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A Brief Review of Hand Hygiene: from Basics to Recent Developments

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Editorial Note:
Hand hygiene is a key infection prevention and control measure in the healthcare settings, where vulnerabilities and gaps have been exposed by the COVID-19 pandemic. To date, the problem of healthcare-associated infection remains substantial and continues to pose serious risks to patients worldwide. With the recent advancements of innovative technology, it is uncertain how has the field of hand hygiene changed, or if at all. In this review we shall revisit the basics of hand hygiene while exploring new developments related to this topic. We welcome any feedback or suggestions. Please direct them to Dr. LUI Leo (e-mail: leo_lui@dh.gov.hk) of Education Committee, the Hong Kong College of Pathologists. Opinions expressed are those of the authors or named individuals, and are not necessarily those of the Hong Kong College of Pathologists.

Introduction

Hand hygiene (HH) has been termed the single most important infection prevention and control (IPC) measure by the World Health Organization (WHO). (1)(2) There is substantial amount of evidence that proper hand hygiene can reduce transmission of healthcare-associated infection (HAI), which is defined as “an infection acquired by a patient during the process of care (including preventive, diagnostic and treatment services) in a hospital or other healthcare facility, which was not present or incubating at the time of admission”. (3-6) HAI remains a serious challenge in healthcare delivery worldwide, affecting approximately 7% of patients in high-income countries and up to 15% in low- and middle-income countries. (6)

Learning Objectives

This brief review serves to 1) revisit the role of HH as an IPC measure in healthcare settings; 2) review the methods of performing HH, ways to conduct training and compliance monitoring; 3) explore recent advances in technology and related applications as well as the future research agenda for HH.

Historical Perspective of Hand Hygiene

Hand hygiene was first identified by the Hungarian obstetrician Ignac Sammelwise (1818–1865). He observed that puerperal fever, which carried high maternal mortality, was at a disproportionately high rate in the first clinic with deliveries carried out by physicians and medical students compared to a second clinic with deliveries made by midwives (16% vs 7% respectively). He noticed that doctors and medical students often went directly to the delivery suite after performing autopsies and usually had foul smell on their hands before they entered the clinic. (12) He enforced a then innovative hand-washing policy that mandated the use of chlorine water for cleaning skin of the hands until the cadaveric smell disappeared before entry was allowed. After a year, mortality rate in both clinics decreased, with the first clinic rate dropping from 16% to 2.4%. In view of his contribution to establishing a strong and specific causal association between unclean hands and puerperal fever, Ignac Sammelwise is also known as the “Father of infection control”. (7)

The Role of Hand Hygiene in preventing Healthcare-Associated Infections

As a major component in standard precautions, HH should always be practiced during patient care regardless of the infectious disease status or the type of procedure undertaken. (8) Although diseases spread by the contact route will logically be the most relevant, proper HH is also important for prevention of diseases with predominant respiratory and airborne transmissions. (9-11) Transmission of pathogens by hands requires transfer of viable organisms from skin (patient or healthcare worker (HCW)) and the environment, in the absence of HH actions. (12)

Systematic review shows that the hands of HCWs are commonly contaminated with multidrug-resistant organisms (MDROs) with pooled prevalence ranging from 4%-9% depending on the organism. (13) Improper HH has been associated with nosocomial outbreaks, e.g. lapses during vascular access procedures have contributed to blood-borne virus outbreak in haemodialysis centres. (14) HH has also been a key IPC measure to terminate outbreaks of *Clostridioides difficile* infection and to prevent hospital outbreaks from happening in the first place. (15)(16)

Indications for Hand Hygiene

Most of us are familiar with the "five moments of HH" advocated by the WHO: #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 (**Figure 1**). (12) Other indications include e.g. after glove removal, moving from a contaminated body site to another body site during care of the same patient, before putting on and after removing personal protective equipment (PPE). (12)(17)(18) Among the five moments, the most commonly missed appears to be moment #5, contributing to almost half of all missed opportunities in one study. It is possible that HCWs might misjudge the risk of pathogen spread during seemingly low-risk activities like taking blood pressure and reading case notes. (19)

Performing Hand Hygiene

HH can be accomplished by hand washing or using alcohol-based handrub (ABHR).

Hand Washing

Hand washing with soap and water is advised when hands are visibly dirty and/or caring for patients known or suspected of having spore-forming pathogens such as *Clostridioides difficile*, or some non-enveloped (non-lipophilic) viruses such as hepatitis A virus, norovirus and enteroviruses to which alcohol has no or minimal antimicrobial activity. (18)(20) Hand washing requires a supply of clean water with liquid plain or antimicrobial soap. Compared to rubbing hands with antiseptics, washing hands

under running water can eliminate bacteria additionally by mechanical removal. (12) It is rather common for facilities to install touchless electronic water faucets nowadays. However, it should be noted that these devices tend to be associated with higher rate of water contamination, particularly with *Legionella*, *Pseudomonas* and *Acinetobacter*. Related hospital outbreaks have been reported which may require replacement with manual faucets to stop. Use of touchless faucets in high-risk settings e.g., intensive care units, wards with immunocompromised patients is generally not advisable. (21-25) They may be considered to enhance hand hygiene compliance in the community, but their design should minimise stagnation of water, with regular monitoring, flushing and proper maintenance carried out to reduce biofilm formation. (26)

Drying hands after hand washing is a critical step that is occasionally neglected. Disposable paper towel instead of air dryer is recommended in healthcare settings, due to the fact that strong air currents can aerosolize bacteria from the hands and cause cross contamination to the environment and persons nearby. (27-29)

Alcohol-Based Handrub

The alcohol used in ABHR is either ethanol or isopropanol. As alcohol is not a good cleansing agent, ABHR is not recommended when there is visible contamination of hands with proteinaceous materials. (12) However, in other clinical situations, ABHR is the preferred means for routine HH. (18) Compared to using soap and water, ABHR has the advantages of superior microbiocidal activity, reduced drying of the skin and convenience. (18) There is evidence that providing easily accessible ABHR (along with other IPC measures) improves compliance of HH among HCWs. (30-32) The Society for Healthcare Epidemiology of America (SHEA) recommends placing at least two dispensers for each private room: one in patient room and one in hallway. (33)

Alcohol has excellent in-vitro germicidal activity against Gram-positive and Gram-negative vegetative bacteria (including MDROs), *Mycobacterium tuberculosis*, and some fungi. (34) Alcohol solutions containing 70–80% alcohol is recommended because it is relatively more effective against non-enveloped viruses. (12)

The ideal volume of alcohol hand rub to be applied to the hands may vary with different formulations. In practice, if the hands feel dry after rubbing for less than 10–15 seconds, it is likely that an insufficient volume has been applied. Emollients (e.g. glycerol) are added to reduce drying of the skin, which may cause a sensation of stickiness after applications. (12)

Alcohol is a flammable substance and its storage is restricted. There is guidance on safe use, handling and storage in workplace published by the Labour Department. (35) Alcohol is regulated by the Dangerous Goods Ordinance (Cap. 295) (except aqueous solution containing not more than 24% of ethanol). (36)

Several years ago, a piece of research showing increased tolerance of vancomycin-resistant enterococci (VRE) towards alcohol disinfectant caused great concern among the medical community. (37) However, the percentage of alcohol used in the study (23%) is actually much lower than the concentration used in practice for HH (60-90%). (38) Besides, other researchers did not notice any increase of minimum inhibitory concentration (MICs) during periods before and after using ABHR. (39) Therefore, ABHR is still considered to be effective against VRE.

Ethanol has been classified as a carcinogen as beverages, and is recently under scrutiny by the European Chemical Agency for potential safety concerns in its use as a disinfectant (including ABHR). If determined to be harmful, there could be far-reaching implications for the field of infection control. (85) At the time of writing, the issue is still under deliberation. (40) Nonetheless, we should bear in mind that absorption of alcohol through skin and inhalation have been shown to be minimal after application as handrub. (12)(41)

"Bare Below Elbow"

To perform HH effectively, fingernails should be kept short and artificial nails, hand jewellery should be avoided (a plain ring can be kept as minimum). Long sleeves should be rolled up, and cuts and abrasions should be covered with waterproof dressing. (12)(18)(42)(43) The concept of "bare below elbow" has been advocated during HH promotion in public hospital (44) and integrated into the design of white coats for doctors. (84)

Hand Hygiene Technique

The steps for hand washing and hand rub are similar. Proper coverage of all surfaces of the hands is important. Some parts are more easily missed than others, such as finger webs and back of fingers. (45) Each health authority may have a slightly different recommendation. For example, the WHO recommends 6 steps while the Centre for Health Protection (CHP) of Hong Kong (China) recommends 7 steps including the wrists, similar to United Kingdom, Australia and Chinese mainland (12)(18)(46-48). The U.S. Centers for Disease Control and Prevention (CDC) advocates only 3 steps for hand rubbing, without referring to each specific area of the hand. (49) Note that there is no universally agreed and standardized sequence, and the most effective yet feasible technique is unknown. (50) Surgical hand scrub, on the other hand, requires a more sophisticated process. (12)

To facilitate education and assessment of technique under direct supervision, fluorescent marker can be added to the ABHR to help visualize the degree of coverage of the hand surface under ultraviolet light inspection. (51) It has been shown that correct performance of HH sequence does not guarantee adequate coverage of the hands. (52) An innovative idea is to use infra-red thermal imaging to map the coverage by detecting temperature differences caused by alcohol evaporation from skin surface. (53)

Smart watches, rings and other wearable devices have also been studied with the goal to automatically analyse HH performance by capturing and analysing motion pattern data. (54)(55) However, putting devices on hands performing HH appears to contradict with the principle of effective HH. If decided to adopt wearable devices for monitoring practice, armband may be a more reasonable option. (56) Alternatively, camera can be set up to identify anatomical points on hands to provide data for training machine-learning models, theoretically enabling the artificial intelligence system to recognize and assess HH movements. However, such model may struggle if the recorded images deviate from the specific positions outlined in the training guidelines. For instance, the hands need to be aligned with the sink for actions to be recognized. Ambient lighting can affect system performance as well. (57)

Compliance Monitoring

Like other IPC measures, HH can only be as effective as the extent to which they are properly followed. HH compliance is calculated by counting the number of HH actions (as numerator) and dividing it by the total number of HH opportunities occurring (as denominator) and then multiplied by 100%. Sometimes only the numerator is collected for convenience. An ideal HH compliance monitoring method should be unobtrusive (does not interfere with the behaviour of the observed), reliable (reflecting the reality even during complex activities) and cost-effective. Such a perfect method does not exist in real world. Approximate information is therefore obtained by direct observation by persons (observer, patient or HCW) or indirectly by product uptake (consumption) and automated (electronic) monitoring systems. (12)

Direct Observation

Direct observation by validated observer is the gold standard for monitoring HH compliance. Validation is achieved by parallel observation jointly performed with a confirmed observer, followed by active discussion over discordant results until concordance is reached. A stringent adherence to the same methodology over space and time is necessary, with a representative sample selected. An example of the observation form from the WHO is shown as **Figure 2**. Direct observation is time-consuming, labour-intensive, and captures only a small sample of opportunities amidst the long hours of patient care. (12)

Direct observation may not be possible if the potential HH action occurs outside the patient care zone (e.g. disposal of body fluid away from bedside), is obscured e.g. by privacy curtains or if the patient zone is not well defined e.g. in an outpatient setting. (58) With its subjective nature, staff may also be more easily discouraged by repeated negative feedback and even lose the incentive to improve. (59)

The “Hawthorne effect” refers to changed behaviour of the observed during the period of observation that does not reflect the real situation in practice. One way to reduce Hawthorne effect is to desensitize HCW by conducting frequent unobtrusive,

unannounced observations and ward visits to habituate HCWs to the presence of observers. (12) Periodic observations are useful as they inform the IPC team the current situation in clinical areas and serve as visible reminders to HCWs. (59) Alternatively, covert observations ("secret shopper") may be adopted by enlisting observers unknown to the unit personnel to conduct the observation, but this act may lead to distrust among HCWs. (12)(33)

A piece of good news on this labour-intensive monitoring method is that a small number of well-validated and good-quality observations may be more important than collecting a big number of observations, and appears not to compromise the quality of observation. (60)(61) A duration of 10-20 minutes should be adequate, and observations conducted randomly over different shifts and days are preferred to enhance representativeness, although this will carry resource implications. (62) Successful direct observation requires constant training and competency checking to ensure consistent and valid results generation. (12) As different clinical specialities may conduct procedures unique to themselves, the way observation is conducted may need to be tailored according to specialty's own needs to enhance the effectiveness and meaningfulness of results. (63)

Feedback can be given after observation to facilitate education and foster a patient safety culture. Feedback should be made in a timely manner: immediately (after direct observation) or as soon as possible (after covert observation), and regularly. Formats of feedback should be multiple, i.e., verbal, written and on multiple occasions to maximise the chance of successful communication. (33)

Product Uptake

Measuring the consumption of HH products (ABHR, liquid soap or paper towel) as a marker of hand hygiene actions offers the advantages of objectiveness (no Hawthorne effect), labour- and cost-saving and the ability to provide continuous measurement over the defined period. There is, however, no information on the number of HH opportunities. Hence the denominator needs to be substituted by surrogate measures e.g., patient-days or workload indicators. (12) Other limitations of this method include wastage by spillage and consumption by non-HCWs e.g., visitors (especially in publicly

accessible points) not being excluded and are difficult to be quantified. (59) Moreover, it does not determine if the HH actions are performed at the right moments in the sequence of patient care. (12)

Electronic Hand Hygiene Monitoring Systems

With the development of artificial intelligence and other advanced wireless technologies, HH compliance monitoring may be potentially assisted by automatic systems. The advantages of electronic HH monitoring systems include efficiency, objectivity and the ability for continuous monitoring. These systems use real-time locating features, such as blue-tooth, radio-frequency identification or Wi-Fi network to transmit data across the defined areas. (64) Continuous capture of HH data results in the number of observations easily exceeding that generated by direct observation at a scale of about 50-100 times. (65)(66)

A typical setup is for HCWs to wear a badge which registers an event whenever HCW enters or leaves the patient zone, as well as activate the soap or ABHR dispenser. The number of patient room entries and exits are taken as the 'before' and 'after' patient contact moments (#1 & #4). Dividing this by the number of dispensing events and then multiply by 100% gives the overall HH compliance rate for these two moments. (67) Data can be collected from different wards, staff categories, times of the day, days of the week and work shifts. (68) However, the measurement is not a complete reflection of the clinical scenario, since details on the opportunities inside patient room are not recorded. Examples of missed opportunities may include touching objects again after performing HH before touching patients, touching objects directly after touching patient without performing HH in between, or not performing HH after body fluid exposure risk and before aseptic procedures. (69)

Others have attempted real-time continuous surveillance with computer vision and depth sensors to record different types of motion images of the HCWs for analysis by machine learning. Privacy is a concern in these scenarios. In one study privacy issue was addressed by the fact that the computer vision was unable to discern human faces and colours of clothing, and that no viewing of the video data was carried out by humans. (70)

To validate electronic monitoring systems, direct observation is needed to benchmark HH opportunities. For this purpose, remote video observation with independent observer unknown to the unit may be more suitable since reducing observer and sampling bias is of high importance. Major challenges of remove video observation include balancing the view restriction of the camera for patient privacy protection, the potential need for patient consent and cost. (33)

Sensory cues may be added to electronic monitoring systems as reminders to HCWs to perform HH. For instance, a visible light signal on the ABHR dispenser providing immediate feedback and acknowledgement of HH action has been found to increase compliance of HCWs during the period it was switched on. (71) In another study, audible alerts with physical vibration occur whenever the sensor cannot detect relevant HH events with respect to the defined patient zone. Sensory cues likely work by creating a social obligation with expectation from self and others to perform HH. However, compliance rate dropped once the reminder was removed, so the improvement was not sustainable. (69)

Acceptability by HCWs to electronic systems can be mixed, especially among doctors who are typically unconvinced unless technology is well supported by evidence, and nurses and managers who tend to be concerned about practical issues like costs and staff reactions. (62) Most studies using these systems are of short-term (over months), small-scale (restricted to one or two wards) and involve highly motivated staff who are likely to perform well. Hence whether they will work in the long term and in other clinical areas are difficult to predict. The impact on infection rate is also unknown as it is usually not measured as an outcome. There are also technical challenges like issue of accuracy, data integration, privacy, confidentiality, usability and needs of infrastructure improvement. Most studies do not include details of challenges encountered in implementation and ways to overcome, and standardized measurement tools to evaluate system performance are still lacking. (64) Finally, the costs for such systems may be substantial, including upfront purchasing cost, ongoing subscription fee for maintenance, dedicated personnel to manage the project, ongoing validation, data analysis and interpretation efforts. (66) Taking all these factors together, it can be concluded that routine use of electronic hand hygiene monitoring system is probably not yet well supported by evidence at this moment. Efforts may

instead be better channelled to enhance the rigor and accuracy of direct observation. (62) **Table 1** gives an overall comparison of various approaches for HH compliance monitoring.

Promotion of Hand Hygiene

Strategies to improve adherence to hand hygiene practices should be multimodal and multifaceted. Activities that are more effective usually involve interactive visits with educational components, meaningful feedback and reminders with local consensus established. Educational materials alone without these add-ons are unlikely to be successful. (12)

The WHO attaches great importance to HH promotion. Hand Hygiene Day has been a major event held annually since 2009 (**Table 2**). (72)(82) CHP also organises similar event every year, sometimes echoing the themes of the WHO. Both public and private hospitals are encouraged to participate in the event. (73)

Successful HH campaigns usually require a "top-down" approach with commitment of senior leadership, but "bottom-up", frontline owned campaigns can also work if well planned and implemented. In a Canadian project, committed frontline staff leaders or 'champions' that serve as role models were identified to enhance HH compliance in patients and their families. Surprisingly, a secondary increase among HCWs was also noted which was sustainable on follow-up evaluations. The key to success was attributed to having a simple and straightforward programme design and a high degree of person-to-person education for motivation. (74)

According to the WHO, patient empowerment is defined as a process in which patients understand their role, are given the knowledge and skills by their healthcare provider to perform a task in an environment that recognizes community and cultural differences and encourages patient participation. (12) It is increasingly recognized as a potential target for multimodal HAI prevention. (75) However, actual implementation may not be easy as it seems due to social pressure in speaking up and worries about damaging the patient-HCW relationship. (12) Less direct way of reminder e.g. visual prompts may be provided to facilitate expression. (76) One study showed that most patients chose to thank healthcare providers for performing HH or

even remain silent, instead of actively reminding HCW to wash their hands, highlighting the difficult of the patient empowerment approach. (77)

Other innovative ideas for HH promotion have also been explored. Gamification elements e.g., point system can be added to introduce friendly competition among HCWs and create a supportive environment. Both intrinsic reward (recognition) and extrinsic incentive (e.g., gift vouchers) play a part in encouraging positive behaviour. (78) Interactive robots strategically placed at hospital entrances, outpatient areas and day centres may be more commonly seen in the future for promotion of hand hygiene. Frequent and regular cleaning of these robots should be performed to ensure hygiene and prevent transmission of diseases. (79)(80)

Future Research for Hand Hygiene

The WHO has facilitated consensus formation among IPC experts to set out priority statements for HH research. These statements serve to provide ideas for exploration by scientists, guide policy-makings by government officials and resource investments from donors. There are six core domains identified: system change, training and education, evaluation and feedback, reminders and communication, institutional safety climate, impact of HH improvement on HAIs and antimicrobial resistance. (81) Fundamentals of HH such as handrub compositions and HH technique are also potential research topics. (82)

Conclusion

HH holds a crucial position in IPC and HAI prevention. Education in the technique and indications of HH have been successful, but adherence to best practices is important to ensure positive outcome in patient safety. There are some successes in using technology to assist training and compliance monitoring of HH, but many challenges remain ahead and not every question has an answer. Further research in various domains will be needed to continue knowledge advancement on this important topic in infection prevention and control.

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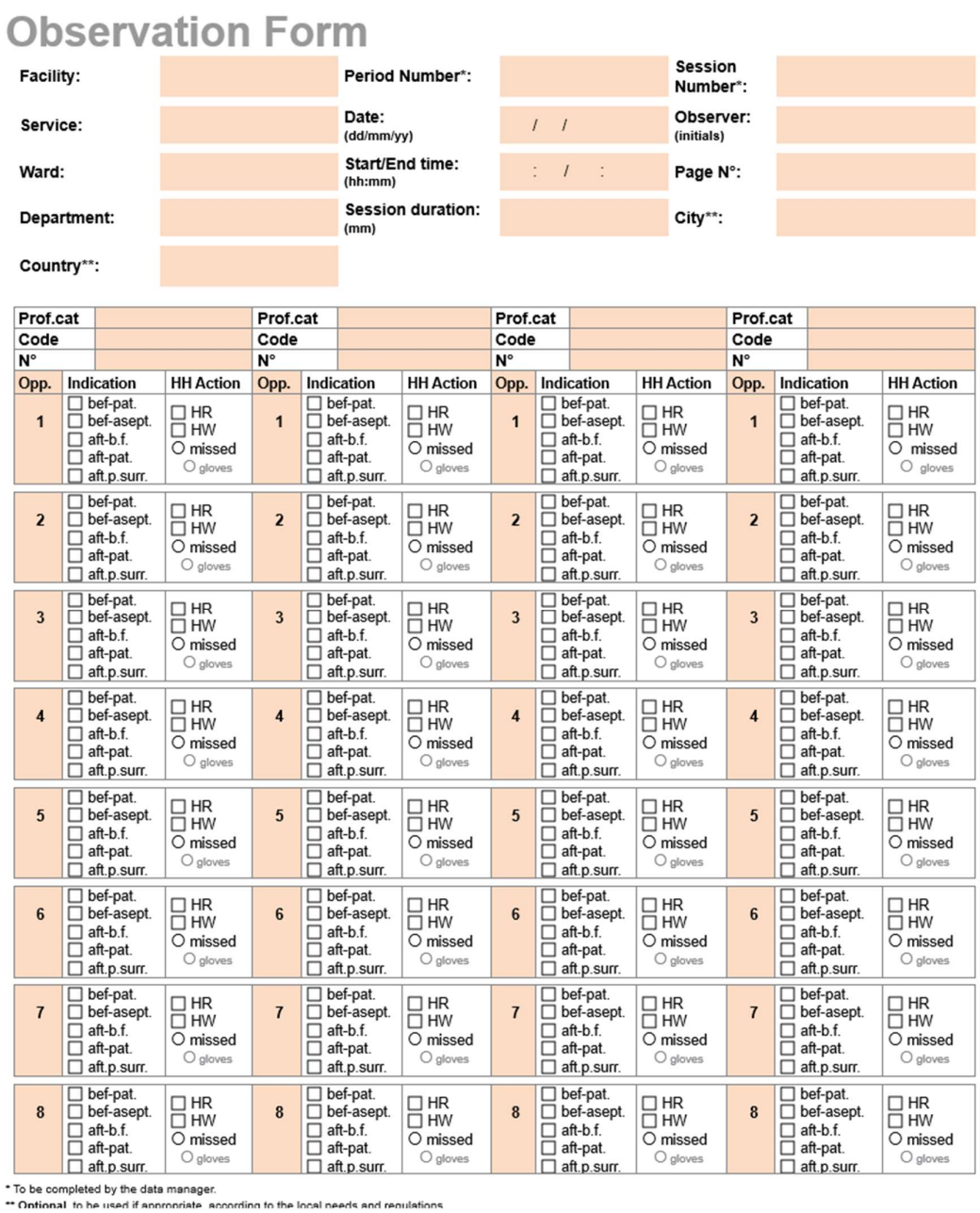
Figure 1. Five Moments for Hand Hygiene (83)

Figure 2. Hand Hygiene Observation Form by the WHO (12)



Observation Form

Facility:		**Period Number*:**		**Session Number*:**	
Service:		**Date:** (dd/mm/yy)	/ /	**Observer:** (initials)	
Ward:		**Start/End time:** (hh:mm)	: / :	**Page N°:**	
Department:		**Session duration:** (mm)		**City**:**	
Country:**					

Prof.cat			Prof.cat			Prof.cat			Prof.cat		
Code			Code			Code			Code		
N°			N°			N°			N°		
Opp.	**Indication**	**HH Action**	**Opp.**	**Indication**	**HH Action**	**Opp.**	**Indication**	**HH Action**	**Opp.**	**Indication**	**HH Action**
1	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	1	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	1	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	1	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
2	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	2	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	2	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	2	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
3	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	3	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	3	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	3	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
4	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	4	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	4	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	4	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
5	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	5	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	5	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	5	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
6	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	6	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	6	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	6	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
7	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	7	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	7	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	7	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
8	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	8	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	8	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	8	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves

* To be completed by the data manager.

** Optional, to be used if appropriate, according to the local needs and regulations

Table 1. Advantages and Disadvantages of various Hand Hygiene Monitoring

Approaches (adapted) (12)

Monitoring Approach	Advantages	Disadvantages
Direct observations by expert observers	● The only way to reliably capture all HH opportunities ● Details can be observed ● Unforeseen qualitative issues can be detected	● Time-consuming ● Skilled and validated observers required ● Prone to observation, observer and selection bias
Self-report by HCW	● Inexpensive	● Overestimates true compliance ● Not reliable
Direct observations by patients	● Inexpensive	● Potential negative impact on patient-HCW relationship ● Reliability and validity remain to be demonstrated
Consumption of hygiene products such as ABHR, soap and towels	● Inexpensive ● Reflects overall HH activity without selection bias ● Validity may be improved by surrogate denominators	● Does not reliably measure the need for HH (opportunities) ● No information about appropriate timing of HH actions ● Patient and visitor usage as well as prolonged product stocking can affect validity
Automated (electronic) monitoring systems	● Absence of observer may reduce observer bias ● Potential to produce much information about HH behaviour and infectious risk	● Limited real-world and long-term experience ● Ethical issues e.g., privacy and confidentiality ● Unknown acceptability by staff ● Can be costly and error-prone

Table 2. Themes and Calls to Action of the WHO SAVE LIVES: Clean Your Hands May 5 World Hand Hygiene annual campaign, 2009–2025 (72) (82)

Year	Themes & Calls to Action
2009	Global launch of the 1st annual campaign SAVE LIVES: Clean Your Hands on May 5
2010	Participation of health-care facilities in a Hand Hygiene Moment 1 Global Observation Survey
2011	"Track your progress, plan actions, and aim for hand hygiene sustainability"; participation of health-care facilities in the first WHO Hand Hygiene Self-Assessment Framework global survey
2012	"Create your action plan based on your facility's results using the WHO Hand Hygiene Self-Assessment Framework"
2013	Focusing on hand hygiene monitoring and feedback, and reminding health-care facilities that patients have a voice too
2014	"It's in your hands, prevent sepsis in health care"; participation of health-care facilities in the second WHO Hand Hygiene Self-Assessment Framework global survey
2015	"Safety starts here"
2016	"See your hands, hand hygiene supports safe surgical care"
2017	"Fight antibiotic resistance—it's in your hands"
2018	"No action today; no cure tomorrow—make the WHO 5 Moments for Hand Hygiene part of protecting your patients from resistant germs"
2019	"Clean care for all—it's in your hands"; participation of health-care facilities in the third WHO Hand Hygiene Self-Assessment Framework global survey
2020	"Nurses and Midwives, clean care is in your hands"
2021	"Seconds save lives—clean your hands"
2022	"Unite for safety: clean your hands"
2023	"Accelerate action together. SAVE LIVES – Clean Your Hands"
2024	"Why is sharing knowledge about hand hygiene still so important? Because it helps stop the spread of harmful germs in health care."
2025	"It might be gloves. It's always hand hygiene"