

# Hand hygiene

## Microorganisms on the hands

Price (1938) has classified bacteria recovered from the hands into two categories;

**Resident organisms:** the resident flora consists of micro-organisms living under the superficial cells of the stratum corneum and can also be found on the skin's surface. These microorganisms are normal flora of the skin and include coagulase-negative staphylococci (*mainly Staphylococcus epidermidis*), members of the genus *Corynebacterium* (commonly called 'diphtheroids'), and *Propionibacterium spp.* Since resident flora is usually deep-seated in the epidermis, they are not easily removed by a single hand washing procedure. The reduction of resident flora is required before aseptic/surgical procedures and this is achieved by performing surgical scrub.

**Transient organisms:** transient flora is not part of the normal flora and colonized the superficial layers of the skin. It is often acquired by HCWs during direct contact with patients or by contaminated environmental surfaces. These microorganisms usually survive only for a limited period of time and are easily removed by hand washing or use of alcoholic hand rub on physically clean hands. The transient flora includes most of the organisms responsible for cross-infection, eg Gram-negative bacilli (*Escherichia coli*, *Klebsiella spp*, *Acinetobacter baumannii*, *Pseudomonas spp*, *Salmonella spp*, etc), Staph. Aureus, vancomycin resistant enterococci, *Clostridium difficile*, and viruses (norovirus, influenza, etc).

## Hand washing using soap and water

Hand washing refers to the application of soap (plain or antimicrobial) and water on the hand. Despite the fact that plain soap has minimal antimicrobial activity, it can be used for routine hand washing (WHO, 2009). Soap acts through its detergent properties and by mechanical action which removes dirt, organic material, loosely adherent transit and a small portion of the resident flora from the hands.

**Water:** although water is considered the 'universal solvent', water alone is not suitable for cleaning dirty hands as soap or detergent is needed with water to remove hydrophobic substances such as fats and oils which are after present on soiled hands. Despite common belief, water temperature does not appear to be a critical factor for removal of microorganisms from hands being washed. However, use of very hot water for hand washing should be avoided as it increases skin irritation and may cause damage. After hand washing, through rinsing and drying is necessary.

**Soap:** plain, neutral pH soap can be used for routine hand washing. Added substances (including antimicrobial agents) should be avoided as they have *no added benefit* and may cause allergies,

irritation, or dryness of the skin; humectants should be added to the soaps to reduce skin irritation and dryness.

If a bar of soap is used then the bar should be small in size to allow frequent changing . In order to avoid contamination with microorganisms, it should be kept dry (in a soap rack or on a magnet or ring) to promote drainage of water. However, the actual hazard of transmitting microorganisms with previously used soap bars is negligible as they are frequently washed away during hand washing.

Liquid soap should be stored in closed containers and the dispensers should be *regularly cleaned*. If liquid soap is dispensed from reusable containers, these *must be cleaned when empty and dried before refilling* with fresh soap to avoid microbial contamination. Special attention should be taken to clean pump mechanisms as these have been implicated as sources of across-infection.

**Antiseptic preparation:** preparations containing antiseptics (chlorhexidine gluconate detergent, povidone iodine solution, triclosan, etc.) are more effective in removing resident microorganisms and are used for surgical scrub but their use is not normally necessary for everyday clinical practice.

**Hand drying:** ideally, hands should be dried using individual *good quality paper* towels. Reusing or sharing of cloth/fabric towels must be avoided in health care facilities as they are recognized as a source of cross-infection. If cloth/fabric towels are used, then they *must be single-use* and sent to the laundry. When towels (paper or fabric) are used to dry hands, it is important to pat the skin rather than rub it, to avoid cracking of skin. Air dryers are slow, noisy, and can be used by only one individual at a time therefore their use in health care facilities is not recommended.

**Nailbrushes:** routine use of nailbrushes is not recommended because they damage the skin, encouraging the proliferation and persistence of microorganisms on the skin.

### **Hand hygiene using alcohol hand rub**

In 1888, P. Furbringer was the first to recommend alcohol for hand disinfection of surgeons and medical staff. Numerous reports confirm that alcohol-based formulations have better efficacy, shorter application time, are well tolerated, and therefore have better acceptability than hand washing. In addition, they can be easily available *at the point of care* and this has resulted in improved compliance with hand hygiene. According to WHO guidelines, alcohol-based hand rub is the *preferred* means for routine hand antisepsis (WHO, 2009). However, there are a few situations where hand washing should be preferred, eg. when hands are visibly dirty or soiled with blood or other body fluids, or where exposure to potential spore-forming pathogens is strongly suspected or proven, and after using the toilet.

The hygienic hand rub method is convenient and useful especially in areas where a hand-wash basin is not readily available, eg

- Emergency situations where there may be insufficient time and/or hand washing facilities.
- When hand washing facilities are inadequate
- In the community or when return to a hand-wash basin is impractical
- During a ward round where there is a need for rapid hand disinfection.

### **Hand rub products**

Hand rubs are available as gel, rinses, or foam. In general, gels are more expensive and may produce a feeling of humectant 'build-up'. Some gel formulations may have reduced antimicrobial efficacy compared with rinse. Hand rub rinses are less viscous and often dry more quickly than gels or foams, therefore they are less likely to produce a feeling of humectant 'build-up' but they often have a stronger smell of alcohol than gels. Like gels, foams are more expensive, may produce a stronger feeling of 'build-up' with repeated use, and may take longer to dry.

The promotion of hand hygiene is highly cost-effective, and the introduction of alcohol-based hand rub can be prohibitive if the product is purchased from a commercial supplier. In such cases, consideration should be given to producing hand rub locally based on WHO formulations (WHO, 2009).

### **Efficacy of alcohol-based hand rub products**

Alcohol-based hand rub are *more effective* in decontaminating hands than soap and water. However, the efficacy of alcohol-based, hand hygiene products is affected by the type of alcohol used, concentration of alcohol, contact time, volume of alcohol used, and whether the hands are wet when the alcohol is applied. Alcohol solutions containing 60-80% ethanol are most effective. Higher concentrations are less effective as proteins are more difficult to denature in the absence of water.

One ml. of alcohol is significantly *less effective* than 3 ml. Although ideal volume applied to the hands is not know (as it may vary for different formulation), in general, if the hands feel dry after being rubbed together for less than 10-15 seconds , it is likely that an insufficient volume of alcohol rub was applied. The recommended duration of the entire procedure for hand hygiene using alcohol hand rub is 20-30 seconds.

Alcohol has no activity against bacterial spores or protozoan occysts and has poor activity on some non-enveloped viruses (such as norovirus, rotaviruses, or enteroviruses) and may require higher ethanol concentration (90%). As a result, some health care facilities have adopted guidelines to wash hands when dealing with suspected/confirmed cases of patients with

diarrhoeal illness. In recent years, widespread use of alcohol-based hand rubs has been thought to be associated with the increase of *C. difficile*-associated infection. However, it is important to note that *C. difficile* infections began to rise in the USA long before the widespread use of alcohol hand rub. It is important to note that alcohol hand rub is effective against vegetative form but not against spores of *C. difficile*.

### Indication and technique of hand hygiene

The WHO guidelines have simplified the recommended indications to performs hand hygiene into the concept of ‘My Five Moments’ which is summarised and the ‘patient zone’ is defined as the patient’s intact skin and his/her immediate surroundings which are colonized/contaminated by the patient flora and the ‘*health care area*’ as containing all other surface outside the patient zone.

For effective hand hygiene, the following criterial must be met: 1) Using an *effective compound*, 2) enough *amount of product* available to cover hands, 3) use of *correct technique* to cover all areas, and 4) performing hand hygiene at the *right moment*.

The perfect hand hygiene technique has never been evaluated in prospective clinical trials. However, the proposed technique and steps recommended for hand hygiene allows effective hand disinfection as it covers all parts of the hand and can significantly improve bacterial killing. The last two steps are very important, i.e wetting of the thumb and the fingertips as these parts of the hands are frequently touched during patient care activity and are most often missed during hand hygiene by the HCWs. Nails should be kept short to allows through cleaning o the hand to prevent tears in gloves. Artificial nails should be discouraged as they contribute to increased bacterial counts

<b>Five moments for hand hygiene and examples of clinical situations</b>	
<b>The five moments</b>	<b>Examples</b>
1. Before touching a patient	<ul style="list-style-type: none"> <li>• Shaking hands, helping a patient to move around, get washed</li> <li>• Applying oxygen mask, giving physiotherapy, taking pluse, blood pressure, chest auscultation, abdominal palpation, recording ECG, etc</li> </ul>
2. Before clean/aseptic procedure	<ul style="list-style-type: none"> <li>• Skin lesion care, wound dressing, subsutaneous injection, catheter insertion, opening a vascular access system or a draining system, secretion aspiration, preparation of food, giving medication, instilling eye drops, pharmaceutical products, sterile materials etc.</li> <li>• Before handling an invasive device for</li> </ul>

	<p>patient care, regardless of whether or not gloves are used</p> <ul style="list-style-type: none"> <li>• Before moving from a contaminated body site to another body site during care of the same patient</li> </ul>
3. After body fluid exposure risk	<ul style="list-style-type: none"> <li>• Skin lesion care, wound dressing, subcutaneous injection, drawing and manipulating any fluid sample, opening a draining system, endotracheal tube insertion, removal and secretion aspiration, clearing up urines, faeces, vomit, handling waste (bandages, napkins, incontinence pads), cleaning of contaminated and visibly soiled material or areas (soiled bed linen, lavatories, urinal, bedpan, medical instruments) etc</li> <li>• Before moving from a contaminated body site to another body site during care of the same patient</li> <li>• After contact with body fluids or excretions, mucous membrane, non-intact skin or wound dressing</li> <li>• After removing sterile or non-sterile gloves</li> </ul>
4. After touching patient surroundings	<ul style="list-style-type: none"> <li>• After contact with inanimate surfaces and objects (including medical equipment) in the immediate vicinity of the patient, perfusion speed adjustment, monitoring alarm, holding a bed rail, leaning against a bed, clearing the bedside table, changing bed linen, with the patient out of the bed, etc.</li> <li>• After removing sterile or non-sterile gloves</li> </ul>

### Five Moments of Hand Hygiene

The World Health Organization has published standard guideline describing the situations when hand hygiene is indicated in health-care sectors. (Figure 1)

### Steps of hand rubbing/washing

WHO has also laid down the guidelines describing the appropriate steps involved for an effective hand rubbing and hand washing (Figure 2)

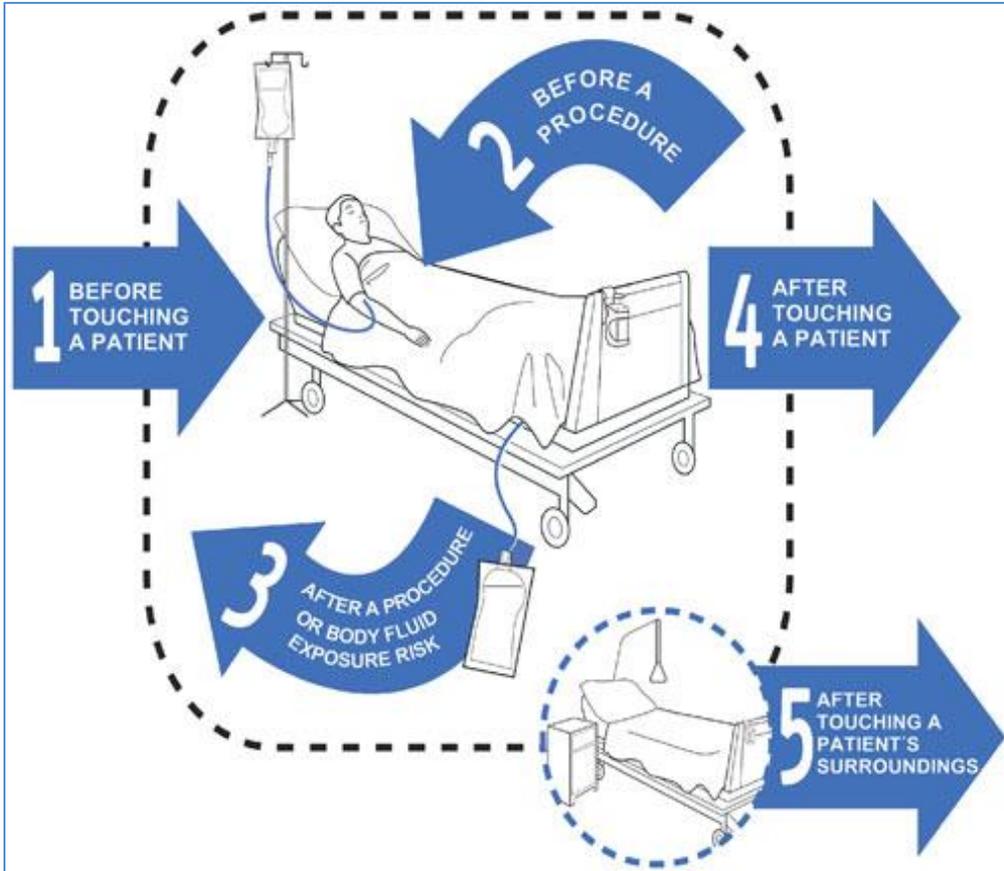


Figure 1 – Five moments for hand hygiene (WHO)

**STEP 1** apply hand rub

## Hand Rub

Duration- 20-30 seconds)



Figure 2-Steps of hand washing and hand rubbing (WHO)

### Hand hygiene compliance

Although hand washing is considered to be the most important single intervention for preventing HCAs, studies have repeatedly shown poor compliance with hand hygiene by hospital personnel. Failure to comply is a complex problem that includes elements of lack of motivation and lack of knowledge about the importance of hand hygiene. It may also be due to real or perceived obstacles, such as understaffing inconveniently located hand washing facilities, ready availability of the hand hygiene products, and an unacceptable hand washing product. One of the most important factors for compliance is that alcohol hand rub should be available at the *point of care*.

The acceptability of the agent is use is a crucial determinant of HCW compliance. Therefore it is an essential criterion for the selection of preparations for hand hygiene and is dependent upon general appreciation of the product, and its ease of use combined with its dermatological effects. All preparations used for hand hygiene must be acceptable to the user and should not damage the skin on repeated use. If staff do not accept the preparation, it will not be used. Therefore, it is recommended that a trial be undertaken before introduction of a new product in some areas to assess the acceptability by staff. A standardized and validated methodology is available from the WHO. 1) a protocol for evaluation of tolerability and acceptability of alcohol-base hand rub in

use or planned to be introduced, and 2) a protocol for evaluation and comparison of tolerability and acceptability of different alcohol-based hand rub products.

While the cost of hand hygiene products will continue to be an important issue for department responsible for purchasing such products, the level of acceptance of products by HCWs is even more important. An inexpensive product with undesirable characteristics may discourage hand hygiene among HCWs and the resulting poor compliance will not be cost-effective.

A number of strategies have been suggested to improve compliance with hand hygiene. Long-term success will require development of multifaceted programmes, and sustained efforts at promoting compliance with hand hygiene. WHO has developed comprehensive tools to promote hand hygiene in health care facilities and these tools are available from the WHO website.

### **Monitoring of consumption of hand hygiene products**

Monitoring of consumption of hand hygiene products, eg. consumption of the number of bars of soap used and/or amount of alcohol hand rub and liquid soap used in litres, as a measure of hand compliance is *not effective* as it lacks a denominator. In addition, in some countries (especially in the UK) hand hygiene products are also used by visitors and patients, therefore consumption measurement does *not* reflect how much it has been used by the clinical team. The consumption data are imprecise as resources are required to keep an accurate record of the products issued by the pharmacy or store to each ward/department and do not guarantee that the product which has been issued is actually used.

### **Observations of hand hygiene compliance**

Hand hygiene compliance can be calculated using the following formula:

$$\text{Compliance of hygiene} = \frac{\text{Number of hygiene action performed}}{\text{Required hand hygiene action (opportunities)}} \times 100$$

Direct observation to monitor hand hygiene compliance is ideal but it is time consuming and requires skill and training. It is subject to various bias and confounding.

### **Bias**

The method proposed by WHO states that hand hygiene observation should be open and the observer should declare his/her presence before commencing. It is important that observers should be trained using the WHO *Hand Hygiene Technical Reference Manual* and the *Hand Hygiene Training* film. Hand hygiene observation should include all opportunities in the visual field and the observer's moves (if needed) to follow action. In addition to interobserver variation, hand hygiene observation is also subject to bias from HCWs (especially if s/he is doing her own ward/department) and the Hawthorne effect (where subjects improve or modify their behaviour in response to that fact that they are being 'observed') thus giving an increased compliance. However if the observation surveys are conducted regularly, this bias would be equally

distributed among all observations and HCWs are likely to get used to the fact that they are being observed.

## **Confounding**

Monitoring of hand hygiene compliance is also subject to confounding factors. For example:

- Time of day/night when the observation is done.
- Type of patients and health care setting.
- Intensity of care.
- High number of opportunities on short time.
- Professional categories of included HCWs.

Therefore it is essential that *timely feedback* must be given to the clinical area which should provide details on the type of setting (ward/department), professional categories, type of indications, and number of observations with percentage of compliance.

## **Issues related to alcohol-based preparations**

Alcohols are flammable. Flashpoints of commonly used alcohol-based hand rubs range from 17.5-24.5°C, depending on the type and concentration of alcohol present. Therefore, it is important that alcohol-based hand rubs should be stored away from high temperatures of flames. After using hand rub, the hands should be completely dry before contacting electrical outlets or plugs. Consult the safety officer at your health care facility for specific guidelines.

Alcohol used is prohibited in some religions and the adoption of alcohol-based formulations for hand hygiene may cause difficulties for some HCWs mainly because of their concern about its absorption via the skin. In the Islamic tradition, which generally poses the toughest challenge to alcohol use, the Qur' and permits any substance that man can manufacture or develop as a medical agent (Ahmed et al, 2006: Allegranizi et al, 2009).

Where there is thought to be high risk of ingestion, consideration should be given to the labelling of the hand rubs with an emphasis on the sanitizing properties and with a warning of dangers associated with ingestion. Bottles containing smaller quantities should be used, if possible, and 500-ml containers should be secured. Health care facilities should have local guidance on how to deal with ingestion based on products available.

## **Skin reactions related to hand hygiene**

Frequent and repeated use of soaps and other detergents are responsible for chronic dermatitis among HCW's and this can be reduced by the addition of humectants, i.e ingredient (s) added to hand hygiene products to moisturize the skin. In addition, skin irritation is also found due to the presence of antimicrobial agents and other ingredients present in the soaps of the formulation.

A skin reaction to hand hygiene products may be increased by low relative humidity which most commonly occurs in winter months in the northern hemisphere. This is because in dry seasons, the lipid depletion from hands occurs more quickly, especially in an individual with dry skin. In tropical countries and during dry and cold periods with low relative humidity should be avoided. In addition, HCWs with darker skin have significantly healthier skin and less skin irritation than those with lighter skin.

Two major types of skin reactions are associated with hand hygiene:

**Irritant contact dermatitis** is extremely common and is caused by frequent use of hand hygiene products. The damage to the skin is caused by denaturation of stratum corneum proteins, changes in intercellular lipids, and decreased stratum corneum water-binding capacity. This can be reduced by using moisturizing skin care products and by avoiding soap and water hand washing before or after an alcohol-based product is used.

**Allergic contact dermatitis** is very rare and is present as delayed type reactions or less commonly as immediate reactions (contact urticaria). The most common causes of contact allergies are fragrances and preservatives present in the hand hygiene products.

Exposure to irritation soaps and detergents can be minimized by promoting the use of alcohol-based hand rubs containing humectants. These products are well tolerated and are associated with a better skin condition when compared with either plain or antimicrobial soap.

### **Hand care**

Hand care is important, because intact skin is a natural defence against infection. Damage to the skin also changes skin flora, resulting in more frequent colonization by staphylococci and Gram-negative bacilli. In addition, the irritant and drying effects of hand preparations have been identified as one of the reasons for lack of compliance with hand hygiene. The following points must be kept in mind to reduce skin irritation.

- Frequent hand washing lead to progressive depletion of surface lipid due to the action of lipid-emulsifying detergents resulting in deeper action of detergents into the superficial skin layers. Alcohols are responsible for depletion of the lipid barrier on the skin due to lipid-dissolving properties of alcohols which is inversely related to their concentration, and ethanol tends to be less irritating than n-propanol or isopropanol. Therefore hand preparations containing emollients and moisturizers should be used.
- Washing hands with soap and water immediately before or after using an alcohol based product is not only unnecessary, but may lead to dermatitis (Kampf, 2003).
- Donning of gloves while hands are still wet (either from hand washing or applying alcohol hand products) is also not recommended as it increase the risk of skin irritation.
- To minimize chapping of hand, don't use hot water and *pat hands* dry with good quality towel paper rather than rubbing them.

- Apply an emollient hand cream regularly to protect skin from the drying effect of hand washing preparations.
- Since liquid soaps, hand lotions, ointments, or creams used by HCWs may contain ingredients that cause contact allergies, it is essential that HCWs should use product approved by the health care facility's Occupational Health Department.
- Cover cuts and abrasions with water-resistant occlusive dressings which should be changed as necessary.
- Frequent use of gloves also contributes to dermatitis due to allergy to latex proteins and shear forces associated with wearing or removing gloves.
- Seek medical advice if you have skin problems such as exudative lesions or weeping dermatitis and avoid direct contact with patient care until the condition resolves as per advice of the Occupational Health Department.

### **Hand care products**

Hand care products are used to help prevent excessive dryness. Some are also responsible for skin sensitization, therefore, only suitable hand creams or lotions should be used and the following points should be considered in their choice:

- They should be supplied in small, individual-use containers that are not refilled.
- Some types of hand creams and lotions may interact with antiseptics (eg. chlorhexidine) and affect the integrity of gloves.
- Aqueous-based hand creams should be used before wearing gloves as oil-based preparation may cause latex gloves to deteriorate.