

Review Article

Infection control in dermatology practice

皮膚科日常服務中的感染控制

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Infection control is an often neglected topic until the outbreak of severe acute respiratory syndrome (SARS) in 2003, when eight healthcare workers succumbed as a result of community and nosocomial outbreaks. This alerted all healthcare workers to comply with infection control practices in both the in-patient and out-patient settings as failure to do so might be a matter of life and death. Standard and transmission-based precautions have been promoted in the hospitals since 1996 and have also been applied in the dermatology clinic in the recent years. Standard precautions should be applied in all patients with the potential to infect others through blood and body fluids and include hand hygiene, careful handling of sharps, and the appropriate use of personal protective equipments during exposure to blood, body fluids, secretions, excretions except sweat, and breached skin and mucous membranes. Transmission-based precautions are the additional measures against pathogens that are spread through contact, droplets, and air. Among all infection control measures, hand hygiene practice using waterless alcohol-based hand rub remains the cornerstone of infection control – a 3 log reduction of microbial load can be achieved after 15 seconds of hand rubbing. Since most of the common pathogens including community-associated methicillin resistant *Staphylococcus aureus* and influenza virus can survive on the hands for a short period of time, frequent use of alcohol-based hand rub, especially before touching the mucous membranes, can prevent self-inoculation of these pathogens. On the other hand, application of directly observed hand hygiene among patients and regular cleaning of the clinic may help to reduce the risk of environmental contamination by pathogens like *Chlamydia trachomatis* and *Neisseria gonorrhoeae* which can survive on dry inanimate surfaces for 1-3 days, and papillomavirus which can survive for up to 7 days.

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在二零零三年沙士疫情爆發前，感染控制這一課題都一直被人忽略，結果在這場波及整個社區和所有醫院的世紀疫情中，有八名醫護人員付出寶貴的生命。這次教訓，令所有醫護人員都得到警惕，無論在病房或門診都要謹守感染控制措施，因一時的錯失可關乎到生死。標準及傳播途徑為基準的防護其實早在一九九六年已開始在醫院推廣，近年亦已普及至皮膚科門診。標準防護適用於所有可能經血液或體液傳播本身疾患的病人，包括手部衛生、利器的小心處理，及在可能接觸到病人的血液、體液、分泌物、汗水以外的排泄物或皮膚及黏膜傷口時，正確使用個人防護裝備。而傳播途徑為基準的防護則是進一步的措施，針對各種由身體接觸、飛沫或空氣傳播的致病原。在所有感染控制方法中，使用酒精搓手液的手部衛生仍是控制感染的基石——因十五秒的酒精搓手液清潔便可將原來的細菌數目減至千份之一。由於很多常見的病原體包括社區抗藥性金黃葡萄球菌及流感病毒等都可在手部短暫生存，固恒常的酒精搓手液清潔，尤以接觸自己黏膜為甚，可保護自己免受病原體的感染。此外，直接監察病人的手部衛生及診所的定時清潔，都有助減少病原體對室內環境的污染風險；因皮膚及性病科常見的病原體如衣原體及淋病病菌，可在死物的乾燥表面生存一至三日，而乳頭瘤病毒更可長達七日。

Keywords: Alcohol-based hand rub, hand hygiene, standard and transmission based precautions

關鍵詞：酒精搓手，手部衛生，標準及傳播途徑為基準的防護

Introduction

Infection control is an ancient subject with an emphasis on hand hygiene practice and patients' segregation and isolation. In the mid-1800s, Ignaz Semmelweis (1818-1865), a Hungarian physician in Vienna, hypothesized that puerperal fever was spread by the hands of healthcare workers based on the observation that women who gave birth outside the hospital were less likely to develop fever. He found that medical students who were responsible for deliveries usually performed autopsies before assisting in deliveries. Thus, disinfection of hands would probably prevent the transmission of infection from cadavers to

pregnant women. After the implementation of handwashing with chlorinated lime before assisting in deliveries, the death rate reduced significantly. Florence Nightingale (1820-1910), an English nurse, proposed that hospital design might be related to the transmission of infection. She rejected the concept of long hospital corridors which limited sunlight exposure and natural ventilation, and believed that the sick patients should be isolated as she considered respiratory secretions were potentially dangerous.¹ Despite a longstanding history of infection control practice with interval modification (Table 1), it is still an often missed or neglected subject in the medical profession.

Table 1. Evolution of infection control practice

Year of recommendation	Infection control practice
1877	Placing patients with infectious diseases in separate facilities (later known as infectious disease hospitals)
1910	Introduction of cubicle system of isolation
1970	Seven isolation precaution categories
1983	Category specific & disease specific
1985	Universal precautions
1987	Universal precautions & body substance isolation
1996	Standard precautions & transmission based precautions

The outbreak of severe acute respiratory syndrome (SARS) in Hong Kong in 2003 with deaths of 8 healthcare workers greatly enhanced the awareness of the importance of infection control among the frontline staff for a sustained period of time.² The compliance with infection control practice seems to be determined by the perception of our staff on whether their own personal safety was threatened.³ The contemporary recommendations of standard and transmission-based precautions in the hospital can also be applied in the dermatology clinic.

What do we mean by standard precautions?

Standard precautions should be applied to all patients with the potential to infect others through contact with blood and other body fluids, and include hand hygiene, handling of sharps with care, and the appropriate use of personal protective equipments (PPE) (e.g. gloves and gowns, masks, goggles and face shields) in case of any exposure to blood, body fluids, secretions, excretions except sweat, and breached skin and mucous membranes. In the dermatology setting, gloves should be worn during contact with potentially infectious skin in nail clipping for fungal examination or performing cryotherapy for the treatment of warts. After the procedure, gloves should be removed immediately and followed by hand hygiene either by hand-rubbing with waterless alcohol-based hand rub or washing with soap and water.

Careful handling of sharps is also important while collecting blood samples for syphilitic serology or human immunodeficiency virus (HIV) antibody. The risk of blood-borne viruses transmission is about 33% for hepatitis B virus, 3% for hepatitis C virus, and 0.3% for HIV, if the source patient of needle stick injury is known to be positive for HBeAg, HCV RNA, and HIV Ab respectively. Even in the setting of botulinum toxin injection to the facial muscle with potential contamination by a

tiny amount of capillary blood, blood-borne viruses especially hepatitis B and hepatitis C can be transmitted. Therefore, recapping of needle is an absolute contraindication. Moreover, the used needle should be directly disposed into a puncture resistant box which is readily available in the clinical setting nowadays.

What do we mean by transmission-based precautions?

Transmission-based precautions are the additional measures against pathogens which are spread by contact, droplets, and air (Table 2). In the dermatology out-patient setting, there are technical difficulties to prevent airborne transmission by building an airborne infectious isolation room for patients who might be infected with *Mycobacterium tuberculosis*, measles, and varicella zoster virus. This requires a major renovation and engineering to install a high efficiency particulate air (HEPA) filter with at least 12 air changes per hour in a well-concealed room. Since over 90% of the adult population in Hong Kong have been immunized or infected with measles and variella zoster virus, one may have protective antibody already. As for the prevention of potential transmission of *M. tuberculosis* in the clinic setting, a surgical mask may be offered to patients who present with chronic cough as source control so as to reduce the risk of transmission.

Prevention of droplet transmission of bacteria and viruses can be easily achieved at the nursing station. Upon registration, the clinic nurse can offer a surgical mask to any patient with respiratory symptoms. This measure is important to control the spread of pathogens during coughing and sneezing, in which over 40,000 droplets of 0.5-12 μm would be expelled at a velocity of 100 m/s, thus contaminating the clinic environment. As the viruses can survive on inanimate objects and hands for a certain period of time (Table 3), infection may then be acquired via indirect contact of the mucous

Table 2. Examples of clinical syndrome and medically important pathogens which can be transmitted via airborne, droplet, and contact route

Route of transmission	Examples
Airborne	<i>Mycobacterium tuberculosis</i> Measles Varicella zoster virus
Droplet	Influenza virus Adenovirus Mumps & Rubella Parvovirus B19 Pertussis <i>Mycoplasma pneumonia</i> Invasive <i>N. meningitidis</i> Invasive <i>H. influenzae</i> type b Streptococcal pharyngitis Diphtheria (pharyngeal) Pneumonic plague
Contact	Colonization with multiple drug resistant bacteria <i>Clostridium difficile</i> Norovirus & rotavirus Respiratory syncytial virus Parainfluenza virus Enterovirus Skin infections of highly contagious agents

membrane with the environment through the hands.

Contact transmission of multi-drug resistant bacteria, respiratory and gastrointestinal viruses is the most common cause of outbreak inside the hospital. With the emergence of community-associated methicillin resistant *Staphylococcus aureus* (CA-MRSA) in Hong Kong, the risk of transmission of this virulent pathogen in the outpatient setting will be increased. Good practice of hand hygiene and proper use of personal protective equipment is crucial to reduce the risk of transmission.

Environmental hygiene in infection control

Since most of the medically important bacteria and viruses can survive on inanimate objects for a prolonged period of time (Tables 3 & 4), regular environmental cleaning and disinfection may reduce the microbial load and the risk of pathogen transmission. Recent studies have shown that hospital surfaces may facilitate the transmission of nosocomial pathogens and enhanced cleaning can reduce the incidence of MRSA.^{4,5} We therefore

Table 3. Survival of viruses on inanimate surface and on hands

Organism	Duration on inanimate surface	Duration on hands
Influenza virus	12–48 h	10–15 min
Parainfluenza virus	10 h	NA
RSV	6 h	<20 min
Adenovirus	7 d–3 mo	NA
SARS-CoV	72–96 h	NA
Rhinovirus	6–60 d	2 h
Rotavirus	8 h–12 d	4 h
Norovirus	1–2 d	>30 min
HAV	2 h–60 d	Several hours
HBV	7 d	NA
HCV	NA	NA
HIV	7 d	NA
Papillomavirus	7 d	NA

propose the use of commercially available disinfectants such as sodium dichloroisocyanurate (PRESEPT) for daily cleaning of the frequently touched areas in the outpatient clinic according to the manufacturer's recommendation (Table 5). In addition, disposable towels should be used to prevent the cross-contamination during the cleaning procedure.

Hand hygiene practice in healthcare setting

Hand hygiene remains the most important element in infection control as the hands are usually the final common pathway for pathogen transmission. At present, there are two World Health Organization (WHO) formulations of

Table 4. Survival of bacteria on inanimate surfaces and hands

Organism	Duration on inanimate surface	Duration on hands
<i>S. aureus</i>	1–7 mo	>150 min
VRE	5 d–4 mo	60 min
<i>C. difficile</i>	1 d–5 mo	NA
<i>E. coli</i>	2 h–16 mo	6–90 min
<i>K. pneumoniae</i>	2 h–30 mo	2 h
<i>S. marcescens</i>	3 d–2 mo	>30 min
<i>Acinetobacter spp</i>	3 d–5 mo	>150 min
<i>Pseudomonas spp</i>	6 h–16 mo	30–80 min
<i>M. bovis</i>	>2 mo	NA
<i>M. tuberculosis</i>	1 d–4 mo	NA
<i>C. trachomatis</i>	1 d	NA
<i>N. gonorrhoeae</i>	3 d	NA

Table 5. Instruction for use of PRESEPT disinfectant tablet

For disinfection	Required concentration of available chlorine	Dilution methods (0.5 g per tablet)	Steps for use
Blood spillage	10,000 ppm	11 tablets in 300 ml water	Squeeze over blood and leave for at least 2 minutes; Wipe up with disposable disinfectant-saturated cloths
Environmental hygiene	1,000 ppm	3 tablets in 750 ml water	Wipe down surface with disposable disinfectant-saturated cloths
Stainless steel instruments	560 ppm	1 tablet in 1 L water	Immerse for 1 hour; Rinse thoroughly with running water
Rubber and plastic utensils	140 ppm	1 tablet in 2 L water	Immerse for 1 hour; Rinse thoroughly with running water

alcohol-based hand rub solutions. Formula I consists of ethanol 80% v/v, glycerol 1.45% v/v, and hydrogen peroxide 0.125% v/v, whereas formula II consists of Isopropyl alcohol 75% v/v, glycerol 1.45% v/v, and hydrogen peroxide 0.125% v/v. Theoretically, ethanol is better for virucidal activity and isopropyl alcohol is better for bactericidal activity but there is no major difference in clinical practice. Glycerol serves as skin emollient and hydrogen peroxide inhibits the tiny amount of bacterial spores which have entered into the bottle of alcohol-based hand rub. Alcohol-based hand rub is effective against a wide range of enveloped viruses, vegetative bacteria, fungi, and also useful for mycobacteria and non-enveloped viruses if the contact time is up to 20 seconds. In general, rubbing the hands with alcohol-based hand rub (palm to palm, palm to back, finger webs, finger tips, thumb, and wrist) for 15 seconds can reduce the microbial density on the surface of hands by 3 logs. In contrast, washing the hands with soap and water for 15 seconds can only decrease the microbial load by 0.8 log. The use of alcohol-based hand rub is not just convenient to us but also more effective in microbial killing than washing with soap and water.

There are five moments of hand hygiene as recommended by WHO: (i) before touching a patient; (ii) before clean or aseptic technique; (iii) after body fluid exposure; (iv) after touching a patient; and (v) after touching patient surroundings. However, the most important moment – the sixth moment is to perform hand hygiene before touching the mucous membranes of the nose and eyes. Touching of the mucous membranes is usually a subconscious behavior. In fact, attendees at Sunday school and medical conferences were not infrequently observed to be touching their mucous membranes.⁶ Therefore, it is important that healthcare workers do not practice this high risk behavior in the clinical areas as one must be able to protect oneself before protecting one's patients.

Directly observed hand hygiene (DOHH) practice should be highly promoted in the dermatology clinic by delivery of 3 ml of alcohol-based hand rub to each patient upon registration at the nursing station with instruction on hand rubbing after touching their infectious body sites. Since the process of hand hygiene is closely observed by the healthcare workers, the compliance would be assured. In fact, the use of DOHH has been successfully implemented in the hospital setting in the prevention and control of nosocomial transmission of both bacterial and viral pathogens⁷⁻⁹ and should therefore be useful in the dermatology clinic.

Area of uncertainty

The data of using alcohol-based hand rub in the control of scabies, an ectoparasitic skin disease caused by the mite *Sarcoptes scabiei* variety *hominis*, is lacking. Soap and water should be used after examining patients with suspected or confirmed scabies. In addition, further investigation has to be conducted to examine the safety measures against the potential infectious material by carbon dioxide laser-generated plume.¹⁰

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