelines on the management of community-acquired pneumonia.¹² Patients with SARS in the ICU should be treated for drug resistant and atypical pathogens. *Pseudomonas aeruginosa* should be covered if patients have risk factors such as structural lung damage, recent hospitalization, high dose steroids, malnutrition, or recent antibiotics.

Clinical management of severe SARS

Patients with SARS who developed hypoxaemic respiratory failure (16%) met the current definition of Acute Lung Injury (ALI) and Acute Respiratory Distress Syndrome (ARDS).¹³ These include refractory hypoxaemia, bilateral diffuse pulmonary infiltrates on chest X-ray and a $\text{PaO}_2/\text{FIO}_2$ ratio of less than 300. The recommended clinical management of severe SARS is the same as for patients with ALI/ARDS as the clinical and pathological manifestations of lung injury from severe SARS cannot be distinguished from ALI or ARDS.

Mechanical ventilation of severe SARS

Survival in patients with ALI/ARDS is improved by adopting a strategy of ventilation with low tidal volumes (6ml/kg predicted body weight).¹⁴ The mode of ventilation in patients with SARS is controversial. Many clinicians believe that the risks of intubation for nosocomial transmission are significant and favour noninvasive mechanical ventilation. On the other hand many physicians favour early intubation under relatively controlled conditions and that noninvasive ventilation may itself be associated with nosocomial transmission to health care workers. Furthermore, while noninvasive ventilation might be considered as a modality for short-term improvement in hypoxaemic respiratory failure, SARS is generally a disease requiring longer term support as this form of lung injury is not rapidly reversible.

Corticosteroids in severe SARS

During the SARS epidemic many patients were treated with either pulse steroids or very high doses of corticosteroids. The resultant small studies that were published were not randomized controlled trials, which is not surprising considering the rapid emergence of SARS in a rapidly short time period. Anecdotally, several cases of more rapid clearing of chest X-rays have been reported and one case series reported more rapid resolution of fever, respiratory symptoms and chest X-rays but no differences in survival.¹⁵

Indications varied but corticosteroids were generally reserved for patients with SARS and persistent fever, worsening hypoxaemia, worsening dyspnoea and progression of lung pathology on chest X-ray. Pulse steroids were generally administered at doses of 500-1000mg of methylprednisolone intravenously for three days but often longer. Many patients also received low dose steroids as recommended in the Surviving Sepsis Campaign Guidelines.¹⁶

However in patients with early ALI/ARDS or sepsis pulse steroids or high dose steroids do not appear to improve survival^{17,18,19} and are not recommended.²⁰ A large study by the ARDS Clinical Trials Network does not support the use of steroids for late or unresolving ALI or ARDS.²¹ There is also increasing evidence of long-term morbidity – muscle weakness and neuropathy.^{18,22,23,24}

Adjuvant strategies for severe SARS

The morbidity and mortality in critically ill patients is decreased by several adjuvant strategies as recommended in the most recent Surviving Sepsis Campaign guidelines.²⁵ These include

- Deep vein thrombosis prophylaxis. Depending on the risk factors present this can be based on pharmacologic or physical methods.^{26, 27, 28, 29}
- Stress ulcer prophylaxis. H2 receptor inhibitors are efficacious.^{30,31}
- Sedation protocols in critically ill mechanically ventilated patients.^{32,33,34}

- Avoidance of neuromuscular blockers because of prolonged neuromuscular weakness and paralysis, especially when used in conjunction with steroids.^{35,36,37}
- Semirecumbent position with head of the bed elevated to 45° in mechanically ventilated patients (38-42) to limit aspiration risk and prevent the development of ventilator-associated pneumonia.

Preparation of the health care worker and the health care system

There have been many publications describing the outbreak of SARS in 2003.^{3,4,5,6,43} Specific recommendations concerning clinical issues, infection control, expansion of facilities and research associated with SARS have also been published.^{44,45,46,47}

Organizational planning

SARS highlighted the need for a high level of vigilance and alertness throughout all parts of the healthcare system. Contingency planning prior to an outbreak and providing a leadership structure within a hospital and within individual departments is essential. The framework of response to infectious disease outbreaks within the Hospital Authority begins with watchfulness and surveillance of abnormal patterns of infections, which is part of the everyday risk management culture within the practice of medicine. When an abnormal pattern of infectious disease is detected a swift assessment by the hospital infection control team on the significance of the infection, risk of hospital spread, availability of existing knowledge and guidance to treatment and control, and potential threat to the community enables the hospital to take appropriate actions to manage and control the outbreak. When it is considered that the outbreak poses a significant risk to the hospital system the Hospital Authority initiates a contingency response with a clear command structure. In addition the Government has its own alert and response system for combating infectious diseases on both a local and regional basis.

Within the specialty of intensive care a culture has developed where everyone recognizes that their work may have wider public health implications and that an illness in one patient may have consequences for the whole ICU. Many of Hong Kong's ICUs have upgraded their isolation facilities and may have a separate ICU specifically for the admission of SARS cases or other infectious diseases patients. Cohorting and isolating appropriate patients is part of the everyday management of an ICU. In addition, all ICUs have contingency plans in place in the event of SARS or Highly Pathogenic Avian Influenza occurring in Hong Kong. These focus on staff deployment and training, hardware procurement, and surge capacity.

The CDC has provided guidelines to help healthcare facilities prepare for the outbreak of an infectious disease.⁴⁵ These emphasize the importance of

- Identified leadership structure
- Delegation of responsibility
 - Sustaining the work force
 - Access controls
 - Communication
 - Education and training
 - Infection control procedures
 - Psychosocial support
 - Data collection
 - Clinical management protocols

Consideration also needs to be given to the following areas:

- Should SARS patients be cared for in one or several institutions
- Should SARS patients be cared for in separate ICUs
- Transportation of non-SARS patients to other facilities or ICUs
- Transportation of potentially contagious SARS patients within a healthcare facility
- Mobilization of manpower as staff may be lost due to fear, quarantine and illness
- Ensuring adequate and advance supplies of consumables and durable materials and equipment
- Clinical and infectious disease training for all healthcare workers
- Communication strategies both horizontally and vertically. Intensive care leadership will need to communicate with the hospital administration, infectious disease specialists, infection control teams, SARS ward physicians, Accident and Emergency specialists, the laboratory, and public health officials.
- Identifying psychosocial support for health care workers. Despair, depression and a sense of isolation were common reactions in health care workers during the SARS epidemic. Some health care workers were viewed as being high risk themselves by the community because of their work with SARS patients. Health care workers also had concerns for their family members during SARS not just in terms of the risk to their families but also concerning childcare, economic support and the provision of appropriate accommodation.

Infection control precautions in the ICU

Effective protection of health care workers is of utmost importance and is also crucial in breaking the chain of transmission. In the ICU, the risk of transmission is high as viral shedding peaks during the second week of the illness¹⁵ when admission is usually required. Droplet spread can be increased by aerosol-generating interventions, for example, nebulisers, intubation and bronchoscopy.

Six key strategies are crucial as infection control measures in the ICU to prevent nosocomial transmission of SARS.

- Dilution and removal of contaminants through the use of negative pressure isolation rooms
- Use of personal protective equipment, e.g. gowns, gloves, eye, face and respiratory protection
- Hand hygiene
- Environmental cleaning and disinfection
- Source control measures aimed at containing the patient's secretions
- Limiting contact with patients

Considerable time should be spent on increasing awareness, education and vigilance of all health care workers with regards an infectious diseases outbreak and the standards required for personal protection. Training extends from the most senior to the most junior of staff. All hospital staff should undergo yearly training and refresher courses in infection control. Staff within ICU should undergo yearly N95 mask fit testing.

On a day-to-day basis, maintenance of a high level of vigilance should be paramount. All staff should change into ICU attire before entering the ICU. In addition, surgical masks and jackets (not white coats) should be standard uniform. All non-ICU staff entering the ICU should wear surgical masks and colour coded gowns to reflect their status. Hand washing programs should be regularly monitored and reinforced. Non-clinical areas previously located within an ICU, such as storerooms,

library, seminar room, doctors on call rooms, offices, and kitchens should be moved out of the immediate vicinity of the clinical areas. The only exceptions are the relative's interview room and an emergency shower and toilet. There should be no eating or drinking within the ICU environs.

Monitoring and policing the system takes considerable effort. Each day an assigned registered nurse should act as the monitor. Infectious control infringements should be identified and staff education programs conducted on a regular basis.

All patients should be assessed as to their risk of infectious disease prior to admission. Suspect cases are identified, isolated and screened until proven negative either for SARS or HPAI. Personal protective equipment should be readily available at the entrance and at nominated sites within the ICU.

Procedures involving the airway should be viewed as placing staff at risk. Full personal protective equipment including N95 mask and face shield should be routinely worn before and during endotracheal intubation, flexible bronchoscopy, and percutaneous tracheostomy. In-line, closed endotracheal suction system should be routine. Nebulizers should not be used in ICU and BiPAP only under strict guidelines. Patients receiving BiPAP should be isolated and the level of PPE raised. Training programs on manual handling of bodily secretions should be regularly conducted.

Table 1. Summary of appropriate standards and infection control precautions necessary when caring for SARS patients^{44,46}

Airborne infection isolation room

Negative pressure isolation rooms: equipped with ante-chamber

Avoid disruption of negative pressure barrier

Personal protective equipment (PPE)

Basic: gown, gloves, eye protection (i.e. goggles or face shield), and respiratory protection (i.e. N95 mask)

During aerosol generating procedures

Provide written instructions to healthcare workers as to how to put on and remove PPE

Avoid touching face and surfaces

Monitor PPE use: concept of a 'policeman'

Hand hygiene

Ensure availability of hand hygiene products (i.e. sinks with antibacterial soap, disposable towels and alcohol-based handrub.

Environmental cleaning and disinfection

Assigned staff to clean SARS environment

Clean horizontal and frequently touched surfaces at least daily

Equipment and procedures

Oxygen therapy

Avoid bag-valve mask ventilation

Intubation

Mechanical ventilators

Non-invasive ventilation

Bronchoscopy

Patient transportation

Avoid unless essential

Visitors and personnel

Limit to essential staff only

Staff education

Provide training on infection control procedures

Provide training on donning and removal of PPE

Emphasize importance of vigilance

Emphasize importance of alerting supervisors when breaches occur

Prognosis

As the first wave of SARS began to subside, the death rate proved to have been about 14 to 15 percent of those diagnosed. In people over age 65, the death rate was higher than 50 percent. Many more were sick enough to require mechanical ventilation and more still required hospitalization in intensive care units.

Intensive public health policies are proving to be effective in controlling outbreaks. Many nations stopped the SARS epidemic within their own countries. All nations must be vigilant, however, to keep this disease under control. Viruses in the coronavirus family are known for their ability to change (mutate) in order to better spread among humans.

Conclusion

In the short term the 2003 SARS epidemic was devastating to the people and economy of Hong Kong. In the longer term it provided Hong Kong an opportunity to prepare for future infectious disease outbreaks. Many lessons have been learned and constant revision and refinement of new policies, procedures, protocols and contingency plans is ongoing. Within ICU, the epidemic has resulted in a change in ICU culture with far greater emphasis on the detection, surveillance, prevention and management of infectious diseases. Protection of health care workers is paramount.

International experts in infectious disease and epidemiologists consider it likely that there will be another outbreak of a seriously transmissible respiratory pathogen. Clinicians, hospital administrators and government officials across the world have addressed organizational issues within health care systems and issues concerning health care workers so that it might be better able to handle the next outbreak. As a result it is hoped that there will be less confusion, decreased public concern and decreased transmission rates.

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2. Avian Influenza

Virology of Avian Influenza (H5, H7, H9)

- Influenza viruses are enveloped RNA viruses that have 8 segmented genomes.
- There are 2 major antigenic glycoproteins embedded in their surface membrane, the hemagglutinin (HA) and neuraminidase (NA).
- H5 and H7 avian influenza viruses are highly pathogenic avian influenza (HPAI) that can cause sudden onset of rapidly progressive fatal diseases in birds and poultry.
- Highly pathogenic H5N1 viruses replicate in ducks' respiratory and intestinal tracts and are excreted in large amount in respiratory secretions and in faeces for 11 days and some for 17 days and longer. Infected ducks can remain asymptomatic.
- Avian influenza can infect birds, poultry, cats, leopards and tigers but generally do not affect human beings. Under exceptional situations, e.g. close contact at high concentration with avian virus, human can be infected.
- Studies found that the hemagglutinin (HA) gene sequence of H5N1 coded multiple basic amino acids, which inserts adjacent to a cleavage site. This change enabled avian influenza to be cleaved by intracellular proteases, resulting in widespread systemic infections and multi-organ involvement.
- H5N1 virus infects the macrophages and alveolar epithelial cells. It is a potent cytokine inducer (especially TNF- α and interferon- β). It prompts unregulated cytokine production in macrophages. This may contribute to the unusual severity of H5N1 diseases and tissue damages in infected host. A higher response of CCL3, CCR1 and CCR5 in adult macrophages than in neonatal macrophages is observed.

Current Situation

- Since December 2003, outbreaks of H5 avian influenza among poultry had been reported in many Southeast Asian and European countries.
- As of 30 May 2009, a total of 429 confirmed human cases of H5N1 avian influenza infection with 262 deaths have been reported in Azerbaijan, Bangladesh, Egypt, Iraq, Laos, Myanmar, Nigeria, Cambodia, China, Indonesia, Pakistan, Turkey, Djibouti, Thailand and Vietnam. Most of these cases have been linked to direct contact with diseased birds.
- WHO reported that the overall case fatality of human avian influenza A (H5N1) infection is 61%; it is highest among persons 10 to 19 years of age and lowest among persons 50 years of age or older.
- H7 and H9 influenza A became statutorily notifiable diseases in addition to H5 diseases since 31 December 2004.
- Human cases of Avian influenza in Hong Kong since 1999: Five cases of H9N2 noted without any confirmed human H5N1 cases.

CLINICAL FEATURES

Incubation period

The incubation period of avian influenza A (H5N1) may be longer than other known human influenza virus. In 1997, most cases occurred within 2 to 4 days after exposure. In clusters in which limited, human-to-human transmission has probably occurred, the incubation period ranged from 3 to 9 days.^{6,34}

Infectivity and human to human transmission

- Direct avian-to-human H5N1 virus transmission is the predominant means of human infection. Handling of sick or dead

poultry during the week before the onset of illness is the most commonly recognized risk factor. As of the date of this document, no sustained efficient human-to-human transmission of avian influenza A is known to have occurred, and there is no evidence to suggest airborne transmission from humans to humans²⁷. But limited, nonsustained human-to-human transmission has probably occurred during very close, unprotected contact with a severely ill patient. Respiratory secretions and all bodily fluids, including faeces, should be considered potentially infectious.³⁰

- The following are considered risk factors for acquiring H5 infections
 - Exposure to live infected poultry one week before onset of illness⁷⁻⁸
 - Close physical contact with H5 infected patients⁹
 - Health care workers¹⁰
 - Laboratory staff handling H5 virus

Special clinical features

- Most patients with influenza A (H5N1) have initial symptoms of high fever (typically a temperature of more than 38°C) and an influenza-like illness with lower respiratory tract symptoms²⁰. However, absence of lower respiratory symptoms among children has been reported more frequently since 2005. Early consultation and antiviral therapy may have altered the clinical course of these illnesses.^{34, 35}
- Gastrointestinal symptoms (including diarrhoea, abdominal pain, and vomiting) are evident in 50% of the 1997 Hong Kong H5N1 avian flu cohort¹¹⁻¹² and in 70% of the 2003- 2004 Vietnam/ Thailand cohort¹³. Watery diarrhoea may precede respiratory manifestation by up to one week²¹
- Isolated encephalopathic illness or diarrhoea without apparent respiratory symptoms have also been reported²².
- Conjunctivitis is observed in 87.6% H7N7 infected persons.¹⁴
- Symptoms of H9N2 infection are generally mild and self limiting.¹⁵
- Leukopenia, lymphopenia, mild-to-moderate thrombocytopenia, and elevated levels of aminotransferases are common but not universal. Other reported abnormalities include elevated levels of creatine phosphokinase, hypoalbuminemia, and increased d-dimer levels and changes indicative of disseminated intravascular coagulopathy.^{34, 35}

Clinical progression and mortality

- Patients with severe H5N1 diseases may develop primary viral pneumonia with subsequent progression to respiratory failure with manifestation of Adult Respiratory Distress Syndrome (ARDS). The median time from onset of illness to ARDS was reported to be 6 days in Thailand.²⁰
- Multi-organ failure with signs of renal dysfunction and sometimes cardiac compromise has been common. Other complications included ventilator-associated pneumonia, pulmonary hemorrhage, pneumothorax, pancytopenia, Reye's syndrome, and sepsis syndrome without documented bacteraemia.²⁰
- The median day for mortality is 9-10 days after symptoms onset (ranges from day 6 – day 30).
- Risk factors predicting severe diseases and poor prognosis include old age, delayed presentation to hospital, early presence of pneumonia, leucopenia and lymphopenia as well as increased levels of lactate dehydrogenase at presentation.^{11,12,20,33}

DIAGNOSIS

Radiological Features

- Radiographic changes include diffuse, multifocal, or patchy infiltrates; interstitial infiltrates; and segmental or lobular consolidation with air-bronchograms.
- Radiographic abnormalities were present a median of 7 days after the onset of fever in one study.²³
- There are no specific or diagnostic radiological features except rapid and dramatic worsening of chest X-ray.

Laboratory Diagnosis for Avian Influenza^{20,33,34,35,48}

- Detection of viral RNA by means of conventional or real time reverse-transcriptase polymerase chain reaction remains the best method for the initial diagnosis of influenza A (H5N1) infection.
- Unlike other influenza A infection, H5N1 viruses can replicate efficiently only in cells in the lower region of the respiratory tract where the avian receptors are prevalent. Accordingly, oropharyngeal swab specimens and lower respiratory tract specimens (e.g. bronchoalveolar lavage or tracheal aspirates, if available) are the preferred specimens for testing as the diagnostic yields are higher. Nasal or nasopharyngeal swab specimens are acceptable. Other non-respiratory specimens, e.g. stool, CSF for viral culture should be taken as clinically indicated.
- Detection of H5N1 viral RNA in faeces or blood may provide prognostic information though it has lower diagnostic sensitivity than those from respiratory specimens.
- Specimens collected within the first 3 days of illness onset are more likely to detect H5N1 influenza virus. Negative result in single respiratory specimen do not rule out influenza A (H5N1) virus infection. Repeated collection of multiple specimen types is recommended.
- WHO recommends against the use of rapid antigen tests for the detection of human infections of avian influenza because:
 - Poor clinical sensitivity for the detection of influenza A (H5N1) virus
 - Unable to differentiate between human and avian subtypes of influenza A viruses.
 - A negative rapid test result does not exclude human infection with avian influenza viruses.
- The turnaround time of these tests are as follows:

	Immunofluorescence assay	RT-PCR	Virus culture	Serology
Turnaround time *	< 24 hours	4-6 hours	2-10 days	<24 hours**

* based on working day, and when specimens were received

**requires paired sera of 10-14 days interval to confirm the diagnosis

Immunofluorescence assay

Immunofluorescence assay (IFA) can be used for the detection of virus in either clinical specimens or cell culture using H5-specific monoclonal antibody

Virus Culture

- Specimen inoculated into Mardin-Darby Canine Kidney cells to produce cytopathic effects within.
- Sub-typing can be done subsequently by immunofluorescence staining with H5 specific monoclonal antibodies or haemagglutination-inhibition test or using H5 specific RT-PCR.

Paired serology⁴⁸

- Detection of anti-H5 antibodies is essential for epidemiological investigations and may provide retrospective diagnostic confirmation in patients.
- Microneutralization assay are the most reliable methods for the measurement of highly pathogenic avian influenza A specific antibody. But they are labour intensive and require biosafety 3 facilities.
- To detect any significant 4-fold rise or more or single titre of 1:80 or more in convalescent phase samples are considered to be diagnostic.

ANTIVIRAL THERAPY

- In Hong Kong, antivirals available for the treatment and/or prophylaxis of influenza A include the M2 inhibitors (amantadine) and the neuraminidase inhibitors (zanamivir and oseltamivir).
- Laboratories in WHO influenza network showed most recent H5N1 strains are **resistant against M2 inhibitors** (Amantadine and Rimantadine).¹⁷
- WHO advises against the use of M2 inhibitors because of risk of increasing the selective pressure for resistant strains with pandemic potential.¹⁷
- Oseltamivir remains the primary antiviral agent of choice for the treatment of A(H5N1) virus infections. Though there is no clinical controlled trial on the optimal dose and duration of therapy for H5N1 infected patients, observational evidence suggests that early oseltamivir administration may be associated with reduced mortality in patients.^{36,37}
- In contrast to uncomplicated seasonal influenza, A(H5N1) disease is associated with higher levels and more sustained viral replication.³³ Oseltamivir treatment is warranted for patients with influenza A(H5N1) virus infection presenting to clinical care at a later stage of illness. The optimal treatment regimen of oseltamivir should therefore be guided by the clinical course of the disease in the patient.
- Early prescription with modified regimen of oseltamivir for adults, including a two-fold higher dosage (150 mg BD), longer duration (a total of 10 days) and combination therapy with amantadine or rimantadine 100 mg BD (unless there is good reason to believe that the virus is likely to be amantadine resistant) has been recommended by some experts as an alternative.^{37,38} No adverse pharmacologic interactions have been shown in humans.⁴⁰
- For infants <1 year of age, consult paediatric infectious disease specialists for advice on off-label use of oseltamivir with informed consent in this age group.
- For children aged 1-12 years old, the modified regimen of oseltamivir treatment should be 4mg/kg BD for 10 days. Consultation with paediatric infectious disease specialists is necessary in case this regimen is considered. For ease of administration :
 - ≤15 kg 60mg BD x 10 days
 - >15 - 23 kg 90mg BD x 10 days
 - >23 - 40kg 120mg BD x 10 days
 - >40 kg 150mg BD x 10 days
- Whereas, the dosage of amantadine / rimantadine for children should be as follows: Children 1-9 years and Children ≥10 years who weigh <40 kg: 5 mg/kg/day in 2 divided doses (maximum dose: 150 mg/day). Children ≥10 years who weigh ≥40 kg: 100 mg twice daily.
- FDA advises clinicians to closely monitor patients taking oseltamivir for signs of abnormal behaviour, in particular, if a dose higher than the standard recommended dose of oseltamivir is used. Recent study from Beijing showed that Chinese and Japanese may be at higher risk of neuropsychiatric adverse events following oseltamivir administration, as

a result of a single nucleotide polymorphism in the human cytosolic sialidase gene being over-represented in these 2 populations⁴⁹. Hence, if neuropsychiatric symptoms occur, the risks and benefits of continuing treatment should be evaluated.

- The oral bioavailability of oseltamivir in patients with severe diarrhoea or gastrointestinal dysfunction related to influenza A (H5N1) virus infection or those in whom the drug has been administered extemporaneously (e.g. by means of a nasogastric tube) is uncertain.^{30,37,39}
- During oseltamivir therapy, the emergence of highly resistant variants with an H274Y neuraminidase mutation may be associated with a fatal outcome.³⁸ Infection by influenza A (H5N1) viruses containing an N294S mutation that causes a reduction in oseltamivir susceptibility by a factor of 12 to 15 times was reported to be present in two Egyptian patients with fatal disease before therapy⁴¹, and avian influenza A (H5N1) viruses with reduced susceptibility to neuraminidase inhibitors are occasionally detected.⁴²
- Zanamivir is active against oseltamivir-resistant variants with N1 neuraminidase mutations at H274Y or N294S, the value of inhaled zanamivir has not been studied in human influenza A (H5N1) disease. Suboptimal delivery to sites of infection in patients with pneumonic or extrapulmonary disease is a concern.^{30,43}
- Recent study from Hong Kong showed that mice infected by the H5N1 virus show significant improvements in survival rate ($P = 0.02$), survival time ($P < 0.02$), and inflammatory markers ($P < 0.01$) if they are treated, at 48 hours after viral challenge, with a triple combination of zanamivir, celecoxib, and mesalazine, when compared with zanamivir alone.⁵⁰

INFECTION CONTROL MEASURES

- Standard precautions incorporated with respiratory hygiene and cough etiquette should be applied to ALL patients at ALL times, including those who have avian influenza. In addition to standard precautions, transmission-based precautions which include droplet, contact and airborne infection isolation precautions should be adopted based on risk assessment.
- Apply standard, droplet and contact precautions for routine patient care of suspected or confirmed AI patients. During aerosol-generating procedures in A (H5N1) virus-infected patients, health-care workers should wear eye protection, gowns, gloves and particulate respirators that are at least as effective as the NIOSH-certified N95, EUFFP2 or equivalent. Besides, procedure should be undertaken in an airborne precaution room.
- Negative pressure isolation room with adequate ventilation (>12 air changes per hour) is recommended if available.
- Such practice should be implemented at time of admission and continued until 7 days after resolution of fever for adult persons (> 12 years of age), and 21 days after onset of illness for children (≤ 12 years of age) as young children can shed virus at higher titres for up to 21 days
- HEPA filter should be attached to the expiratory ports of ventilators, and a closed tracheal suctioning system used for aspiration of respiratory secretions to reduce generation and spread of infectious aerosols. To minimize risk of nosocomial infection, maintain adequate medical ward ventilation during application of oxygen therapy or noninvasive positive pressure ventilation (NPPV). If NPPV is to be used, a closed system with a head helmet and expiratory port HEPA filter is recommended whenever possible.
- Limit the number of health care workers with direct contact with patient and limit access to the environment of patients.
- Take proper infection control precautions and personal protective equipment (PPE) when collecting the specimens.
- Those caring for infected patients should monitor temperature twice daily and report any influenza like illness for 10 days after the last possible AI exposure.

- If unwell for any reason, health care workers should not be involved in direct patient care. Health care workers with fever (temperature $\geq 38^{\circ}\text{C}$) and patient contact should undergo appropriate diagnostic testing. If an alternative cause is not identified, they should be treated immediately with oseltamivir on the assumption of influenza infection.
- Those with a possible exposure to infectious aerosols, secretions, or other body fluids or excretions because of a lapse in aseptic technique should be considered for post-exposure chemoprophylaxis with oseltamivir as soon as possible for 7 to 10 days. The duration of post-exposure prophylaxis may be extended to 14 days if continuous spread in the source environment occurs.
- Adults and adolescents 13 years of age or above: 75mg QD x 7-10 days after last known exposure.
- Children 1-13 years old : (*Body weight Duration after last known exposure*)
 - ≤ 15 kg (30 mg QD x 7-10 days)
 - $>15 - 23$ kg (45 mg QD x 7-10 days)
 - $>23 - 40$ kg (60 mg QD x 7-10 days)
 - > 40 kg (75 mg QD x 7-10 days)
- At the emergency response level, pre-exposure prophylaxis for the health care workers involving direct patient care should be considered.

H5N1 VACCINE

- Current influenza vaccine against circulating H3N2 and H1N1 subtypes is not effective against H5N1 and other types of avian influenza virus.
- Vaccination with the seasonal inactivated [influenza vaccine](#) is to reduce the risk of coinfection and potential reassortment between avian and circulating human strains.
- Multiple vaccines are currently under study and one non-adjuvanted H5N1 vaccine has been approved by the FDA in April 2007⁴⁴. A major problem with the development of an effective vaccine against avian influenza (and H5, in particular) has been poor immunogenicity in humans^{45,46}.
- Non-adjuvanted H5N1 vaccine is intended for use in adults from 18 to 65 years of age and is given as two doses one month apart. The vaccine was well-tolerated; the most common side effects were pain at the injection site, headache, malaise, and muscle pain. The vaccine was safe, immunogenicity was modest.
- Adjuvanted vaccines are associated with better overall immune responses despite a lower dose of antigen to be given. Some of these "antigen-sparing" approaches have used subvirion versus whole virion vaccine design. Up till now, a two doses regimen of an adjuvanted H5N1 (1194-clade 1) vaccine, at 3.8 μg , is available and conferred significant antigen sparing as well as cross clade (to cover clade 2) neutralising antibody response⁵¹.

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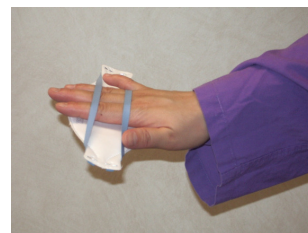
Remarks : C = Checklist , G = Guideline, L = Leaflet , P = Poster , PG = Photo Guide

N95 Respirator Wearing Guide

Applicable to 3M™ 9210(N95) , 1862 (FFP2) , 1870(FFP2/N95) Folding Type Respirator

All these models have water resistant properties

1. Staff should wear N95 respirator in designated area, place both securing straps (upper and lower) to outward side as shown in photo.
2. Pre-mould the nose bridge metal bar with slight curvature, then spread out the respirator to cup shape.
3. Putting on the respirator – metal bar (Upper) side should be on top and resting on nose bridge area, the other (lower) side should cover chin snugly with lower securing strap pulled over to posterior neck below earlobe level.
4. Pull the upper securing strap over to upper occipital area. Tidy both securing straps and avoid twisting, finely adjust respirator position to maximize comfort and fitting.
5. Bi-manually place finger tips on the ridge of nose bridge, apply even and gentle pressure gradually outward to mode metal bar according to nose and face contour.
 - **Caution : Don't ever try to pinch the metal bar by only one hand. This could cause sharp angle formation of metal bar and lead to leakage thus causing respirator failure.**
6. **Positive Pressure Seal Check** : Bi-manually and gently conceal respirator, blow air out intentionally. If leakage of air out via rim of respirator is felt (usually warm), readjustment of securing straps is indicated.
Negative Pressure Seal Check : Bi-manually and gently conceal respirator, suck air in intentionally. Slight collapse of respirator is normal and indicates proper wearing. If leakage of air in via rim of respirator is felt (usually cool), readjustment of securing straps is indicated.



Caution : Never enter isolation or high risk area before respirator is properly worn!

N95 Respirator Wearing Guide

Applicable to 3M™1860 , 3M™1860S ; Gerson 2735、 2735S & 2737

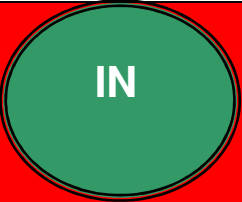
3M™1860、 1860S ; Gerson 2735S & 2735 have water resistant properties

Gerson 2737 does not have water resistant properties

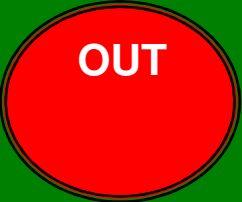
1. Staff should wear N95 respirator in designated area, place hand through both securing straps (upper and lower) as shown in photo.
2. Putting on the respirator – metal bar (Upper) side should be on top and resting on nose bridge area and the lower side should cover chin snugly.
3. Pull the lower securing strap over to posterior neck below earlobe level.
4. Pull the upper securing strap over to upper occipital area. Tidy both securing straps and avoid twisting, finely adjust respirator position to maximize comfort and fitting.
5. Bi-manually place finger tips on the ridge of nose bridge, apply even and gentle pressure gradually outward to mold metal bar according to nose and face contour.
 - **Caution : Don't ever try to pinch the metal bar by only one hand. This could cause sharp angle formation of metal bar and lead to leakage thus causing respirator failure**
6. **Positive Pressure Seal Check** : Bi-manually and gently conceal respirator, blow air out intentionally. If leakage of air out via rim of respirator is felt (usually warm), readjustment of securing straps is indicated.
Negative Pressure Seal Check : Bi-manually and gently conceal respirator, suck air in intentionally. Slight collapse of respirator is normal and indicates proper wearing. If leakage of air in via rim of respirator is felt (usually cool), readjustment of securing straps is indicated.



Caution **Never enter isolation or high risk area before respirator is properly worn!**

	Protective Measures Step by Step
	 Wash Hands with Antiseptics 
	Put on N95 Mask 
	 Wash Hands with Antiseptics 
	Put on Cap 
	Put on Full Face-shield 
	Put on Gown 
	 Wash Hands with Antiseptics 
	Put on Gloves

Gowning Area

	Protective Measures Step by Step
	Remove Gloves 
 	Wash Hands with Antiseptics 
	Remove Gown 
 	Wash Hands with Antiseptics 
	Remove Full Face-shield 
	Remove Cap 
 	Wash Hands with Antiseptics 
	Remove N95 Mask 
 	Wash Hands with Antiseptics 
	Put on Surgical Mask

PPE Donning & Removal Assessment Checklist

Name of Staff: _____

Assessment Date : _____

Department: _____

Assessor : _____

PPE Donning Assessment



Step	Action	Action Requirement	Pass	Fail	Remarks
1	Wash hands OR Use Alcohol Based Handrub	Wash hands or hand rub five times in each step (according to hand hygiene photo guide)			
2	Wear N95 Respirator	Perform Fit Test (According to the wearing method of N95 Respirator)			
3	Wash hands OR Use Alcohol Based Handrub	Wash hands or hand rub five times in each step (according to hand hygiene photo guide)			
4	Put on Disposal Cap	Cover all hair and both ears			
5	Put on Full Face-shield	Wear on forehead			
6	Put on Disposal Gown	Cover the whole body, well tie the string & cannot touch the floor (string tie on the side of gown)			
7	Wash hands OR Use Alcohol Based Handrub	Wash hands or hand rub five times in each step (according to hand hygiene photo guide)			
8	Put on Latex Gloves	Put on gently and wrap both sleeves			

PPE Removal Assessment



Step	Action	Action Requirement	Pass	Fail	Remarks
1	Remove Latex Gloves	Put down gently & dispose into waste bin			
2	Wash hands OR Use Alcohol Based Handrub	Wash hands or hand rub five times in each step (according to hand hygiene photo guide)			
3	Remove Disposal Gown	Loose the string of body first, & then the string of neck, remove gown gently and dispose into waste bin			
4	Wash hands OR Use Alcohol Based Handrub	Wash hands or handrub five times in each step (according to hand hygiene photo guide)			
5	Remove Full Face-shield	Motion gently: put down forward & dispose into waste bin			
6	Remove Disposal Cap	Motion gently: put down backward & dispose into waste bin			
7	Wash hands OR Use Alcohol Based Handrub	Wash hands or hand rub five times in each step (according to hand hygiene photo guide)			
8	Remove N95 Respirator	Motion gently: hold by hand to remove & dispose into waste bin			
9	Wash hands OR Use Alcohol Based Handrub	Wash hands or hand rub five times in each step (according to hand hygiene photo guide)			
10	Put on Surgical Mask	Cover nose & mouth tightly			

PERSONAL PROTECTIVE EQUIPMENT (Avian Flu) Photo Guide

Standard precautions for ALL patients

Transmission based precautions as indicated

**** based on risk assessment**

Risk Assessment Risk Item	High Risk Patient Areas	Other Patient Areas
1. Enter isolation room (No patient contact)	  ** N95 Respirator or Surgical Mask	 Surgical Mask
2. Close patient contact (<1 meter)	  ** N95 Respirator or Surgical Mask    Disposable Gown Full Face Shield or Goggles	 Surgical Mask
3. Procedures with high risk of generating aerosols (e.g. NPA, BiPAP, Resuscitation, Intubation, Nebulizer, Suction, and Brochoscopy) and requiring prolong close contact with affected patients	 N95 Respirator   Disposable Gown Disposable cap    Latex Gloves Full Face Shield or Goggles	  ** Surgical Mask or N95 Mask   Disposable Gown Latex Gloves   Full Face Shield or Goggles
4. Other activities, no anticipated patient contact	 Surgical mask	 Surgical mask

Wear Face Shield

Avoid Splash

Protect Mucous Membrane

Ensure tight connection



Forceful Aspiration of tissue



Routine sputum suctioning



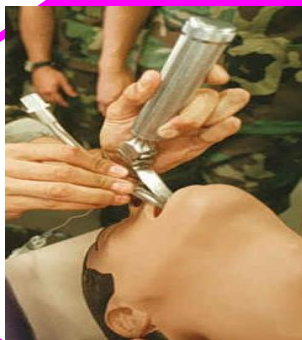
Put on your face shield



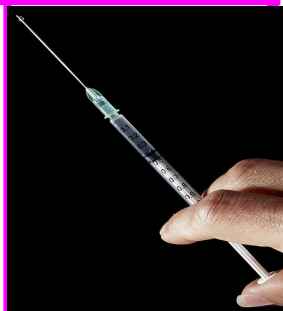
Routine wound cleansing



High risk procedure



Injection resistant



Summary of Transmission-based Precaution

Summary of Recommended Airborne Precautions

Requirements	Airborne Precautions
Single Room	Yes Door closed It is recommended that single patient rooms be fitted with ensuite facilities. In the advent of no ensuite facilities, a toilet and bathroom should be dedicated for individual patient use.
Negative Pressure*	Yes, if available otherwise single room with door closed and window open
Hand Hygiene	Yes Hand cleaning with soap and water or water-free alcohol based skin cleanser
Gloves	Standard Precautions Use to protect for anticipated contact with blood and body substances
Gown/Apron	Standard Precautions Use to protect where soiling or splashing are likely
Mask	Yes, N95 or P2 Mask (perform fit check each time a mask is worn to ensure it fits the face firmly with no gaps between the mask and the wearers face according to manufacturer instructions prior to entering room) Remove mask after leaving patient room
Protective eyewear	Standard Precautions Use to protect eyes if splash likely or where aerosol may be generated
Special Handling of Equipment	Standard Precautions Avoid contaminating environmental surfaces and equipment with used gloves
Transport of Patients	Surgical mask for patient when they leave the room ^{1,3} Patients on oxygen therapy must be changed to nasal prongs and have a surgical mask over the top of the nasal prongs for transport (if medical condition allows). Advise transport staff of level of precautions to be maintained. Respiratory hygiene for coughing and sneezing patients suspected of having an infectious respiratory illness. Notify area receiving patient.
Alert	Respiratory hygiene for coughing patients Visitors to patient room must also wear P2 or N95 mask and perform hand hygiene Signage of room indicating precautions to be applied Patient Medical Records must not be taken into the room.
Room Cleaning	Refer to local cleaning policy. May require additional cleaning with a disinfectant agent depending on the organism. Consult with infection control professional.

* Where there are competing patient priorities for a negative pressure room, infection control and infectious diseases/microbiology staff must be consulted.

Summary of Recommended Droplet Precautions

Requirements	Droplet Precautions
Single Room	Yes, or Cohort with patient with same pathogen (in consultation with infection control professional, or infectious diseases physician). It is recommended that single patient rooms be fitted with ensuite facilities. In the advent of no ensuite facilities, a toilet and bathroom should be dedicated for individual or cohort patient use.
Negative Pressure	No special air handling or ventilation required
Hand Hygiene	Yes Hand cleaning with soap and water or water-free alcohol based skin cleanser
Gloves	Standard Precautions Use to protect for anticipated contact with blood and body substances
Gown/Apron	Standard Precautions Use to protect where soiling or splashing are likely
Mask	Yes Surgical Mask Remove mask after leaving patients room
Protective eyewear	Yes
Special Handling of Equipment	Standard Precautions Avoid contaminating environmental surfaces and equipment with used gloves
Transport of Patients	Respiratory hygiene for coughing and sneezing patients suspected of having an infectious respiratory illness. Surgical mask for patient when they leave the room. Patients on oxygen therapy must be changed to nasal prongs and have a surgical mask over the top of the nasal prongs for transport (if medical condition allows). Advise transport staff of level of precautions to be maintained. Notify area receiving the patient.
Alert	When cohorting patients, they require minimum of one metre of patient separation. Visitors to patient room must wear a fluid resistant surgical mask and protective eyewear (if unable to maintain 1 meter distance) and perform hand hygiene. Patient Medical Records must not be taken into the room. Signage of room.
Room Cleaning	Refer to local cleaning policy. May require additional cleaning with a disinfectant agent depending on organism. Consult with infection control professional.

Summary of Recommended Contact Precautions

Requirements	Contact Precautions
Single Room	Yes, or Cohort with patient with same pathogen in consultation with infection control
Negative Pressure	No special air handling or ventilation required
Hand Hygiene	Yes Hand cleaning with soap or antiseptic and water, or water-free alcohol based skin cleanser
Gloves	Yes, If there is direct contact with the patient or their environment.
Gown/Apron	Yes, If there is direct contact with the patient or their environment.
Mask	Standard Precautions Use to protect face if splash or aerosol likely
Protective eyewear	Standard Precautions Use to protect eyes if splash likely or where aerosol may be generated
Special Handling of Equipment	Single use or if reusable, process before next patient Avoid contaminating environmental surfaces and equipment with used gloves
Transport of Patients	Respiratory hygiene for coughing and sneezing patients suspected of having an infectious respiratory illness. Notify the area receiving patient. Advise transport staff of level of precautions to be maintained.
Alert	Remove gloves and gown/apron and perform hand hygiene on leaving the room. Patient Medical Records must not be taken into the room. Signage of room.
Room Cleaning	Refer to local cleaning policy. May require additional cleaning with a disinfectant agent depending on organism. Consult with infection control professional.

Guidance on Admission of an Infectious Attendant in Accident and Emergency Unit / Out-patient Clinic Setting

Objectives :

1. To enhance the clinical staff on the infection control concept in the working environment
2. To familiarize clinical staff on the implementation of the infection control concept into daily practice with limited resources
3. To build up confidence and team spirit among all staff to tackle the outbreak of emergence and reemergence of infectious diseases
4. To provide framework for hands-on practice to enforce the infection control practices

Accident and Emergency Unit / Out-patient Clinic

1. Triage of attendant:
 - According to the sign and symptom of various infectious disease
 - According to the epidemiological link
 - i. Fever
 - ii. Travel history
 - iii. Occupational history
 - iv. Contact history of the related infective agents
 - v. Clustering of people with same sign and symptom
2. Cohorting identified infectious attendants with the epidemiological link in order to prevent spread / outbreak of infectious agents
 - Identify specific area / room for the containment of these infectious attendants
 - Environmental preparation of the containment area or room:
 - i. Ensuite toilet and hand basin in the isolation area or room (if possible)
 - ii. Set up hand hygiene sanitary and personal protective equipment (PPE) station for health care worker(HCW) to donning and removal of PPE (Refer to PPE Station Set Up illustration)
 - iii. Separate the areas for donning and removal of PPE
 - iv. Post up poster of donning and removal of PPE in the related areas to remind the clinical staff on steps of the procedure. (Refer to Step for donning of PPE & Steps for removal of PPE)
 - v. Post up poster of handwashing and alcoholic handrubbing near the hand basin to remind clinical staff on the steps for hand hygiene. (Refer to Steps for Handwashing and alcoholic handrubbing)

- Assign specific health care workers to take care the infectious attendants with appropriate personal protective equipment and related infection control practice as according to the route of transmission of the infective agents(Refer to the Summary of Recommended Standard Precautions & Summary of Transmission-based Precaution)
- Identify the equipment that used by the infective attendant with specific label
- Identify the cleansing utensil for use in the cohorting area or isolation room with specific label
- Separate the reusable equipments, consumables and cleansing utensil for the infectious patients from the non-infectious one.

3. History taking

- Sign and symptom of infectious diseases, e.g. fever, rash, blister, vesicles, headache, oral flush, face and body flushing
- Epidemiological linkage of the related infectious diseases
 - i. Fever
 - ii. Travel history
 - iii. Occupational history
 - iv. Contact history of the related infective agents
 - v. Clustering of people with same sign and symptom

4. Transportation of the identified infectious attendant

- Assign specific health care workers with donning of appropriate personal protective equipment to transport the infectious attendant to ward or in-patient areas
- Assist the infectious attendant to put on surgical mask to prevent spread of infective agent during transportation.
- Identify the specific route for the transportation of the infectious attendant to the designated place
- Put all the documents, folders, equipments and consumables of the infectious attendants into the plastic bags before transportation
- Disinfect the transported stretcher / wheelchair and equipments immediately after transportation

5. Disinfection of the used equipments and terminal disinfection

- Wear appropriate PPE to protect the performing clinical staff to prevent exposure, splash and splatter during cleansing
- Use 1:49 Sodium Hypochloride solution or appropriate disinfectant solution to disinfect the reusable equipments and consumables which used by the infectious attendants
- Use 1: 249 Sodium Hypochloride solution to disinfect the feeding utensil of the infectious attendant

- Chlorine bleach/Clorox preparation: prepare fresh each day and changed when it becomes dirty or following use (Refer to Dilution of Chlorine bleach/Clorox Photo Guide)
- Remove the PPE immediately after the disinfection by the performing staff

6. Terminal disinfection / Environmental disinfection

- Discard the single used consumables and clinical waste in plastic leakage preventable bag (Indicated for incineration if feasible)
- Discard all sharps to the puncture- proof container with proper covered and send for incineration
- Limit agitation when handling soiled linen and disposing the waste to prevent gross contamination.
- Securely closed or tier up the container or bag used for containing waste and soiled linen with alert marking before removal.
- Contain the heavily soiled linen with blood or other fluids by leak proof bags to prevent spread of infectious agent.
- Use 1:49 Sodium Hypochloride solution to mop and disinfect the cohorting area for containment of the infectious attendants with the cleansing principle – from clean to dirty & from top to bottom.
- Ventilate the cohorting area for one hour before open for the subsequent cohorting of another infectious attendants
- Limit traffic to the cohorting area during cleansing and ventilating period with indicated signage
- The performing staff should perform handwashing and donning of PPE before the procedure and remove PPE immediately after disinfection

Checklist on Admission of Patient with Avian Influenza (AI)

Purposes:

1. To standardize the admission procedure on handling of Avian Influenza cases
2. To prevent spreading of infection in clinical setting for patients and staff
3. To maintain a clean and safe environment

Method: Use below checklist as a tool for staff to monitor and manage the essential patient activities

Date / Time : _____ / _____

Ward in-charge: _____

Staff Nurse: _____

Health Care Supporting Staff: _____

Ward cleansing staff: _____

<u>Phases</u>	<u>Responsible person</u>	<u>Admission Procedure</u>	√ column
Preparation for admission	Ward in-charge	1. To obtain information regarding the patient's condition, i.e. general condition, status for resp., Cardiovascular system, hydration condition To alert all ward staff for receiving a highly suspected avian influenza case To designate an isolation room for receiving case To assign designated carers (to minimize handling staff number)	
	Ward in-charge / Designated Staff Nurse	2. Check isolation room ventilation To check the negative pressure (if applicable) To ensure natural / assisted ventilation is satisfactory in case negative room is not available (i.e. opened windows assisted with uni-directional fanning or exhaust fanning) To enter time log sheet for the process of AI patient admission	
	Staff Nurse	3. To put up appropriate isolation precaution signage To prepare medical equipments, admission documents and necessary consumables marked for designated patient use only To prepare the admission tray To prepare the laboratory form and equipment for collection of nasopharyngeal aspirate specimen	
	Cleansing Staff	4. To prepare patient isolation room with • garbage bin with plastic bag • linen bin with laundry bag To prepare anteroom of isolation room with • garbage bin with red plastic bag • linen bin with laundry bag • container for goggles (if goggle instead of full face shield is used)	
	Patient receiving team	5. To gown up with appropriate and prepare for admission	
Procedure upon patient admission	Cleansing Staff	6. To disinfect the patient transporting stretcher / wheel chair thoroughly with large alcohol wipe To transport the stretcher / wheel chair out of anteroom/isolation room after disinfection To remove all PPE in anteroom/ designated PPE Removal area	
		7. To remove all the dirty linen and refuse inside the ante/isolation room with full PPE To remove all PPE in anteroom / designated PPE removal area	
	Designated Staff Nurse	8. To set up all alarm limits for medical equipments which used by the patient To obtain history and perform physical assessment To communicate with colleagues outside by available means and complete the admission procedure To assists doctor in physical examination and ensures patient safety To remind the importance of respiratory hygiene to patient and relatives	
		9. To obtain detail patient and family history from the accompanied relative in safe environment (i.e. cold zone / non-clinical area) To educate and assist relative to remove PPE (if indicated)	

	Health Care Supporting Staff	10. To collect the contaminated private clothing of the patient and put into the translucent plastic bag for proper treatment (dispose if infectious risk cannot be eliminated)	
Admission procedure inside patient room	All staff working inside the patient room	11. To discard all disposable items into the garbage bin after use	
	Health Care Supporting Staff	12. To disinfect all instrument and medical equipments moved out from the isolation room by large alcohol wipe / 1:49 Sodium Hypochloride solution	
	Staff nurse	13. To complete ward and room entry log sheet To prepare supply of carry additional equipments for patient physical examination and treatment To act as patrol nurse to monitor the infection control compliance for both staff and relatives	
	Cleansing Staff	14. To clear up garbage bins and soiled linen bins in patient room and anteroom if 2/3 full noted	

(****Remarks** : role delineation can be modified subject to user's actual staffing level)

Observers' name: _____

Comments/Recommendations: _____

Patient Care Checklist

New influenza A (H1N1)

June 2009

Replaces: 15 May 2009
Expires: December 2009.

UPON ARRIVAL TO CLINICAL SETTING/TRIAGE

- ☐ Direct patient with flu-like symptoms to designated waiting area
- ☐ Provide instruction and materials to patient on respiratory hygiene/cough etiquette
- ☐ Put medical/surgical mask on patient if available and tolerable to patient

UPON INITIAL ASSESSMENT

- ☐ Record respiratory rate over one full minute and oxygen saturation if possible
- ☐ If respiratory rate is high or oxygen saturation is below 90% alert senior care staff for action[#]
- ☐ Record history, including flu-like symptoms, date of onset, travel, contact with people who have flu-like symptoms, co-morbidities
- ☐ Consider specialized diagnostic tests (e.g. RT-PCR)
- ☐ Use medical/surgical mask, eye protection, gloves when taking respiratory samples
- ☐ Label specimen correctly and send as per local regulations with biohazard precautions
- ☐ Consider alternative or additional diagnoses
- ☐ Report suspected case to local authority

INITIAL AND ONGOING PATIENT MANAGEMENT

Supportive therapy for new influenza A (H1N1) patient as for any influenza patient including:

- ☐ Give oxygen to maintain oxygen saturation above 90% or if respiratory rate is elevated (when oxygen saturation monitor not available)
- ☐ Give paracetamol/acetaminophen if considering an antipyretic for patients less than 18 years old
- ☐ Give appropriate antibiotic if evidence of secondary bacterial infection (e.g. pneumonia)
- ☐ Consider alternative or additional diagnoses
- ☐ Decide on need for antivirals* (oseltamivir or zanamivir), considering contra-indications and drug interactions

This checklist is intended for use by hospital staff treating anyone with a medically suspected or confirmed case of new influenza A (H1N1) per local definition. This checklist highlights areas of care critical for the management of new influenza A (H1N1).

It is not intended to replace routine care.

BEFORE PATIENT TRANSPORT/TRANSFER

- ☐ Put medical/surgical mask on patient if available and tolerable to patient

BEFORE EVERY PATIENT CONTACT

- ☐ Put on medical/surgical mask
- ☐ Clean hands
- ☐ Put on eye protection, gown and gloves if there is risk of exposure to body fluids/splashes
- ☐ Clean and disinfect personal/dedicated patient equipment between patients
- ☐ Change gloves (if applicable) and clean hands between patients

IF USING AEROSOL-GENERATING PROCEDURES ALSO (e.g. intubation, bronchoscopy, CPR, suction)

- ☐ Allow entry of essential staff only
- ☐ Put on gown
- ☐ Put on particulate respirator (e.g. EU FFP2, US NIOSH-certified N95) if available
- ☐ Put on eye protection, and then put on gloves
- ☐ Perform planned procedure in an adequately ventilated room

BEFORE PATIENT ENTRY TO DESIGNATED AREA (isolation room or cohort)

- ☐ Post restricted entry and infection control signs
- ☐ Provide dedicated patient equipment if available
- ☐ Ensure at least 1 metre (3.3 feet) between patients in cohort area
- ☐ Ensure local protocol for frequent linen and surface cleaning in place

BEFORE ENTERING DESIGNATED AREA (isolation room or cohort)

- ☐ Put on medical/surgical mask
- ☐ Clean hands

The above applies to visitors also

BEFORE LEAVING DESIGNATED AREA (isolation room or cohort)

- ☐ Remove any personal protective equipment (gloves, gown, mask, eye protection)
- ☐ Dispose of disposable items as per local protocol
- ☐ Clean hands
- ☐ Clean and disinfect dedicated patient equipment and personal equipment that has been in contact with patient
- ☐ Dispose of viral-contaminated waste as clinical waste

The above applies to visitors also

BEFORE DISCHARGE OF CONFIRMED OR SUSPECTED CASE

- ☐ Provide instruction and materials to patient/caregiver on respiratory hygiene/cough etiquette
- ☐ Provide advice on home isolation, infection control and limiting social contact
- ☐ Record patient address and telephone number

AFTER DISCHARGE

- ☐ Dispose of or clean and disinfect dedicated patient equipment as per local protocol
- ☐ Change and launder linen without shaking
- ☐ Clean surfaces as per local protocol
- ☐ Dispose of viral-contaminated waste as clinical waste

*#See instructions on the back side for additional information and references. Equipment on this checklist is recommended if available.

This checklist is not intended to be comprehensive.

Additions and modifications to fit local practice are encouraged.

ABOUT THIS CHECKLIST

The WHO *Patient Care Checklist: new influenza A (H1N1)* is intended for use by hospital staff treating a patient with a medically suspected or confirmed case of new influenza A (H1N1). This checklist combines two aspects of care: i) clinical management of the individual patient and ii) infection control measures to limit the spread of new influenza A (H1N1).

WHO Patient Safety Checklists are practical and easy-to-use tools that highlight critical actions to be taken at vulnerable moments of care. They are produced in a format that can be referred to readily and repeatedly by staff to help ensure that all essential actions are performed. WHO Patient Safety Checklists are not comprehensive protocols and are not intended to replace routine care.

How to use the checklist

Staff can use this checklist in a variety of ways - ticking the boxes is optional. The objective is to ensure that no critical patient care items are missed during or immediately following care.

The checklist can be:

- used as part of the patient's clinical record;
- reproduced as wall posters for hospitals or clinics; or
- printed up as cards for staff members to carry around with them.

Parts of the checklist can also be extracted for use in any of these formats.

This checklist does not replace clinical guidance or clinical judgment. Its users should also familiarize themselves with the relevant WHO guidance documents referenced below, which were used in the development of the checklist.

Local modification

The WHO *Patient Care Checklist: new influenza A (H1N1)* may be reformatted or revised to accommodate local practice. Facilities and individuals are cautioned, however, against making the checklist too complex.

Related guidance

Guidance relating to infection control:

Infection prevention and control in health care in providing care for confirmed or suspected A (H1N1) swine influenza patients Interim guidance (Publication date: 29 April 2009) http://www.who.int/csr/resources/publications/infection_control/en/index.html

Infection prevention and control of epidemic- and pandemic-prone acute respiratory diseases in health care. WHO Interim Guidelines (Publication date: June 2007) http://www.who.int/csr/resources/publications/WHO_CD_EPR_2007_6/en/

Guidance relating to clinical management:

Clinical management of human infection with new Influenza A (H1N1) virus (Publication date: 21 May 2009) http://www.who.int/entity/csr/resources/publications/swineflu/clinical_managementH1N1_21_May_2009.pdf

*Currently there are a lack of data on the clinical effectiveness of antivirals for this disease. Antiviral drugs are to be used according to national pandemic influenza preparedness plans. If antivirals are prescribed, oseltamivir or zanamivir should be used for influenza A (H1N1) patients because of increased risk of the resistance with other antivirals. Where antiviral drugs are available for treatment, clinicians should make decisions based on assessment of the individual patient's risk. Risks versus benefits should also be evaluated on a case-by-case basis.

Such guidance may be updated as the situation evolves. For the most up-to-date guidance on the checklist and other documents, refer to the WHO web site (www.who.int) or contact your WHO country office.

GLOSSARY OF SELECTED CHECKLIST TERMS

Clean hands: Hands can be cleaned either by handwashing with soap and water or by handrubbing with an alcohol-based handrub formulation. The preferred technique while caring for suspected or confirmed cases of new influenza A (H1N1) is handrubbing, unless hands are visibly soiled. Hands must be cleaned at five key moments: 1) before touching a patient; 2) before clean/aseptic procedure; 3) after body fluid exposure risk; 4) after touching a patient; and 5) after touching patient surroundings.

Designated area (isolation room / cohort): The placing of patients either colonized or infected with the same pathogen in one designated area. It is specifically used when single or isolation rooms are not available. It allows for identified health-care workers to provide care to these specific patients with the aim of trying to prevent spread of infection to others. Patients with confirmed infection should ideally be in a separate cohort to those with suspected infection.

Cough etiquette: Health-care workers, patients and family members should cover mouth and nose (e.g. with a tissue) when coughing or sneezing. If a tissue is used, discard it in a bin with a lid and then clean hands. Cough etiquette should be communicated to patients through posters and leaflets.

Separate waiting area: Waiting area for symptomatic persons should be separate from general waiting area. This can be a separate part of the general waiting area as long as there is at least one metre (3.3 feet) distance between the designated area and the regular waiting area. Maintain at least one metre between symptomatic patients within this designated area.

Eye protection: This can either be an eye visor, goggles, or a face shield. Conventional eye glasses are not designed to protect against splashes to eye mucosa and should not be used as eye protection.

Flu-like symptoms: Fever, cough, headache, muscle and joint pain, sore throat, runny nose, and sometimes vomiting and diarrhoea.

Gown: A clean, non-sterile long-sleeved gown.

Infection control guidance to patient/caregiver on discharge: If patient still symptomatic or if patient less than one year old (Patients less than one year old may continue to be infectious for three weeks after cessation of symptoms):

- Patient quarantined: the sick person should be placed in a separate room and should have limited social contact.
- Instruction on cough etiquette.
- All persons in the household should perform hand hygiene frequently and after every contact with the sick person.
- The caregiver should wear the best available protection to prevent exposure to respiratory secretions, and avoid contact with body fluids or contaminated items; minimize close (less than 1 metre) and face-to-face contact with the patient; perform hand hygiene when indicated.

Medical/surgical masks: Procedure or surgical masks to protect the wearer's nose and mouth from inadvertent exposures (e.g. splashes).

Particulate respirator: A special type of fit-tested mask with the capacity to filter particles to protect against inhaling infectious aerosols (e.g. EU FFP2 and US NIOSH-certified N95).

Respiratory hygiene: See cough etiquette

#RESPIRATORY RATE

(reference for high values):

AGE	RESPIRATORY RATE
<2 months	≥60/minute
2–11 months	≥50/minute
1–5 years	≥40/minute
>5–12 years	≥30/minute
≥13 years	≥20/minute

CHECKLIST DEVELOPMENT PROCESS

In response to the pandemic threat by a new influenza A (H1N1) strain, the checklist development process began on 30 April 2009. The checklist development group in the WHO Patient Safety Programme collaborated with technical experts in WHO Health Security and Environment. They consulted experts in three areas: i) infection control, ii) clinical management of pandemic-prone Influenza, and iii) health care checklists. The design and content of the checklist were developed iteratively through successive rounds of consultation. Clinical teams in a number of settings tested its clarity and usability. Its use in clinical practice will be the subject of ongoing evaluation.

Action List for HSI Admissions

	Action	Monitor
UPON ARRIVAL TO CLINICAL SETTING		
Direct patient with flu-like symptoms to designated waiting area	Nurse	
Provide instruction and materials to patient on respiratory hygiene/cough etiquette	Nurse	
Put medical/surgical mask on patient if available and tolerable to patient	Nurse	
Inform respective authorities	Nurse	
UPON INITIAL ASSESSMENT		
Record respiratory rate over one full minute and oxygen saturation if possible	Nurse	
If respiratory rate is high or oxygen saturation is below 90% alert senior care staff for action	Nurse	
Record history, including flu-like symptoms, date of onset, travel, contact with people who have flu-like symptoms, co-morbidities	Nurse	
Take Nasopharyngeal Aspirate / Nasal & Throat Swabs	Nurse	
Use medical/surgical mask, eye protection, gloves when taking respiratory samples	Nurse	
Label specimen correctly and send as per guideline with biohazard precautions	Nurse	
Ensure specimen taken is of good quality	Nurse	
Consider alternative or additional diagnoses	Doctor	
Report suspected case to respective authorities	Doctor	
Consider Chest X Ray	Doctor	
Consider other tests	Doctor	
Report to Health Care setting Infection Control personnel	Doctor	
INITIAL AND ONGOING PATIENT MANAGEMENT		
Supportive therapy for new influenza A (H1N1) patient as for any influenza patient including:		
Give oxygen to maintain oxygen saturation above 90% or if respiratory rate is elevated (when oxygen saturation monitor not available)	Doctor	
Give paracetamol /acetaminophen if considering an antipyretic for patients less than 18 years old	Doctor	
Give appropriate antibiotic if evidence of secondary bacterial infection (e.g. pneumonia)	Doctor	
Consider alternative or additional diagnoses Consider other tests	Doctor	
Decide on need for antivirals* (oseltamivir or zanamivir), considering contra-indications and drug interactions	Doctor	
Update clinical condition	Doctor	

BEFORE PATIENT TRANSPORT/TRANSFER		
Put medical/surgical mask on patient if available and tolerable to patient		
BEFORE DISCHARGE OF CONFIRMED OR SUSPECTED CASE		
Check virology results & make sure clinically fit for discharge	Doctor & Nurse	
Provide instruction and materials to patient/caregiver on respiratory hygiene/cough etiquette	Nurse	
Provide advice on home isolation, infection control and limiting social contact	Nurse	
Record patient address and telephone number for probable contact tracing	Nurse	
AFTER DISCHARGE		
Dispose of or clean and disinfect dedicated patient equipment as per local protocol	Supporting Staff	
Change and launder linen without shaking	Supporting Staff	
Clean surfaces as per local protocol	Supporting Staff	
Dispose of viral-contaminated waste as clinical waste	Supporting Staff	

The action guide may be updated and modified should circumstances so required.

Checklist on handling of acute gastroenteritis cases
during enteric viral/bacterial infection epidemics

Purposes:

1. To standardize the infection control practices on handling of acute gastroenteritis cases
2. To prevent spreading of infection in clinical setting for patients and staff
3. To maintain a clean and safe environment

Method: Use below checklist as a tool for staff to monitor and manage the essential patient activities

Recommended infection control measures in general ward	Action taken	
	Yes	No
Prompt isolation of patient to ☐ single room ☐ corner bed ☐ cohort		
Take contact precaution until GE symptom have subsided		
Minimize number of staff contact		
Pay attention to patients with symptoms of diarrhea and vomiting		
Restrict patient & staff movement from affected area to unaffected area		
Designated equipment		
Designated toilet facilities		
Remind patient to wash hands after toileting		
Provide vomiting bag / bowl at bedside		
Pay attention to patient with feeding tube		
Alert private food safety and remove any exposed food e.g. fruit, cake or juice etc		
Proper procedure on handling of excreta / change of napkins should be strictly observed (No double gloving)		
Restrict visiting for affected area		
Prompt and wide area cleansing and disinfection; clean affected areas of 2 meters around with 1000 ppm Sodium Hypochloride Solution - Terminal disinfection after discharge or transfer out, including change of curtain		
Wear PPE before environmental cleansing /assist patient in vomiting		
Be alert and look for any other patient / staff has symptoms		
Staff with diarrhea and vomiting symptoms should seek medical advice and exclusion of symptomatic staff from work until 48 hrs after symptom recovery		
Hand hygiene before and after patient care are essential (after toileting and changing diapers AND before eating or preparing food.)		

Patrol Checklist on Compliance of Infection Control Precaution Measures
during Novel Infectious Disease Outbreak (i.e. H5N1 Avian Flu)

(I) Facilities and System		Yes	No	NA	Remarks
Hand washing facilities	Paper hand towel, Hand washing antiseptics, Garbage bin are at each patient cubicle , isolation room , PPE donning area & removal area				
	Check hand rub at designated site, i.e. ward entrance patient area, trolleys etc.				
Health surveillance	Visitor registration record is in place				
	Staff temperature record is a/v				
PPE trolley	N95 respirator, Surgical mask, Goggle, Face shield, Gown, Latex gloves, disposable cap (optional), plastic bags for keeping pagers, alcoholic handrub				
PPE Donning Room / area	Door is kept closed, N95 staff name list is posted up, floor is dry, room is clean and tidy, linen cart is tidy with sufficient stock <PPE poster> and < PPE Donning Stepwise guide >are a/v Mirror is available				
PPE Removal room / area	Door is kept closed, floor is dry, room is clean and tidy, no unattended soiled linen and garbage <PPE Removal stepwise guide> is a/v				
Sluice room	Door is kept closed, floor is dry , room is clean and tidy, no used bedpan and urinal left unattended, using swan neck method to tie clinical waste, using hot water soluble linen bag (if indicated) Waste segregation poster is a/v				
Pantry	Keep door closed No PPE before entry of pantry Keep place clean and tidy				
(II) Practice : C – Compliance NC – Non-compliance NA – Not applicable		C	NC	NA	Remarks
Hand washing compliance	After handling of contaminated items, i.e. soiled linen, waste, vomitus bowl, bedpan or urinals, used PPE.				
	After contact with blood, body fluids, secretion, excretions, mucous membrane or non-intact skin.				
	Immediately after removal of gloves				
	Immediately after contact of patients				
	Upon leaving ward				
Use of Latex glove	Glove is not used for clean activities e.g. typing computer keyboard, writing patient's notes, preparing food / drinking water, sorting clean linen etc.				

(II) Practice :		C – Compliance	NC – Non-compliance	NA – Not applicable	C	NC	NA	Remarks
Use of Latex glove	Glove is used for							
	● obnoxious procedures or procedures anticipated contacts with blood, body fluids, secretion, excretions, mucous membrane and non-intact skin, e.g. suction, handling urinals and bedpans, changing napkin, draining urine, direct contact of wound.							
	● Should not be washed or disinfected with alcohol-based solutions and reuse.							
	● Gloves should not be used between patients or move from “dirty” to “clean” body sites in the same patient.							
	● When touching patients require contact isolation							
Mask	Worn when caring / visiting patient. (N95 respirator for airborne transmission diseases & High risk procedures / surgical mask for droplet transmission diseases)							
Gown (Disposable / Linen gown)	When caring patient with direct close contact							
Eye protection	During high risk procedure such as taking NPA, suctioning, resuscitation							
PPE Removal	PPE must be removed & wash hands upon leaving the isolation room / cubicle (Designated area).							
(III) Duty of Patrol staff		Y	N	NA				Remarks
Checking	Staff has put on PPE in right steps and method							
	PPE item is sufficient							
	Staff was not wearing jewelry on duty							
Assisting	Staff to put on PPE if required							
	Staff to transfer items from clean zone to dirty zone							
Enhancing	Staff to adhere to infection control measures							
	Staff to wash hands properly							
Log Sheet	Record mobile staff in log sheet							
Reporting	Staff lapse practices							

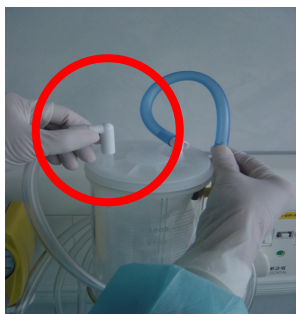
Additional comments and recommendations:

Ward : _____

Date : _____

Auditor : _____

Photo Guide on Suctioning Procedure (Special Points to Tackle “Before” & “After”)

Before procedure		A. Wear appropriate PPE after risk assessment 1. N95 mask / Surgical mask, 2. Full Face Shield, 3. Disposable cap, 4. Disposable gown, 5. Latex glove,
		B. Secure tubing : 1. To ensure the tubing is long enough to reach patient. 2. To check the tubing is connected with L shape connector 3. To ensure the system is secured.
		C. Test the suction force is within desirable range.
After procedure		D. Keep on PPE : Rinsing the tubing with sterile water
		E. Disposing the tubing properly
		F. Degowning according to the infection control guideline

Performing NPA in patients with confirmed/ suspected highly transmissible respiratory infectious diseases – Procedure

Indicator	YES	NO	N/A	Comments
(A) Minimize exposure to infectious agents				
• Minimize the number of staff involved				
• Close the door of the room				
(B) Personal protective equipment (PPEs)				
• A particulate respirator of high filtration efficiency (N95, FFP2 or equivalent) – perform seal check when putting on the respirator				
• Protective eyewear				
• Full-face-shield				
• Long-sleeved fluid resistant disposable gown				
• Gloves				
• Protective footwear: fluid-resistant and enclosed work shoes				
(C) Environmental control - airborne infection isolation				
• Airborne infection isolation room (All room) ▪ maintain a continuous negative pressure difference of at least 2.5 Pa relative to the surrounding areas ▪ provide an air change rate of ≥ 12ACH for newly constructed/ renovated rooms and ≥ 6ACH for existing All rooms ▪ direct exhaust air to the outside open space where there is no air-intake and no people traffic. If recirculation of room air is unavoidable, pass the air through a HEPA filter before the room air is re-circulated.				
• Local exhaust ventilation device (e.g. enclosed booth) to achieve source control ▪ maintain a negative pressure difference of at least 2.5Pa relative to all surrounding areas ▪ achieve an air change rate of ≥ 12ACH ▪ direct exhaust air to the outside open space where there is no air-intake and no people traffic. If recirculation of room air is unavoidable, pass the air through a HEPA filter before the air is re-circulated.				

• Single room with exhaust system to increase ACH and to create a negative pressure ▪ Keep room door closed with room air exhausted directly to outside open space where there is no air-intake and no people traffic				
• Adequately-ventilated single room ▪ Keep the room door closed with windows opened to open space where there is no air intake duct and no people traffic				
• May consider using a portable, industrial-grade HEPA filter to provide air cleaning if an All room or an enclosed booth that is engineered for airborne isolation is not available ▪ Position the HEPA filter appropriately such that all room air passes through the filter - Consult engineer regarding the appropriate placement of the filter				
(D) Preparation				
Preparation of equipment				
• Specimen label, a bottle of transport medium and a mucus extractor				
• Water-proof and leak-proof specimen bag labeled 'biohazard' ▪ Open the bag and stand it on a firm flat surface away from the patient's immediate environment, preferably at the room entrance, with the upper rim of the bag folded slightly back so that the bag is made wide open to avoid causing contamination to the outside of the bag.				
• Suction equipment				
Preparation of nurse				
• Put on personal protective equipment – see 'B'				
Preparation of the patient				
• Verify the personal identification particulars on the specimen label with the patient or against the patient's identification bracelet				
• Affix the specimen label to the mucus extractor				
• Explain the procedure to the patient to allay fear and to gain cooperation, instruct the patient not to struggle during the procedure				
• Arrange the patient in a sitting up position, with the head tilted				

slightly backward				
• Cover the patient's mouth with a surgical mask				
• Remove gloves and perform hand hygiene				
(E) Performing NPA				
• Put on gloves				
• Remove the cap of the bottle of viral transport medium				
• Turn on the suction				
• Connect the mucus extractor to the wall suction tubing				
• Estimate the length of suction catheter to be inserted into the nostril – measures approximately from the base of the nostril to the earlobe				
• Position yourself by the patient's side and avoid facing the patient directly				
• Insert the suction catheter into nostril until it reaches the posterior pharyngeal wall				
• Apply suction and rotate the suction catheter				
• Do not apply suction continuously for more than 15 seconds				
• After obtaining the specimen, suction the whole viral transport medium into the specimen bottle of the mucus extractor				
• Detach the mucus extractor from the suction tubing				
• Detach the suction catheter from the specimen bottle				
• Minimize cross contamination on disposing of the suction catheter: with the gloved-hand still holding the suction catheter, turn that glove inside out so that it wraps the used suction catheter inside it				
• Discard the suction catheter and the glove into a leak-proof, water-proof and sturdy waste bag printed or tagged with 'biohazard' labeling.				
• Remove the glove from the other hand and discard the glove				
• Perform hand-hygiene				
• Put on gloves				
• Cap the specimen bottle securely				
• Shake the specimen bottle gently to mix the specimen with the transport medium				
• Drop the specimen upright gently into the prepared specimen bag				
(F) De-gowning				
• Wash hands immediately after the procedure				

• Remove PPEs in the designated gown-down area				
• Remove PPEs gently and carefully to avoid causing contamination to self and to the environment.				
(G) Packaging and transport of specimen				
• Close the opening of the specimen bag securely				
• Do not put the laboratory request form together with the specimen into the same compartment. If the specimen bag carries a separate compartment for laboratory request form, put the laboratory request form into that designated compartment.				
• Send the specimen to the laboratory immediately				
• Make arrangement with laboratory staff to receive the specimen prior to sending out the specimen				
• If the specimen cannot be sent to the laboratory immediately, keep the specimen in the appropriate storage condition.				
(H) Cleaning and disinfection, and disposal of wastes				
• Reusable equipments are cleaned and disinfected before putting back for common use				
• Reusable respiratory therapy equipments (e.g. suction bottle, suction tubing) are disinfected using at least high level disinfection				
• The specimen transport box is disinfected after use				
• Disposable used equipments and wastes are disposed of in water-proof, leak-proof and sturdy waste bags printed or tagged with biohazard labeling at the point of use				
• The environment is cleaned and disinfected immediately after the procedure				
(I) Record				
• The staff who has performed the procedure is required to enter his/her name and contact number on the designated record				
• The record is filed and kept in a binder for a specified period of time before disposal				

Performing sputum induction - procedure

Indicator	YES	NO	N/A	Comments
(A) Personal protective equipment				
• A particulate respirator of high filtration efficiency (N95, FFP2 or equivalent) – perform seal-check when putting on the respirator				
• Protective eyewear				
• Full face shield				
• Long-sleeved fluid-resistant disposable gown				
• Gloves				
• Protective footwear: fluid-resistant enclosed work shoes				
(B) Environmental control - airborne infection isolation				
• Airborne infection isolation room (All room) ▪ maintain a continuous negative pressure difference of at least 2.5 Pa relative to the surrounding areas ▪ provide an air change rate of ≥ 12ACH for newly constructed rooms or renovated rooms and ≥ 6ACH for existing All rooms ▪ direct exhaust air to the outside open space where there is no air-intake and no people traffic. If recirculation of room air is unavoidable, pass the air through a HEPA filter before the room air is re-circulated.				
• local exhaust ventilation device (e.g. enclosed booth) to achieve source control ▪ maintain a negative pressure difference of at least 2.5Pa relative to all surrounding areas ▪ achieve an air change rate of ≥ 12ACH ▪ direct exhaust air to the outside open space where there is no air-intake and no people traffic. If recirculation of room air is unavoidable, pass the air through a HEPA filter before the air is re-circulated.				
• Single room with exhaust system to increase ACH and to create a negative pressure ▪ Keep room door closed with room air exhausted directly to outside open space where there is no air-intake and no people traffic				
• Adequately-ventilated single room Make sure that the room door is kept closed and the windows opened to open space where there is no air intake and no people traffic				

• May consider using a portable, industrial-grade HEPA filter to provide air cleaning if an All room or an enclosed booth that is engineered for airborne isolation is not available ▪ Position the HEPA filter appropriately such that all room air passes through the filter - Consult engineer regarding the appropriate placement of the filter				
(C) Minimize exposure to infectious agents				
• Put up 'airborne' and 'contact' precaution signages on the room door				
• Hang up a 'No Entry: sputum induction in progress' sign on the room door, until the procedure is finished and 99% of the airborne contaminants has been removed, the duration of which would be subject to factors such as the ACH and size of the room.				
• Staff who are not involved in the procedure are not allowed to enter the room				
• Keep the room door closed				
• Minimize entry and exit during the procedure				
(D) Preparation				
Preparation of the patient				
• See that explanation has been given to the patient				
• See that the patient has been fasted for the duration required				
Preparation of equipment				
• Nebulizer for sputum induction				
• Bronchodilator puffer				
• Specimen labels and specimen bottles ▪ Check the personal identification particulars on the specimen label with the patient or against the patient's identification bracelet ▪ Affix the specimen label to the specimen bottle				
• A water-proof and leak-proof specimen bag labeled 'biohazard', ▪ Open the bag and stand it on a firm flat surface away from the patient's immediate environment, preferably at the entrance of the room, with the upper rim of the bag folded slightly back so that opening of the bag is made wide open to avoid causing contamination to the outside of the bag				
• An empty bottle/ emesis bowl for saliva				
• Peak-expiratory flow meter				
(E) Procedure				

Instructions to patient				
• How to use the nebulizer				
• Take deep breaths while inhaling the mist				
• Expectorate the induced sputum into the specimen bottles provided				
• Cough deliberately and vigorously if spontaneous coughing does not occur				
• Cover the mouth with tissue paper during coughing				
• Spit saliva into the empty bottle / emesis bowl provided				
• Stay inside the booth or room, and to remain there until all specimens have been saved and coughing has stopped				
• Perform hand hygiene after the procedure				
• Put on a surgical mask before leaving the room				
• Call for assistance with the call bell provided should that be required				
Essential steps				
• Take baseline peak expiratory flow rate and vital signs (blood pressure, pulse rate, respiratory rate and SpO ₂)				
• Administer Salbutamol puff as prescribed				
• Measure peak expiratory flow rate after administration of Salbutamol				
• Administer nebulized hypertonic sodium chloride solution				
• Measure peak expiratory flow rate and vital signs immediately and at specified intervals				
• Chest physiotherapy may be employed to enhance the production of sputum				
(F) Observation during the procedure				
- Observe the condition of the patient closely during the procedure and watch out for signs and symptoms of respiratory distress - Continuous pulse oximetry monitoring - Peak flow rate at the specified time intervals - Respiratory rate, blood pressure and pulse rate at the specified time intervals				
(G) Packaging and transport of specimen				
• Put on gloves				
• Cap the specimen bottle securely				
• Drop the specimen into the prepared specimen bag				
• Remove gloves				
• Perform hand-hygiene				

• Close the opening of the specimen bag securely				
• Do not put the laboratory request form together with the specimen into the same compartment. If the specimen bag carries a separate compartment for laboratory request form, put the laboratory request form into the designated compartment.				
• Send the specimen to the laboratory immediately				
• Make arrangement with laboratory staff to receive the specimen prior to sending out the specimen				
• If the specimen cannot be sent to the laboratory immediately, keep the specimen in the appropriate storage condition.				
(H) De-gowning				
• Perform hand hygiene				
• Remove PPEs in the designated gown-down area				
• Remove PPEs gently and carefully to avoid causing contamination to self and to the environment.				
(I) Cleaning and disinfection, and disposal of wastes				
• Reusable equipments are cleaned and disinfected before putting back for common use				
• Reusable respiratory therapy equipments (e.g. reusable nebulizer, suction bottle, suction tubing) are disinfected using at least high level disinfection				
• The specimen transport box is disinfected after use				
• Disposable used equipments and wastes are disposed of in water-proof, leak-proof and sturdy waste bags printed or tagged with biohazard labeling at the point of use				
• The environment is cleaned and disinfected immediately after the procedure				
(J) Gross soiling/ contamination				
• Staff have been taught to change PPE and take an emergency shower or wash liberally as soon as possible if substantial soiling/ contamination has occurred				

Performing cardio-pulmonary resuscitation in patients with confirmed/ suspected highly infectious respiratory diseases - Procedure

Indicator	YES	NO	N/A	Comments
(A) Specific infection control aspects				
Minimize exposure of staff and environment to infectious agents				
• Minimize the number of staff involved				
• Minimize generation of aerosols ▪ minimize the duration of manual bagging via the face mask ▪ avoid open suctioning of airway secretions				
• Close the door of the room or pull close the curtains of the bed				
Personal protective equipment				
• A particulate respirator of high filtration efficiency: N95, FFP2 or a suitable alternative – perform seal check when putting on the respirator				
• Protective eyewear				
• Full face shield				
• Long-sleeved fluid-resistant disposable gown				
• Gloves				
• Protective footwear: fluid resistant and enclosed work shoes				
Manual resuscitator – bag-valve-filter-mask unit (BVM unit)				
• Attach a high efficiency bacterial-viral filter to the patient end of the BVM unit between the valve of the resuscitator bag and the face-mask				
• Filtration efficiency of the bacterial/viral filter ▪ Viral: >99.999% ▪ Bacterial: >99.9999%				
Cardio-pulmonary resuscitation procedure				
1) The first responder ▪ confirm unresponsiveness ▪ Shout for help ▪ Open airway ▪ Confirm absence of respiration and pulselessness ▪ Note the time of cardiac arrest ▪ Be sure already on full PPEs				
2) The first responder ▪ Start external cardiac compression immediately at a rate of 100bpm				
3) The second responder ▪ Call doctor/ central resuscitation team ▪ Mobilize manpower required to carry out the resuscitation				

▪ Move the crash cart to the patient's bedside ▪ Put on full PPEs				
4) When two/ more staff members are available in full PPEs, commence manual bagging with BVFM unit and continue with external cardiac compression. ▪ Attaches ECG electrodes once the crash cart is taken to the bedside. ▪ Authorized personnel can deliver defibrillation if it is a VF/ pulseless VT, followed by immediate external cardiac compression. ▪ Perform CPR using a compression: ventilation ratio of 30:2 (before endotracheal intubation). Deliver each breath over 1 second. Stop chest compression only when the breath is being delivered. ▪ Holds the BVFM unit tightly against the patient's face with both hands to achieve a tight seal between the face and the mask ▪ Depending on the number of staff available, go to either scenario 1 or scenario 2.				
5) Scenario 1 – CPR when more than two staff are available ▪ One staff performs external cardiac compression ▪ One staff holds the BVFM unit tightly against the patient's face with both hands ▪ One staff squeezes the resuscitator bag gently with one hand Scenario 2 – CPR when only 2 staff are available ▪ One staff holds the BVFM unit tightly against the patient's face with both hands ▪ One staff performs both external cardiac compression and squeezing of the resuscitator bag at a compression: ventilation ratio of 30:2				
Endotracheal intubation				
• Prepare the necessary equipment before start				
• If it is anticipated to be a difficult intubation ▪ Call in anaesthetist or intensivist ▪ Prepare equipment for difficult intubation				
• During intubation, if the patient starts to regain consciousness and struggle, the doctor may consider giving the patient sedation +/- muscle relaxant (patient struggling will increase the risk of generation of aerosols).				
• After the endotracheal tube is inserted, inflate the endotracheal				

tube cuff adequately to ensure there is no leak				
• Connect the BVFM unit (with the high-efficiency bacterial/ viral filter attached to it) to the endotracheal tube				
• Ascertain correct position of the endotracheal tube (e.g. by stethoscope or ETCO ₂ detection device if one is available)				
• Fix the endotracheal tube securely in place				
• Performing CPR after intubation ▪ Ventilate at 8-10 breaths per minute and continue to perform external cardiac compressions at a rate of at least 100bpm. ▪ No need to synchronize external cardiac compression with ventilation.				
• Monitor the condition of the patient (blood pressure, ECG and SpO ₂) throughout the whole procedure.				
• Put used reusable equipment into a receiver right at the point of use to minimize cross-contamination				
Connecting the patient to the ventilator				
• Before attaching the ventilator circuit to the endotracheal tube, make sure that the doctor has set the ventilator settings and the ventilator has been put on 'Standby' mode.				
• Reactivate the ventilator after connecting the patient to the ventilator				
The ventilator circuit				
• High efficiency bacterial/viral filter – attach to the expiratory port of the ventilator				
• Gas scavenging system – attach to the exhaust port of the ventilator (if available)				
• High efficiency heat and moisture bacterial/viral filter – attach to the patient end of the ventilator circuit (preferable to using heated water reservoir) ▪ If a closed-suction catheter is available, first attach the closed-suction catheter to endotracheal tube, followed by attaching the high-efficiency bacterial/viral filter to the side connection port of the closed-suction catheter				
• Closed-suction catheter – attach to the patient end of the ventilator circuit				
• Disposable ventilator tubings (preferable to reusable one)				
De-gowning				
• Wash hands immediately after CPR				
• Remove PPEs in the designated gown-down area				
• Remove PPEs gently and carefully to avoid causing				

contamination to self and to the environment.				
Emergency decontamination				
Staff change PPEs and take an emergency shower or wash liberally as soon as possible if substantial soiling/contamination has occurred				
Senior staff mobilize manpower to relief contaminated staff for changing of PPEs or for emergency shower/ wash should that require.				
Cleaning and disinfection, and disposal of wastes				
The receiver of used equipment is put into a plastic bag before removing from the isolation area				
Reusable equipments are cleaned and disinfected before putting back for common use.				
Respiratory therapy equipments are disinfected with at least high level disinfection				
Disposable used instruments and wastes are disposed of as clinical wastes at the point of use				
Sharps are disposed of in sharps box at the point of use (attached to the crash cart)				
The immediate environment is cleaned and disinfected immediately after the procedure				
(B) Crash cart				
Used items are replaced at the earliest possible convenience				
Replaced items are arranged according to the standardized layout as set by the facility				
(C) Documentation				
The CPR procedure				
The resuscitation procedure and the events prior to the cardio-pulmonary arrest are documented in both the CPR record and the patient's clinical notes.				
The facility requires that the CPR record be faxed or sent to the facility CPR subcommittee for record and evaluation.				
Log of staff involved in the CPR procedure				
Staff who have participated in the CPR procedure are required to enter their name and contact number on the designated record				
The records are filed in a binder and are kept there for a specified period before discarding				

Procedures for Taking Throat & Nasal Swab

Prepare Equipments

- Sterile Swabs x 2
- Specimen bottle with viral transport medium (Viral TM Bottle)
- Appropriate PMH microbiology laboratory form & DH2542
- Zip-lock specimen carrier plastic bag



Sterile Swab & Viral TM Bottle

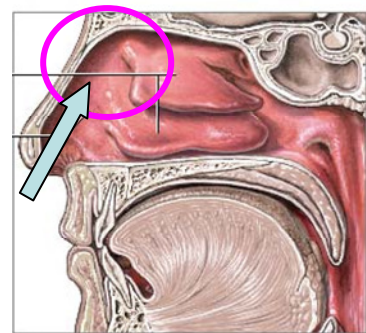
Procedures for taking Throat & Nasal Swab

Prepare Patient

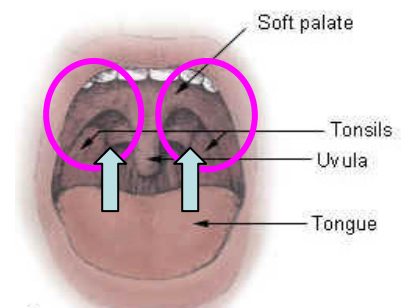
- Explain the procedures to patient (additional assistance may be required for paediatric or uncooperative cases).
- Cover patient's mouth with surgical mask.
- Ask patient to sit up with head tilted slightly backward.

Specimen Taking

- Check expiry date for sterile items before use.
- Staff put on appropriate PPE and wash hands.
- To take **nasal swab**, a dry sterile swab is inserted into the nostril, parallel to the palate, and left in place for a few seconds.
- It is then slowly withdrawn with a rotating motion.
- Specimens from both nostrils are obtained with the same swab.
- The tip of the nasal swab is put into a TM bottle containing 2 - 3 ml of virus transport medium and the applicator stick is broken off.
- To take **throat swab**, both tonsils and the posterior pharynx are swabbed vigorously. And the tip of the throat swab is placed into the **same** TM bottle as described above.
- Screw up the specimen container tightly.
- Use appropriate laboratory form and zip-lock specimen carrier plastic bag.
- Remove contaminated PPE with care, and wash hands.



Nasal Swab



Throat Swab

Aftercare

- Observe patient for any complications, e.g., nasal bleeding, blood stained sputum or desaturation.
- Send out the specimen within 24 hours of collection according to hospital guidelines.
- After office hour, preferably store specimen at 4°C.



Tips of both swabs broken into ONE TM Bottle