

State of Kuwait
Ministry of Health
Infection Control Directorate



Title: Guidelines for Hand Hygiene in Healthcare Settings

Policyno:	4/2018
Effective date:	August 2nd, 2018
Appliesto:	All healthcare settings in Kuwait (Governmental and Private Sectors)

Approved by:

Name	Signature
Head of Committee of Infection Control Policies	
Director of Infection Control Directorate	

Authorized by:

Name	Signature
Under Secretary of Ministry of Health	

Table of Contents

1-	Introduction	4
2-	Purpose	4
3-	Scope	4
4-	Definitions of terms	4
5-	Recommendations	6
	5.1. My 5 Moments for Hand Hygiene	6
	5.2. Hand Hygiene Technique	7
	5.3. Surgical Hand Preparation	10
	5.3.1. Steps Before Starting Surgical Hand Preparation	10
	5.3.2. Protocol for Surgical Scrubbing With Medicated Soap	10
	5.3.3. Surgical Hand Preparation Technique with an Alcohol-Based Handrub Formulation	12
	5.4. Selection and Handling of Hand Hygiene Agents	14
	5.4.1. Standards of Proven Efficacy	14
	5.4.1.1. Hygienic Handwash and Hand Rub Agents	15
	5.4.1.2. Surgical Hand Preparation	15
	5.5. Recommended Preparations Used for Hand Hygiene	15
	5.5.1. Alcohols	15
	5.5.2. Chlorhexidine	16
	5.5.3. Iodine and iodophors	16
	5.6. Skincare	17
	5.7. Methods to Reduce the Adverse Effects of Hand Hygiene Agents	17
	5.8. Gloves	17
	5.8.1. Use	17
	5.8.2. Indications for Gloving and for Glove Removal	18
6-	Other Aspects of Hand Hygiene	18
7-	Educational and Motivational Programmes for Health-Care Workers	19
8-	Governmental and Institutional Responsibilities	19
9-	References	20
10-	Appendices	21
	10.1. Appendix 1: Safety Issues Related to Alcohol-Based Preparations	21
	10.2. Appendix 2: Other Safety-Related Issues	22

Table of Figures

Figure 1:	Five Moments of Hand Hygiene	7
Figure 2:	How to Hand Rub	8
Figure 3:	How to Hand Wash	9
Figure 4:	Surgical Hand Preparation Technique with an Alcohol-Based Handrub Formulation	12

1. Introduction

Hand washing with soap and water has been considered a measure of personal hygiene for centuries and has generally been embedded in religious and cultural habits.

In 1847, Semmelweis recommended that hands be scrubbed in a chlorinated lime solution before every patient contact and particularly after leaving the autopsy room. In 1847, following three months of implementing the hand hygiene measure in an obstetric clinic, the mortality rate fell dramatically from 18.3 to 2.2% in the clinic most affected and remained low after that.

Transmission of healthcare-associated pathogens from one patient to another is mainly via HCWs' hands.

Many trials provided compelling evidence that when compared with no hand washing, hand cleansing with an antiseptic agent between patient contacts reduces transmission of healthcare-associated pathogens. Some studies have demonstrated the effectiveness of hand cleansing on healthcare associated infection (HCAI) rates or the reduction in cross-transmission of antimicrobial resistant pathogens.

2. Purpose

1. To ensure that we have a proper hand hygiene program.
2. To have a clear strategy to improve hand hygiene compliance.
3. To achieve the annual targeted hand hygiene compliance (according to the National Hand Hygiene Educational and Motivational Program, 2013).

3. Scope

The policy applies to all healthcare workers (HCWs) in Kuwait governmental and private healthcare settings.

4. Definition of terms:

- **Hand Hygiene:** A general term referring to any action of hand cleansing.
- **Handwashing:** Washing hands with plain or antimicrobial soap and water.

- **Hand Disinfection:** Is extensively used as a term in some parts of the world and can refer to antiseptic handwash, antiseptic hand rubbing, hand antiseptis/decontamination/ degerming, handwashing with an antimicrobial soap and water, hygienic hand antiseptis, or hygienic hand rub.
- **Hygienic Hand Wash:** Treatment of hands with an antiseptic handwash and water to reduce the transient flora without necessarily affecting the resident skin flora. It is broad spectrum but is usually less efficacious and acts more slowly than the hygienic hand rub.
- **Hygienic Hand Rub:** Treatment of hands with an antiseptic hand rub to reduce the transient flora without necessarily affecting the resident skin flora. These preparations are broad spectrum and fast-acting, and persistent activity is not necessary.
- **Surgical Hand Scrub/Pre Surgical Scrub:** Refers to surgical hand preparation with antimicrobial soap and water.
- Surgical hand rubbing: Refers to surgical hand preparation with Alcohol-based hand rub
- **Plain Soap:** detergents that contain no added antimicrobial agents or may contain these solely as preservatives.
- **Antimicrobial (Medicated) Soap:** Soap (detergent) containing an antiseptic agent at a concentration sufficient to inactivate microorganisms and/or temporarily suppress their growth. The detergent activity of such soaps may also dislodge transient microorganisms or other contaminants from the skin to facilitate their subsequent removal by water.
- **Antiseptic Agent:** An antimicrobial substance that inactivates microorganisms or inhibits their growth on living tissues. Examples include alcohols, chlorhexidine gluconate (CHG), chlorine derivatives, iodine, quaternary ammonium compounds and triclosan.
- **Alcohol-based (hand) rub:** An alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to inactivate microorganisms and/or temporarily suppress their growth.

- **Resident flora (resident microbiota):** Microorganisms residing under the superficial cells of the stratum corneum and found on the surface of the skin.
- **Transient flora (transient microbiota):** Microorganisms that colonize the superficial layers of the skin and are more amenable to removal by routine handwashing.

5. Recommendations

- Wash hands with soap and water when visibly dirty or visibly soiled with blood or other body fluids or after using the toilet
- If exposure to potential spore-forming pathogens is strongly suspected or proven, including outbreaks of *Clostridium difficile*, hand washing with soap and water is the preferred means
- Use an alcohol-based handrub as the preferred method for routine hand antisepsis in clinical situations other than in those handwashing is essentially required e.g. if hands are not visibly soiled.
- Perform hand hygiene according to My five Moments for hand hygiene.

This evidence-based, field-tested, user-centered approach is designed to be easy to learn, logical and applicable in a wide range of settings.

5.1 My 5 Moments for Hand Hygiene:

The My 5 Moments for Hand Hygiene approach defines the key moments when health-care workers should perform hand hygiene.

This approach recommends health-care workers to clean their hands

- before touching a patient,
- before clean/aseptic procedures.
- after body fluid exposure risk.
- After touching a patient.
- after touching patient surroundings.

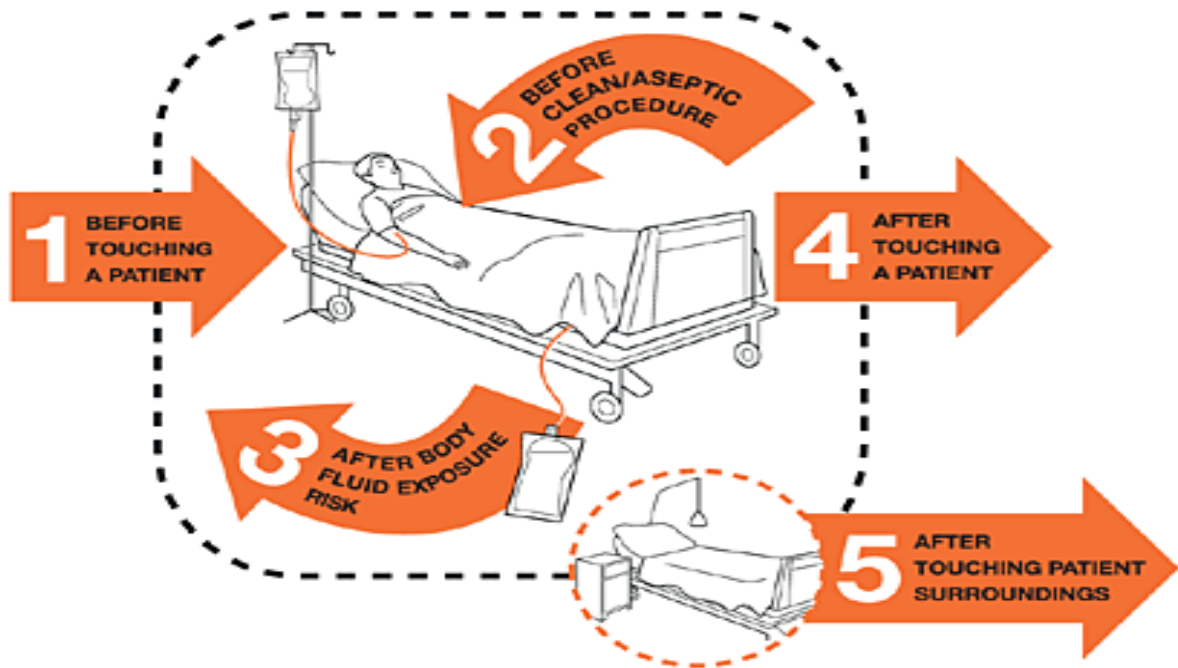



Figure 1: five moments of hand hygiene

5.2 Hand Hygiene Technique

- a. Apply a palm-full of alcohol-based hand rub and cover all surfaces of the hands. Rub hands until dry.
- b. When washing hands with soap and water, wet hands with water and apply the amount of product necessary to cover all surfaces. Rinse hands with water and dry thoroughly with a single-use towel. Use clean, running water whenever possible. Avoid using hot water, as repeated exposure to hot water may increase the risk of dermatitis.
- c. Use a paper towel to turn off tap/faucet
- d. Dry hands thoroughly using a method that does not re-contaminate hands.
- e. Make sure towels are not used multiple times or by multiple people.

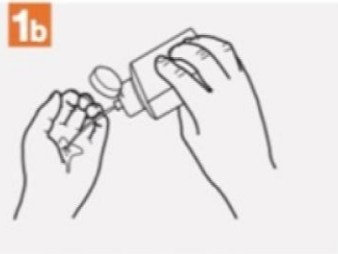
How to Handrub?

RUB HANDS FOR HAND HYGIENE! WASH HANDS WHEN VISIBLY SOILED

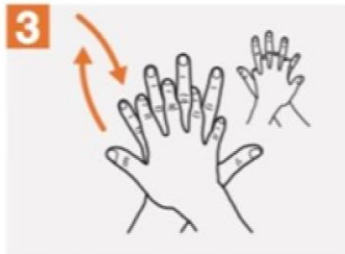
 **Duration of the entire procedure: 20-30 seconds**



Apply a palmful of the product in a cupped hand, covering all surfaces;



Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;



Palm to palm with fingers interlaced;



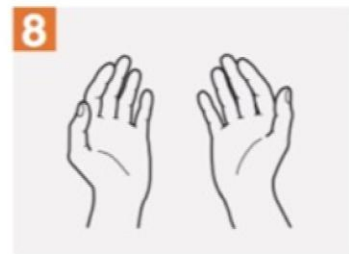
Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Once dry, your hands are safe.



World Health Organization

Patient Safety

A World Alliance for Safer Health Care


SAVE LIVES

Clean Your Hands

Figure 2: how to hand rub

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

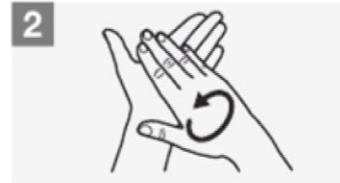
 Duration of the entire procedure: 40-60 seconds



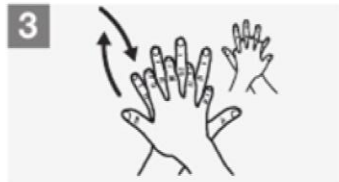
Wet hands with water;



Apply enough soap to cover all hand surfaces;



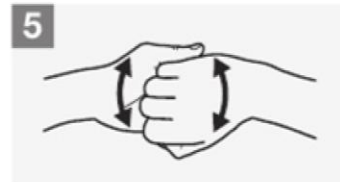
Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;



Palm to palm with fingers interlaced;



Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Rinse hands with water;



Dry hands thoroughly with a single use towel;



Use towel to turn off faucet;



Your hands are now safe.



World Health Organization

Patient Safety

A World Alliance for Safer Health Care

SAVE LIVES

Clean Your Hands

Figure 3: how to hand wash

May 2009

5.3 Surgical Hand Preparation

The most commonly used products for hand antisepsis are chlorhexidine or povidone-iodine containing soap. Application of chlorhexidine or povidone-iodine-containing result in a similar initial reduction of bacterial counts of (70-80%) that achieve 99% reduction after repeated application. Rapid regrowth occurs after application of povidone-iodine, but not after use of chlorhexidine. Washing with hot water should be avoided, using warm water makes antiseptics work more effectively.

5.3.1 Steps before Starting Surgical Hand Preparation

- Keep nails short and pay attention to them when washing your hands, most microbes on hands come from beneath the fingernails.
- Do not wear artificial nails or nail polish.
- Remove all jewelry (rings, watches, bracelets) before entering the operating theatre.
- Wash hands and arms with a non-medicated soap before entering the operating theatre area or if hands are visibly soiled.
- Clean subungual areas with a nail file. Nail brushes should not be used as they may damage the skin and encourage shedding of cells. If used, nail brushes must be sterile, once only (single use). Reusable autoclavable nail brushes are on the market.

5.3.2 Protocol for Surgical Scrub with a Medicated Soap

- Start timing. Scrub each side of each finger, between the fingers, and the back and front of the hand for 2 minutes.
- Proceed to scrub the arms, keeping the hand higher than the arm at all times. This helps to avoid recontamination of the hands by water from the elbows and prevents bacteria-laden soap and water from contaminating the hands.
- Wash each side of the arm from wrist to the elbow for 1 minute.
- Repeat the process on the other hand and arm, keeping hands above elbows at all times. If the hand touches anything at any time, the scrub must be lengthened by 1 minute for the area that has been contaminated.

- Rinse hands and arms by passing them through the water in one direction only, from fingertips to elbow. Do not move the arm back and forth through the water.
- Proceed to the operating theatre holding hands above elbows.
- At all times during the scrub procedure, care should be taken not to splash water onto surgical attire.
- Once in the operating theatre, hands and arms should be dried using a sterile towel and aseptic technique before donning gown and gloves.

5.3.3 Surgical hand preparation technique with an alcohol-based handrub formulation (Figure 4):

The handrubbing technique for surgical hand preparation must be performed on perfectly clean, dry hands. On arrival in the operating theatre and after having donned theatre clothing (cap/hat/bonnet and mask), hands must be washed with soap and water. After the operation when removing gloves, hands must be rubbed with an alcohol-based formulation or washed with soap and water if any residual talc or biological fluids are present (e.g. the glove is punctured).

Surgical procedures may be carried out one after the other without the need for handwashing, provided that the handrubbing technique for surgical hand preparation is followed (Images 1 to 17).



1
Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the dispenser



2
Dip the fingertips of your right hand in the handrub to decontaminate under the nails (5 seconds)



3
Images 3–7: Smear the handrub on the right forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)



4
See legend for Image 3



5
See legend for Image 3



6
See legend for Image 3



7
See legend for Image 3



8
Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your right hand, using the elbow of your other arm to operate the dispenser



9
Dip the fingertips of your left hand in the handrub to decontaminate under the nails (5 seconds)



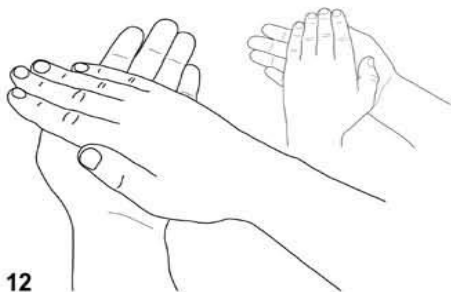
10

Smear the handrub on the left forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)



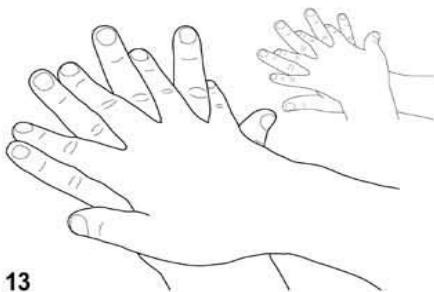
11

Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the distributor. Rub both hands at the same time up to the wrists, and ensure that all the steps represented in Images 12-17 are followed (20-30 seconds)



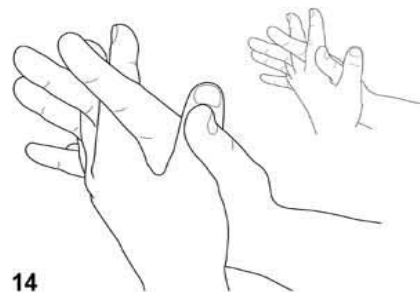
12

Cover the whole surface of the hands up to the wrist with alcohol-based handrub, rubbing palm against palm with a rotating movement



13

Rub the back of the left hand, including the wrist, moving the right palm back and forth, and vice-versa



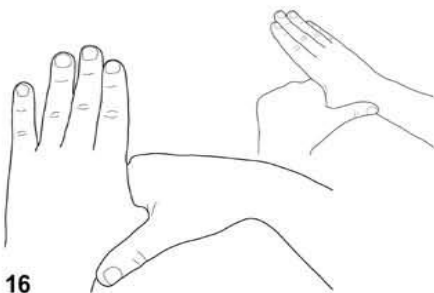
14

Rub palm against palm back and forth with fingers interlinked



15

Rub the back of the fingers by holding them in the palm of the other hand with a sideways back and forth movement



16

Rub the thumb of the left hand by rotating it in the clapsed palm of the right hand and vice versa



17

When the hands are dry, sterile surgical clothing and gloves can be donned

Repeat the above-illustrated sequence (average duration, 60 sec) according to the number of times corresponding to the total duration recommended by the manufacturer for surgical hand preparation with an alcohol-based handrub.

5.4 Selection and Handling of Hand Hygiene Agents

- Provide HCWs with efficacious hand hygiene products that have low irritancy potential.
- To maximize acceptance of hand hygiene products by HCWs, solicit their input regarding the skin tolerance, feel and fragrance of any products under consideration.
- When selecting hand hygiene products:
 - a. Determine any known interaction between products used to clean hands, skin care products and the types of glove used in the institution.
 - b. Solicit information from manufacturers about the risk of product contamination.
 - c. Ensure that dispensers are accessible at the point of care.
 - d. Ensure that dispensers' function adequately and reliably and deliver an appropriate volume of the product.
 - e. Ensure that the dispenser system for alcohol-based hand rubs is approved for flammable materials.
 - f. Solicit and evaluate information from manufacturers regarding any effect that hand lotions, creams or alcohol-based hand rubs may have on the effects of antimicrobial soaps being used in the institution.
 - g. Cost comparisons should only be made for products that meet requirements for efficacy, skin tolerance, and acceptability.
- Do not add soap or alcohol-based formulations to a partially empty soap dispenser. If soap dispensers are reused, follow recommended procedures for cleansing.

5.4.1 Standards of Proven Efficacy

In Europe, the most commonly used methods to test hand antiseptics are those of the European Committee for Standardization (CEN). Germany has their own recommendations; this recommendation is issued by the association of applied hygiene (VAH). In the USA, such formulations are regulated by the Food and Drug Administration (FDA), which refer to the standards of ASTM International (formerly, the American Society for Testing and Materials).

5.4.1.1 Hygienic Handwash and Hand Rub Agents

CEN standards: EN 1499 and EN 1500

ASTM standards:

- ASTM E-1174 (hygienic hand wash and rub)
- ASTM E-1838 (finger pad method for viruses)
- ASTM E-2276 (finger pad method for bacteria)
- ASTM E-2613 (finger pad method for fungi)
- ASTM E-2011 (whole hand method for viruses)

VAH (hygienic hand disinfectant)

5.4.1.2 Surgical Hand Preparation

CEN standard: EN 12791 (surgical hand preparation)

ASTM standard: ASTM E-1115 (surgical hand scrub)

VAH listed (surgical hand disinfectant)

5.5 Recommended Preparations Used for Hand Hygiene

5.5.1 Alcohols:

Most alcohol-based hand antiseptics contain ethanol, isopropanol or n-propanol, or a combination of two of these products. Concentrations are given as either percentage of volume (= ml/100 ml, abbreviated % v/v), percentage of weight (= g/100 g, abbreviated % m/m), or percentage of weight/volume (= g/100 ml, abbreviated % m/v). The antimicrobial activity of alcohols results from their ability to denature proteins. Alcohol solutions containing 60–80% alcohol are most effective, with higher concentrations being less potent. Alcohols have excellent in vitro germicidal activity against Gram-positive and Gram-negative vegetative bacteria (including multidrug-resistant pathogens such as MRSA and VRE), *M. tuberculosis*, and a variety of fungi. However, they have virtually no activity against bacterial spores or protozoan oocysts and very poor activity against some non-enveloped (non-lipophilic) viruses.

Following the widespread use of alcohol-based handrub as the gold standard for hand hygiene in healthcare, concern has been raised about their lack of efficacy against spore forming pathogens, in particular *C. difficile*.

Contact precautions are highly recommended during *C. difficile* associated outbreaks, in particular glove use (as part of contact precautions) and handwashing with a plain or antimicrobial soap and water following glove removal after caring for patients with diarrhea.

Alcohol-based hand rub can then be used exceptionally after handwashing in these instances, after making sure that hands are perfectly dry.

Moreover, alcohol based hand rub, now considered the gold standard to protect patients from the multitude of harmful resistant and non-resistant organisms transmitted by HCWs' hands, should be continued to be used in all other instances at the same facility

5.5.2 Chlorhexidine:

Chlorhexidine's immediate antimicrobial activity is slower than that of alcohols. A solution containing 0.5 chlorhexidine and 60-70% alcohol provide rapid bactericidal action and persistent antimicrobial effect against wide range of microorganisms. A 4% chlorhexidine anti-microbial soap is recommended for surgical hand scrub and hygienic handwash.

Chlorhexidine has good activity against Gram-positive bacteria, somewhat less activity against Gram-negative bacteria and fungi, and minimal activity against mycobacteria. Chlorhexidine is not sporicidal; it has in vitro activity against enveloped viruses such as herpes simplex virus, HIV, cytomegalovirus, influenza, and RSV, but significantly less activity against non-enveloped viruses such as rotavirus, adenovirus, and enteroviruses.

5.5.3 Iodine and Iodophors

Iodine has been recognised as an effective antiseptic since the 1800s, though iodophors have largely replaced iodine as the active ingredient in antiseptics because iodine often causes irritation and discoloring of skin. Povidone-iodine (7.5-10) % significantly reduces the number of microorganisms on the hands and forearms prior to surgery. Iodine and iodophors have bactericidal activity against Gram-positive, Gram-negative and some spore-forming bacteria (clostridia, *Bacillus* spp.) and are active against mycobacteria, viruses and fungi. However, in concentrations used in antiseptics, iodophors are not usually sporicidal.

5.6.Skin Care

- a. Include information regarding hand-care practices designed to reduce the risk of irritant contact dermatitis and other skin damage in education programs for HCWs.
- b. Provide alternative hand hygiene products for HCWs with confirmed allergies or adverse reactions to standard products used in the health-care setting.
- c. Provide HCWs with hand lotions or creams to minimize the occurrence of irritant contact dermatitis associated with hand antisepsis or handwashing.
- d. When alcohol-based hand rub is available in the health-care facility for hygienic hand antisepsis, the use of antimicrobial soap is not recommended.
- e. Soap and alcohol-based handrub should not be used concomitantly.

5.7.Methods to Reduce the Adverse Effects of Hand Hygiene Agents

- Selecting less-irritating products.

Because HCWs must clean hands frequently, it is important for health-care facilities to provide products that are both efficacious and as safe as possible for the skin.

- Use of moisturising skin care products.

For HCWs at risk of irritant contact dermatitis or other adverse reactions to hand hygiene products, additional skin moisturising may be needed.

5.8. Gloves

5.8.1.Use

- The use of gloves does not replace the need for hand hygiene by either hand rubbing or hand washing.
- Wear gloves when it can be reasonably anticipated that contact with blood or other potentially infectious materials, mucous membranes, or non-intact skin will occur.
- Remove gloves after caring for a patient. Do not wear the same pair of gloves for the care of more than one patient.

- When wearing gloves, change or remove gloves during patient care if moving from a contaminated body site to either another body site (including non-intact skin, mucous membrane or medical device) within the same patient or the environment.

5.8.2 Indications for Gloving and for Glove Removal

Gloving

1. before a sterile condition.
2. anticipation of a contact with blood or another body fluids, regardless of the existence of sterile conditions and including contact with non-intact skin and mucous membrane.
3. contact with a patient (and his/her immediate surroundings) during contact precautions.

Glove removal

1. as soon as gloves are damaged (or non-integrity suspected).
2. when contact with blood, another body fluid, non-intact skin and mucous membrane has occurred and has ended
3. when contact with a single patient and his/her surroundings, or a contaminated body site on a patient has ended.
4. when there is an indication for hand hygiene

6. Other Aspects of Hand Hygiene

- Jewelry: Remove rings, wrist-watch, and bracelets before beginning surgical hand preparation. Wearing rings or other jewelry during health care is strongly discouraged.
- Fingernails and artificial nail: Do not wear artificial fingernails or extenders when having direct contact with patients, Keep natural nails short (tips less than 0.5 cm long)

7. Educational and Motivational Programs for Health-Care Workers

- a. Hand hygiene promotion programs for HCWs focus specifically on factors currently found to have a significant influence on behavior, and not solely on the type of hand hygiene products. The strategy should be multifaceted and multimodal and include education and senior executive support for implementation.
- b. Educate HCWs about the type of patient-care activities that can result in hand contamination and about the advantages and disadvantages of various methods used to clean their hands.
- c. Monitor HCWs' adherence to recommended hand hygiene practices (through hand hygiene observations) and provide them with performance feedback (hand hygiene compliance rate).
- d. Encourage partnerships between patients, their families, and HCWs to promote hand hygiene in healthcare settings.

8. Governmental and Institutional Responsibilities

1. For health-care administrators, it is essential that administrators ensure conditions are conducive to the promotion of a multifaceted, multimodal hand hygiene strategy and an approach that promotes a patient safety culture.
2. For national governments, improved hand hygiene adherence should be made as national priority and consider the provision of a funded, coordinated implementation programme, while ensuring monitoring and long-term sustainability. It should promote hand hygiene at the community level to strengthen both self-protection and the protection of others.

9. References

- WHO Guidelines on Hand Hygiene in Health Care, First Global Patient Safety Challenge Clean Care is Safer Care (2009).
- Miller MA, Rosin A, Crystal CS. Alcohol-based hand sanitizer: can frequent use cause an elevated blood alcohol level? *American Journal of Infection Control*, 2006, 34:150– 151.
- Gebel, J. (2007). Testing and listing disinfectants – instrument and product of quality assurance. *GMS Krankenhaushygiene Interdisciplinary*, 2(1), Doc17.

10. Appendices:

10.1. Appendix 1: Safety Issues Related to Alcohol-Based Preparations

Fire hazard issues Alcohols are flammable. Flashpoints of alcohol-based hand rub range from 17.5°C to 24.5°C, depending on the type and concentration of alcohol present. Therefore, risk assessment and minimization is crucial and alcohol-based hand rubs should be stored away from high temperatures or flames in accordance with national regulations . Indeed, most reported incidents were associated with deliberate exposure to a naked flame, e.g. lighting a cigarette. The International Fire Code recently agreed to accept alcohol-based hand rubs in corridors.

The application of alcohol-based hand rubs, hands should be rubbed together until all the alcohol has evaporated.

10.2 Appendix 2: Other Safety-Related Issues

Accidental and intentional ingestion and dermal absorption of alcohol-based preparations used for hand hygiene have been reported. Acute, severe alcohol intoxication resulting from accidental ingestion of an unknown quantity of alcohol-based hand rub was recently reported in the United Kingdom, resulting in the unconsciousness of an adult male patient (Glasgow Coma Scale 3). This unusual complication of hand hygiene may become more common in the future, and security measures are needed. These may involve: placing the preparation in secure wall dispensers; labelling dispensers to make the alcohol content less clear at a casual glance and adding a warning against consumption; and the inclusion of an additive in the product formula to reduce its palatability. In the meantime, medical and nursing staff should be aware of this potential risk.

Alcohol toxicity usually occurs after ingestion. It is primarily metabolized by an alcohol dehydrogenase in the liver to acetone. Symptoms and signs of alcohol intoxication include headache, dizziness, lack of coordination, hypoglycemia, abdominal pain, nausea, vomiting, and haematemesis. Signs of severe toxicity include respiratory depression, hypotension, and coma. Among alcohols, isopropyl alcohol appears to be more toxic than ethanol, but less so than methanol.

Blood isopropyl alcohol levels of 50 mg/dl are associated with mild intoxication and 150 mg/dl with deep coma. Apparently, isopropyl alcohol has no adverse effects on reproduction and is not genotoxic, teratogenic, or carcinogenic.

In addition to accidental ingestion, alcohols can be absorbed by inhalation and through intact skin, although the latter route (dermal uptake) is very low.

More recently, Miller and colleagues conducted two studies in which large amounts of an ethanol-based hand rub were used very frequently over periods of several hours; they found that blood alcohol levels at the end of the trial periods were below the level of detection.