A multidisciplinary program using World Health Organization observation forms to measure the improvement in hand hygiene compliance in burn unit

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Abstract: Nosocomial infections occur frequently in patients with burn injuries and are a major cause of morbidity and mortality. Hand hygiene (HH) was found to be a fundamental element in preventing health care–associated infections. Improving HH compliance is a major target for the World Health Organization (WHO) Patient Safety Challenge. Multimodal approaches including educational programs and the introduction of alcohol based hand-rub in healthcare settings proved to be the most effective strategies for promoting HH compliance. **The aim of this work** was to assess the improvement in hand hygiene compliance of health care workers (HCWs) in burn unit over a period of 12 months, after a multi-faceted training program, by using WHO HH observation forms and to evaluate the relationship between compliance rates and methicillin-resistant *Staphylococcus aureus* (MRSA) incidence rate as a secondary outcome. **Materials and methods;** A direct observational before–after study to assess the improvement in HH compliance after a multi-faceted training program, was implemented at the burn unit, Ain Shams University Hospital. The improvement intervention included lectures, on job training, distributing factsheets and reminders and providing HH supplies as alcohol hand rub dispensers. **Results;** There was a significant increase in average HH compliance percentage from 39.8% during the baseline phase to 61.9% during the improvement phase. This increment was sustained during the control phase (60.6%). HH compliance percentage among different professional categories showed highest compliance among nurses throughout the three phases of the study. The nurses' category also demonstrated the highest percentage as regards WHO 5 moment of HH orientation and performing correct HH technique. There was a drop in health care associated (HA) MRSA incidence rate per 1000 patient days from 10.2 during baseline phase to 8.2 during the improvement phase and 8.3 during the control phase, however the difference was statistically non-significant. **Conclusion;** The multi-faceted training program, through different approaches, was successful to improve HH compliance among HCWs at the burn unit and to decrease HA MRSA incidence rate. **Recommendations;** Continuous improvement efforts as regular training and persistent evaluation, monitoring and feedback are crucial to maintain and even enhance adherence to appropriate HH practice. Additional measures as prudent use of antibiotics, active surveillance for patients with a high risk for MRSA carriage and management of nasal MRSA colonization are recommend for reduction of MRSA incidence rates.
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Key words: Nosocomial infections**;** Hand hygiene**;** Compliance**;** Improvement**;** World Health Organization (WHO)**.**

1. Introduction

Hand hygiene (HH) is a fundamental part of preventing health care–associated infections (HAI), which cause mortality and morbidity, prolong hospital stays, and contribute to increases in health care costs. Improving HH compliance is a major target for the WHO Patient Safety Challenge (WHO, 2006).

Nosocomial infections occur frequently in patients with burn injuries and are a major cause of morbidity and death. The burn wound is especially susceptible to microbial invasion because of loss of the protective integument and the presence of devitalized tissue (Andrew et al., 2002).

MRSA is a global healthcare issue with medical and socio-economic consequences for patients, healthcare professionals and hospital trusts. Patients have increased morbidity and mortality, whilst increasing lengths of stay and additional medical and surgical interventions lead to hospital trusts incurring further costs. Poor hand hygiene is the main source of MRSA transmission within hospital. However, after applying alcohol gel, 99% of transient organisms, including MRSA, are eradicated (Laupland et al., 2008). In an attempt to reduce the incidence of patients with MRSA, hand-hygiene awareness has become more prominent world-wide (Davis, 2010). Furthermore, other studies highlight the direct

relationship between the volume of alcohol gel used and reduced MRSA infection rates in a dose-response manner (Kaier and Frank, 2009).

HH was found to be the single most important factor in the prevention of HAI. The 3 most frequently reported methods of measuring HH compliance were: (1) direct observation, (2) self-reporting by health care workers (HCWs), and (3) indirect calculation based on HH product usage (McGuckin et al., 2009).

Attention to various behavioral factors and formulation of waterless hand-rubs that allow ease of use with improved compliance have contributed to some improvements in HH compliance, with successful national-, local-, and hospital-level HH campaigns being reported from several countries (Sladek et al., 2008). Prior research has identified the importance of feedback on HH compliance and of making HH campaigns multidisciplinary and multimodal (Stout et al., 2007).

Although healthcare worker compliance with HH guidelines is considered the corner stone of the prevention of pathogen cross-transmission (Rozenthal et al., 2005) , the overall proportion of adherence remains low, usually much less than 50% in most hospitals (Cohen et al., 2003). The most effective approach suggested for promoting HH compliance was by using multidimensional strategies including educational programs and the introduction of alcohol based hand-rub in healthcare settings (Randle et al., 2006). Recent reports have emphasized the effectiveness of using multidisciplinary approaches and the relevance of providing contextualized knowledge for activating practices in different fields of healthcare sciences (Freeman et al., 2008).

The aim of this work was to assess the improvement in hand hygiene compliance of HCWs in burn unit over a period of 12 months, after a multi-faceted training program, by using WHO HH observation forms and to evaluate the relationship between compliance rates and MRSA incidence rate as a secondary outcome.

2. Materials and Methods

*** Study design:**

- A direct observational before–after study to assess the improvement in HH compliance after a multi-faceted training program, was implemented at the burn unit, Ain Shams University Hospital. The unit consists of a ward with the capacity of 12 beds, an ICU with the capacity of 5 beds, emergency room with the capacity of 1 bed, and 1 operation theatre. It was carried out during the period from October 2008 till September 2009.

*** Study steps:**

The study was accomplished in four consecutive steps (Table 1):

- Step 1: Defining the study population and assessment of the current status of the unit as regards HH compliance rate, presence of appropriate HH facilities (sinks - soap dispensers - paper towel dispensers) and availability of HH supplies.
- Step 2: Analyzing data collected in step 1 to determine weaknesses and strengths and finding causes of in-adherence to HH guidelines through root cause analysis.
- Step 3: Improvement and taking corrective actions to overcome weaknesses and emphasize strengths to achieve the study's aim through an intensified educational and training program.
- Step 4: Control phase for maintaining direct observation of HH compliance and sustaining the achievements of the improvement phase through regular meetings, educational sessions and routine feedback.
- The team met every two weeks for one hour.

Table 1 : Time schedule

	October & November 2008	December 2008 & January 2009	February to May 2009	June to September 2009
Step 1				
Step 2				
Step 3				
Step 4				

***Step I:**

A. Defining study setting and population :

1. Detailed layout of the unit

A- Ward consisted of :

- 1 Operation theater with a separate scrub area
- 1 Hydrotherapy room with one sink
- 1 Dressing room with one sink
- 3 Patients room 4beds each with no sinks

B- ICU consisted of:

- 1 Corridor with one sink
- 5 Separate cubicles with no sinks

C. Emergency room consisted of:

- 1 Dressing room with one sink
- 1 Operation theater for minor interventions

2. Population

For the audit of practices and survey of knowledge as regard hand hygiene, the population involved was represented in table 2.

Table 2: A list of the health care workers present in the unit and targeted by the study:

Distribution	Doctors	Nurses	Housekeepers
Ward	- Unit manager - 3 residents - 3 assistant lecturers - 1 lecturer - 2 anesthesiologists	4	1
Emergency room	The same members of the ward	3	1
ICU	The same members of the ward	10	1
operation theatre	The same members of the ward	3	1

B. Developing Operational Definitions:

1. Calculation of Hand hygiene compliance% (adherence percentage):

It is defined as the ratio of the number of actions (numerator) that were done correctly to the number of opportunities (denominator) as expressed by the following formula:

$$\textbf{Compliance (\%)} = \frac{\textbf{Hand Hygiene Actions}}{\textbf{Opportunities}} \times 100$$

Where opportunities represent the points in time within the care process when hand hygiene should be performed as specified by the indications. WHO guidelines recommend that five indications be measured which are; before patient contact, before aseptic task, after body fluid exposure risk, after patient contact & after contact with patient surroundings.

While, actions comprise the performance of hand hygiene. Each opportunity should correspond to an action of performing hand hygiene (WHO, 2006).

Adherence ratio was calculated using 2 types of calculations

- **Composite measures**

A composite measure is a compilation of multiple indications into a single adherence ratio. This type of measure is calculated by dividing the sum of observed actions (numerator) by the sum of observed opportunities (denominator) (WHO, 2006).

- **Item-by-item measures**

Item-by-item measures allow looking at hand hygiene adherence for opportunities related to certain indication. When calculating this kind of ratio, the denominator is the total number of opportunities for a given indication. The numerator is the total number of hand hygiene actions observed when the opportunity is present as expressed by the following formulas according to WHO (2006):

$$\frac{\text{\# of observed HH actions before patient contact}}{\text{\# of observed HH opportunities before patient contact}} \times 100$$

$$\frac{\text{\# of observed HH actions before aseptic task}}{\text{\# of observed HH opportunities before aseptic task}} \times 100$$

$$\frac{\text{\# of observed HH actions after body fluid exposure}}{\text{\# of observed HH opportunities after body fluid exposure}} \times 100$$

$$\frac{\text{\# of observed HH actions after patient contact}}{\text{\# of observed HH opportunities after patient contact}} \times 100$$

$$\frac{\text{\# of observed HH actions after contact with patient Surroundings}}{\text{\# of observed HH opportunities after contact with patient surroundings}} \times 100$$

- **The ratio of routine hand washing versus alcohol-based hand rub was also calculated**

2. Evaluation of the staff performance of hand hygiene technique:

The components of hand hygiene technique audit tool were scored from zero to two, depending on whether the technique was neglected, partially performed, or performed. Finally the % of different professional categories performing the correct technique were compared. (Individuals scoring < 30/40 were not considered performing correct technique.)

N.B: for the evaluation of hand hygiene technique, each person will be observed once during his activity.

3. Evaluation of the hand hygiene knowledge assessment of the HCWs:

For simplicity, we categorized the WHO hand hygiene knowledge test for health care workers into 3 main items to be evaluated, which were: staff received previous training on hand hygiene, they knew the importance of hand hygiene (hand washing versus alcohol hand rub), and they were oriented with the WHO 5 moments of hand hygiene. Then the answers for the questions related to each of the previous items were evaluated and a final % of staff members oriented with each item was calculated.

4. Evaluation of the ward structure as regard hand hygiene facilities and supplies:

The components of hand hygiene facilities audit tool were scored according to the Egyptian ministry of health scoring system from zero to two, depending

on whether this component was not present, present not complete, or present and complete. The final evaluation of the whole ward structure as regard the available hand hygiene facilities was calculated (fair if the total score is < 60%, good if the total score is 61-75%, very good if the total score is 76-85%, or excellent if the total score is >85%).

5. Calculation of HA MRSA incidence rate:

- Samples were collected for microbiological identification of MRSA from patients with clinically suspected infection from different sites (burn wound , blood , urine and sputum). All isolates were identified as *Staphylococcus aureus* and were tested for methicillin resistance by the Kirby Bauer disk diffusion method as per Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI , 2006) in the hospital's microbiology laboratory. HA MRSA infection referred to the MRSA infection diagnosed 48 hours after hospital admission.
- Patient demographic data (number of admissions, age, gender and patient days) was calculated.
- The incidence rate for HA MRSA was defined as the total number of new MRSA cases that arose from the defined population in the specified time period, divided by the sum of each individual's time at risk while remaining free of disease according to Bruce (2008) , and was expressed as number per 1000-patient-days.

$$\frac{\text{\# of new HA MRSA cases in a certain period}}{\text{Total number of patient days in the same period}} \times \mathbf{1000}$$

C. Data Collection:

The two methods used for measuring hand hygiene compliance were auditing and survey. According to the WHO (2006) guidelines, auditing (observation) is the "gold standard" for measuring hand hygiene adherence. It is the only way to directly measure health care workers' adherence to hand hygiene guidelines. Observation involves directly watching hand hygiene behavior and record the number of hand hygiene indications, opportunities, and actions. Observation was used also to asses structural considerations in the environment, for example, it was used to assess number of functioning sinks and their distribution, dispensers for liquid soap or alcohol-based hand rub (either wall mounted or freestanding), and whether they were functioning. A Survey in the form of a questionnaire was used to gather information on health care worker attitudes and practices related to hand hygiene (Gould, 2007).

1. Duration of data collection :

- The data was collected in 3 phases as follow:

- Phase 1: baseline data collection that lasted for 4 months (during step1 & step 2)
- Phase 2: data collection during the improvement period that lasted for 4 months (during step 3)
- Phase 3: post intervention data collection that lasted for another 4 months (during step 4)

- Each observation session lasted about 1 hour for a total of 20 sessions (20 hours)/ month with one observer assigned to each session who observed the burn ICU during the first half of the session and then moved to the burn ward, emergency room or operation theater in the second half.
- Observation sessions were scheduled at varied times throughout the day and night, both weekdays and weekends.
- All the observation session , throughout the three data collection phases , were carried out by the study members and the infection control nurses and the link nurse in charge who were sufficiently trained to use WHO HH observation forms. Observers were instructed to record only observations of clear opportunities or indications for HH that were either met or not met.

2. Data collection tools (Table 3):

Table 3: The monitoring tools used for data collection:

Type of the tool	Name of the tool	Developer	Appendices	Reference
Observation check list for indication, technique & ward facility for hand hygiene	WHO observation tools and calculation forms	WHO, world alliance for patient safety	Appendix 1	http://www.who.int/gpsc/en/
	Hand hygiene technique audit tool	Study members	Appendix 2	http://www.who.int/gpsc/en/
	ward structures for hand hygiene audit tool	Study members	Appendix 3	- Egyptian ministry of health scoring tool -http://www.who.int/gpsc/en/
Knowledge `survey	WHO hand hygiene knowledge test for health care workers	- WHO, world alliance for patient safety (English questionnaire) – The study members translated the questionnaire into Arabic for nurses & housekeepers.	Appendix 4	http://www.who.int/gpsc/en/

***Step II:**

Analyzing data during brainstorming sessions that lasted for about 20-30 minutes, study members discussed potential causes of low compliance percentage among burn unit staff. Through root causes analysis the following factors for poor compliance were reported:

- Beliefs that wearing gloves obviates the need for hand hygiene.
- Lack of scientific information of definite impact of improved hand hygiene compliance on health care associated infection rates.
- Not thinking of HH or forgetfulness.
- Understaffing and overcrowding.
- No role model from colleagues.
- Inadequate supplies including liquid soap, paper towels and receptacles.
-Sinks are inconveniently located/shortage of sinks.
- Inadequate training of HCWs on proper hand hygiene technique.
- Inadequate promotional items/posters on hand hygiene distributed to HCWs.
-Inadequate performance feedback system.

***Step III:**

Improvement through chosen Remedies:

1- An educational program was the cornerstone for improving HH compliance. Eight multidisciplinary two-hour educational sessions were scheduled. Study members used data show presentations, films, practical demonstrations and question cards (figure 1). Lectures were arranged addressing the following topics:

- Correction of misconceptions about the definitive impact of strict adherence to hand hygiene on reduction of the HA infection and the organism transmission rates.
- Improving awareness of HCWs about WHO guidelines for HH and raising knowledge concerning indications for HH during daily patient care (5 moments of HH).
- Knowledge concerning different types of hand hygiene products and their action.
- Stressing on the importance of hand hygiene despite the use of gloves.

Figure 1: A multidisciplinary educational session.

2- On the job training of physicians, nursing staff including registered nurses, assistants and housekeeping personnel. The training covered proper indications and techniques of hand washing and the proper use of alcohol hand rub (figure 2).

Figure 2: On the job training.

3- Posters and reminders showing indications and steps of hand washing and alcohol hand rub were distributed, including WHO 5 moments of hand hygiene poster, were distributed in patients' rooms, dressing room, nurse's room, ICU and emergency room.

4- Supplies were provided including:

- Liquid soap dispensers.
- Non-disposable single use towels.
- Receptacles for collecting used towels.
- Bedside alcohols rub wall dispensers.
- Pocket size alcohol rub bottles.

5- Performance monitoring tools were developed highlighting the significance of feedback monitoring system:

- Head nurse was provided with checklists for careful monitoring of hand hygiene compliance and technique to exclude the negative effect of newly introduced hand washing devices. Head nurse and infection control link nurse were empowered to conduct feedback monitoring to sustain HCW's adherence to proper HH practice.
- Monthly HH compliance data (run charts and graphs) were disseminated to all staff members and head of department to provide continuous feedback about the progress of the training program.
- An awarding system was implied among nurses in the form of announcing the nurse most adherent to proper HH practice. This made hospital leadership dedication visible to all participating staff which was important to sustain positive attitudes.

On the other hand it was found that constructing new sinks and providing disposable towels dispensers were unavailable remedies due to high cost. The construction of new sinks was not feasible at the unit for the time being.

***Step IV:**

Control phase to sustain the improvement, the following measures were instituted:

- Selecting a dedicated HH improvement program follow up team including infection control nurses and the unit's link nurse.
- Maintaining administrative support and leadership commitment.
- Providing continuous regular educational and training sessions.
- Supplying new reminders with clear, to the point messages to maintain HH awareness.
- Establishing a continuous feedback system based on direct observation and data dissemination.
- Encouraging staff to adopt role model physicians and nurses with prominent HH compliance improvement.

- **Ethical considerations :**

This study was conducted with the approval of the authorized unit manager of the burn unit in Ain Shams University Hospital.

Explanation to the subjects was made by the responsible person to describe full details about the study, its benefits and how to complete the questionnaire. The collected data were kept in confidentiality to insure protection of privacy.

- **Statistical methods :**

IBMSPSS statistics (V.19.o, IBM Corp., USA, 2010) was used for data analysis. Data were expressed as both number and percentage for categorized data. The following tests were done:

1- Comparison between 2 proportions as regards univariant categorized data.
2- Chi-square test to study the association between each 2 variables as regards the categorized data. The probability of error at 0.05 was considered significant, while at 0.01 and 0.001 are highly significant and >0.05 was considered non significant.

3. Results:

1. Assessment of hand hygiene compliance:

Table 4: Total number of opportunities and actions observed and compliance percentage throughout the three phases of the study:

Months	No. of opportunities /month	No .of actions /month	Compliance%
October/2008	260	100	38.5%
November/2008	256	110	43%
December/2008	210	85	40.5%
January/2009	240	90	37.5%
Total over the baseline phase	966	385	39.8%
February/2009	242	145	59.9%
March/2009	215	142	66%
April/2009	258	156	60.4%
May/2009	260	161	61.9%
Total over the improvement phase	975	604	61.9%
June/2009	243	155	63.7%
July/2009	235	143	60.8%
August/2009	218	129	59.1%
September/2009	212	124	58.4%
Total over the control phase	908	551	60.6%

Table **4** shows the total number of opportunities and actions observed monthly throughout the three phases of the study. Average compliance during the baseline phase was 39.8%, during the improvement phase was 61.9% while during the control phase it was 60.6%. Using comparison between 2 proportions showed that there was a highly significant difference between baseline phase and both, the improvement phase ($Z=9.7354$, $p<0.001$) and the control phase ($Z=9.0119$, $p<0.001$). On the other hand, there was no significant difference between improvement and control phases ($Z=0.5636$, $p>0.05$).

Figure 3 shows the rise in monthly HH compliance percentage, the trend-line shows the increased compliance percentage during the improvement phase and the sustained increment during the control phase.

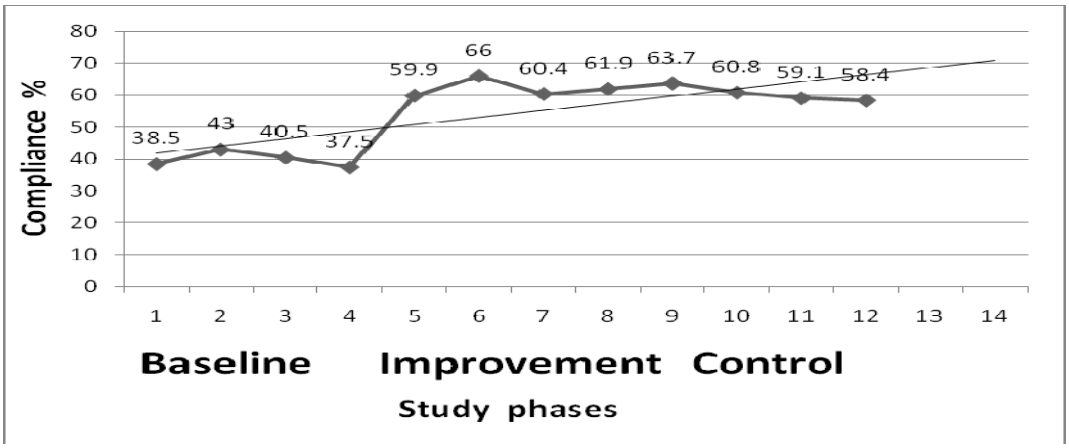

Figure 3: Run chart for average HH compliance percentage throughout the three phases of the study.

Table 5: HH compliance percentage among different professional categories during the baseline, improvement and control phases :

Phase	Baseline			Improvement			Control		
Category	Opp.	Actions	Compl.	Opp.	Actions	Compl.	Opp.	Actions	Compl.
Nurses	753	316	42.8%	731	461	63%	671	441	65.8%
Doctors	164	54	33%	163	92	56.4%	145	78	54%
Workers	49	15	31.4%	81	51	62.9%	92	32	35.4%
Total	966	385	39.8%	975	604	61.9%	908	551	60.6%

Table 5 shows the compliance percentage among different professional categories throughout the study. As regards nurses, there was a highly significant difference between baseline phase and the improvement phase (Z=8.136, p<0.001) and between baseline phase and the control phase (Z=8.968, p<0.001). There was no significant difference between improvement and control phases (Z=1.038, p>0.05). The same results were observed as regards doctors, a highly significant difference was found between baseline and improvement phase (Z=4.2767, p<0.001) and between baseline and control phase (Z=3.7004, p<0.001) , while there was no significant difference between improvement and control phases (Z=0.4665, p>0.05). On the other hand, among workers, there was a highly significant difference between baseline and improvement phase (Z=3.5754, p<0.001) and between the improvement and the control phases (Z=3.702, p<0.001). There was no significant difference between baseline and control phases (Z=0.5002, p>0.05).

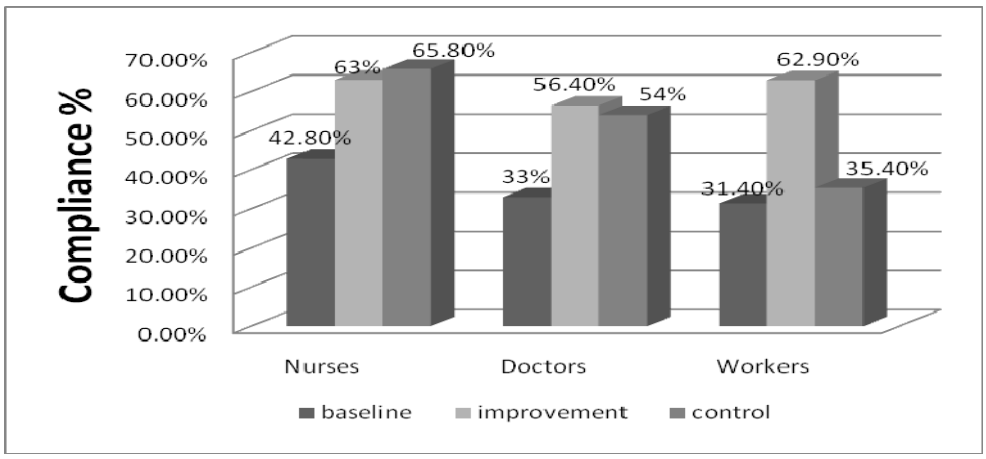

Figure 4: Comparison of HH compliance percentage among different professional categories during the baseline, improvement and control phase.

Figure 4 shows the increased HH compliance percentage during the improvement and the control phases among nurses and doctors, while among workers, the increased HH compliance percentage during the improvement phase was followed by a drop during the control phase.

Table 6: HH compliance percentage according to the WHO indications for HH during the baseline, improvement and control phase:

Phase / WHO indication	Baseline			Improvement			Control		
	Opp.	Actions	Compl.	Opp.	Actions	Compl.	Opp.	Actions	Compl.
Before patient contact	346	108	31.1%	372	186	50%	297	143	48.3%
Before aseptic task	254	127	50%	189	144	76.4%	214	168	78.7%
After body fluid exposure	98	71	72.2%	103	76	74.2%	76	59	77.4%
After patient contact	468	124	26.6%	495	338	68.3%	422	279	66%
After contact with patient surroundings	54	13	24.9%	47	21	45%	38	16	42.5%

Table 6 shows the number of opportunities and actions observed for each of the WHO 5 moments for HH indications, and their calculated compliance percentage:

- Before patient contact indication showed a highly significant difference between baseline phase and both improvement phase (Z=5.1471,p<0.001) and control phase (Z=4.4571,p<0.001), while a non significant difference was found between improvement and control phases (Z=0.4369, p>0.05).
- Before aseptic task indication showed a highly significant difference between baseline phase and both improvement phase (Z=5.6414,p<0.001) and control phase (Z=6.4108,p<0.001), while a non significant difference was found between improvement and control phases (Z=0.5528,p>0.05).
- After body fluid exposure indication didn't show a significant difference between neither of the three phases. A non significant difference was found between baseline phase and both improvement phase (Z=0.32, p>0.05) and control phase (Z=0.78, p>0.05) . Also a non significant difference was found between improvement and control phases (Z=0.49,p>0.05).
- After patient contact indication showed a highly significant difference between baseline phase and both improvement phase (Z=12.94,p<0.001) and control phase (Z=11.79 ,p<0.001), while a non significant difference was found between improvement and control phases (Z=0.7396, p>0.05).
- After contact with patient surroundings indication showed a significant difference between baseline phase and both improvement phase (Z=2.123,p<0.05) and control phase (Z=1.779 ,p<0.05), while a non significant difference was found between improvement and control phases (Z=0.23 ,p>0.05).

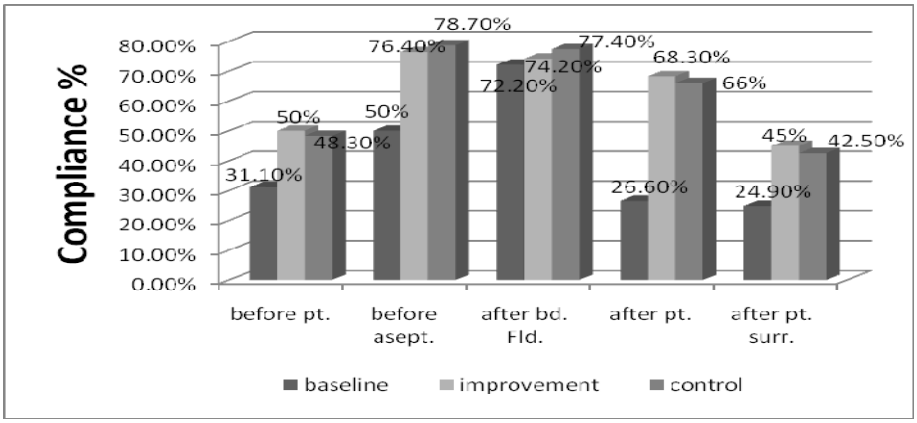

Figure 5: Comparison of HH compliance percentage according to WHO 5 moments of HH indications during the baseline , improvement and control phase.

Figure 5 shows the comparison of HH compliance percentage according to WHO 5 moments of HH indications during the baseline, improvement and control phase. There was an increase in HH compliance percentage as regards before patient contact, before aseptic task, after patient contact and after contact with patient surroundings indications, however no significant change in HH compliance was noticed as regards after body fluid exposure indication.

Table 7 :Comparison of the number of actions in which HCWs used alcohol hand rubbing versus the number of actions in which HCW used hand washing: Using CROSSTAB /CHI- SQUARE TEST (Cell format: count , percent: total ,percent: row, percent :column).

Phase / Item	Baseline	Improvement	Total	Baseline	Control	Total	Improvement	Control	Total
Alcohol hand rubbing	288 29.12 45.14 74.81	350 35.39 54.86 57.95	638 64.51	288 30.77 43.84 74.81	369 39.42 56.16 66.97	657 70.19	350 30.30 48.68 57.95	369 31.95 51.32 66.97	719 62.25
Hand washing	97 9.8 27.6 25.19	254 25.6 72.36 42.05	351 35.49	97 10.36 34.77 25.19	182 19.44 65.23 33.03	279 29.81	254 21.99 58.26 42.05	182 15.76 41.74 33.03	436 37.75
Total	385 38.93	604 61.07	989 100	385 41.13	551 58.87	936 100	604 52.29	551 47.71	1155 100
X^2 P Significance	X^2 P<0.001 Highly significant			X^2 P<0.001 Highly significant			X^2 P<0.001 Highly significant		

Table 7 and figure 6 show that there was a highly significant difference as regards the use of alcohol hand rub versus hand washing during the three phases. The use of alcohol hand rub during baseline phase represented 74.81% (no.=288) in comparison to hand washing which represented 25.19% (no.=97), however during improvement phase there was a drop in alcohol hand rub which represented 57.95% (no.=350) with corresponding increase in hand washing which represented 42.05% (no.=254). Also, when comparing baseline and control phases, the table illustrates that during control phase alcohol represented 66.97%(no.=369) with corresponding increase in hand washing which represented 33.03%(no.=182). On comparing improvement and control phases , alcohol hand rub use increased from 57.95% (no.=350) during improvement phase to 66.97%(no.=369) during control phase , while hand washing dropped from 42.05%(no.=254) during improvement phase to 33.03%(no.=182) during control phase.

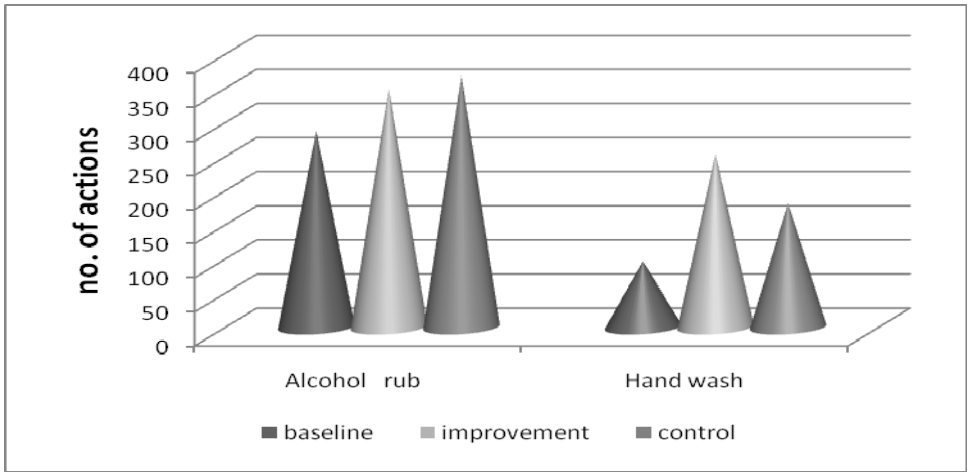

Figure 6: The use of alcohol hand rubbing versus hand washing during the baseline, improvement and control phase.

2. Evaluation of performing correct HH technique:

Table 8: Comparison of the number of personnel performing correct HH technique among different professional categories during the baseline, improvement and control phase:

Phase / Category	Baseline	Improvement	Z & p value	Baseline	Control	Z & p value	Improvement	Control	Z & p value
Nurses (no.20)	6	16	Z=3.17 P<0.01	6	17	Z=3.51 P<0.001	16	17	Z=0.41 P>0.05
Doctors (no.10)	2	5	Z=1.40 P>0.05	2	5	Z=1.40 P>0.05	5	5	Z=0 P>0.05
Workers (no.4)	1	2	Z=0.73 P>0.05	1	3	Z=1.41 P>0.05	2	3	Z=0.73 P>0.05

Table 8 and figure 7 show that there was a highly significant difference between baseline and both improvement and control phases as regards the number of personnel performing correct HH technique among nurses ($p<0.01$), while no significant difference was found between improvement and control phases ($p>0.05$). On the other hand, no statistically significant difference was found between the three phases among doctors and workers ($p>0.05$).

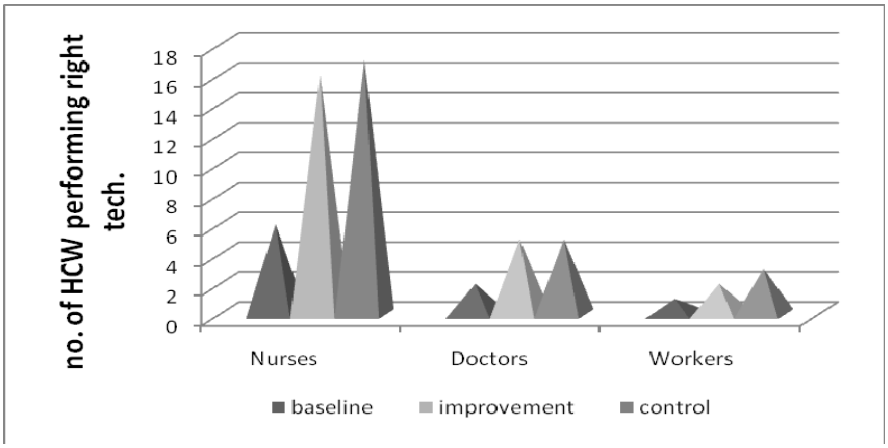

Figure 7: Comparison of the number of personnel performing correct HH technique among different professional categories during the baseline, improvement and control phase.

3. Evaluation of personnel orientation with the WHO 5 moments for hand hygiene:

Table 9: Comparison of the number of personnel oriented with the WHO 5 moments for HH among different professional categories during the baseline , improvement and control phase :

Phase / Category	Baseline	Improvement	Z & p value	Baseline	Control	Z & p value	Improvement	Control	Z & p value
Nurses (no.20)	8	18	Z=3.31 P<0.01	8	19	Z=3.71 P<0.001	18	19	Z=0.6 P>0.05
Doctors (no.10)	3	7	Z=1.78 P<0.05	3	8	Z=2.24 P<0.05	7	8	Z=0.51 P>0.05
Workers (no.4)	1	3	Z=1.41 P>0.05	1	2	Z=0.73 P>0.05	3	2	Z=0.73 P>0.05

Table 9 and figure 8 show that there was a highly significant difference between baseline and both improvement and control phases as regards the number of personnel oriented with the WHO 5 moments for HH among nurses ($p<0.01$) , while no significant difference was found between improvement and control phases($p>0.05$). As regards doctors, there was a significant difference between baseline and both improvement and control phases ($p<0.05$), and no statistically significant difference was found between improvement and control phases ($p>0.05$). No statistically significant difference was found between the three phases among workers ($p>0.05$).

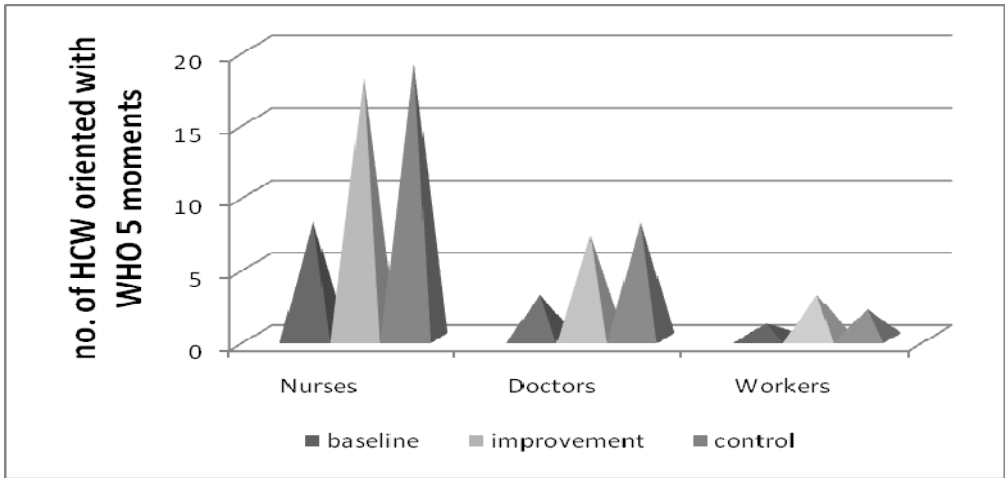

Figure 8: Comparison of the number of personnel oriented with the WHO 5 moments of HH among different professional categories during the baseline, improvement and control phase.

4. Evaluation of hand hygiene facility structure, supplies, availability of educational & training materials, & presence of monitoring& evaluation:

Table 10 : Comparison of hand hygiene facility structure, supplies, availability of educational & training materials, & presence of monitoring& evaluation during the three phases:

Phase / Item	Baseline	Improvement	Z & p value	Baseline	Control	Z & p value	Improvement	Control	Z & p value
Structure (Total score = 24)	12	17	Z=1.47 P>0.05	12	18	Z=1.78 P<0.05	17	18	Z=0.32 P>0.05
Supplies (Total score =14)	7	10	Z=1.16 P>0.05	7	12	Z=2.02 P<0.05	10	12	Z=0.92 P>0.05
Educational & training materials (Total score =10)	5	9	Z=1.95 P<0.05	5	8	Z=1.4 P>0.05	9	8	Z=0.62 P>0.05
Monitoring& evaluation (Total score =6)	2	5	Z=1.75 P<0.05	2	6	Z=2.44 P<0.01	5	6	Z=1.04 P>0.05

Table 10 and figure 9 illustrate the comparison between the three phases as regards hand hygiene facility structure, supplies, availability of educational & training materials, & presence of monitoring& evaluation:

- HH facility structure didn't show a statistically significant difference between baseline and improvement phases or between improvement and control phases (P>0.05). A statistically significant difference was found between baseline and control phases (P<0.05).
- Supplies didn't show a statistically significant difference between baseline and improvement phases or between improvement and control phases (P>0.05). A statistically significant difference was found between baseline and control phases (P<0.05).
- Educational & training materials didn't show a statistically significant difference between baseline and control phases or between improvement and control phases (P>0.05). A statistically significant difference was found between baseline and improvement phases (P<0.05).
- Monitoring& evaluation show a statistically significant difference between baseline and improvement phase (P<0.05) and a highly significant difference between baseline and control phases (P<0.01).

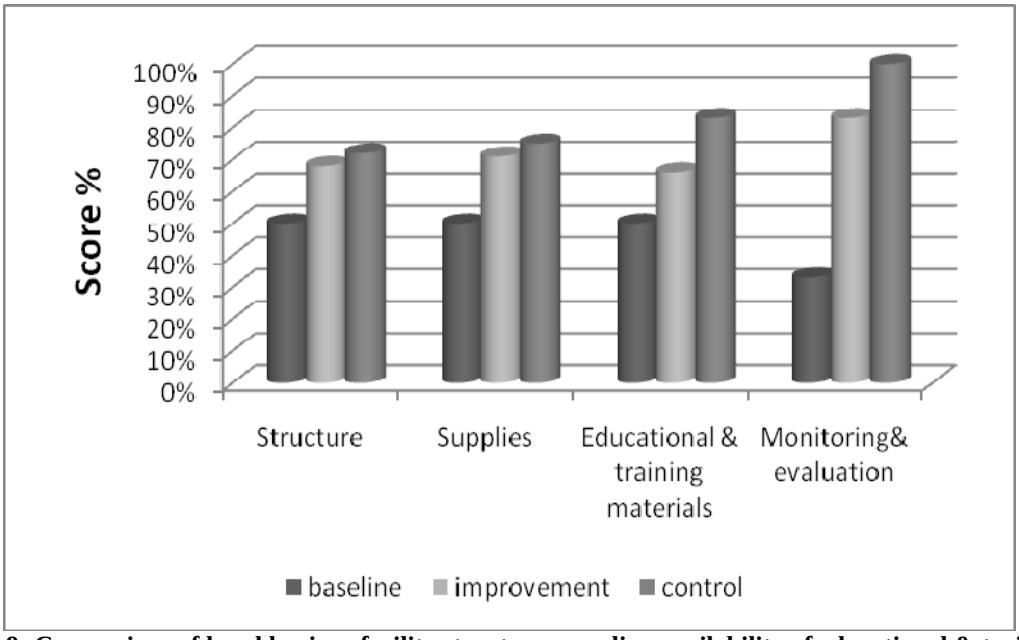

Figure 9: Comparison of hand hygiene facility structure, supplies, availability of educational & training materials, & presence of monitoring& evaluation during the baseline, improvement and control phase.

5. Calculation of HA MRSA incidence rate:

- Table 11: Number of admissions, patient days, infected cases and HA MRSA and comparison of HA MRSA incidence rate among the three phases:

Phase / Item	Baseline 1st October 2008 - 31st January 2009	Improvement 1st February 2009 - 31st May 2009	Baseline 1st October 2008 -31st January 2009	Control 1st June 2009 - 30th September 2009	Improvement 1st February 2009 - 31st May 2009	Control 1st June 2009 - 30th September 2009
Number of admissions Total=192	68	59	68	65	59	65
Patient days Total=2109	778	609	778	722	609	722
Number of HA infections Total=106	45	32	45	29	32	29
Number of HA MRSA cases Total=19	8	5	8	6	5	6
HA MRSA incidence rate per 1000 patient days	10.2	8.2	10.2	8.3	8.2	8.3
Z P Significance	Z=0.520562 p>0.05 non significant		Z=0.506655 p>0.05 non significant		Z=0.027263 p>0.05 non significant	

Table 11 shows that the total number of admissions during the study period was 192 (119 were males and 73 were females) with ages ranging between 12 and 62 (mean was 43±6.4). The total number of HAI (onset 48 hours after admission) was 106 , from which 19 cases were HA MRSA (11 burn wound infections , 2 bloodstream infections, 4 catheter associated urinary tract infections and 2 lower respiratory tract infections) . There was a drop in HA MRSA incidence rate per 1000 patient days from 10.2 during baseline phase to 8.2 during the improvement phase and 8.3 during the control phase , however the difference was statistically non significant .

4. Discussion:

Reduction of the risk of infection is of utmost priority in caring for the burn patients. Prevention of cross contamination between patients and personnel is an important objective of the infection control program in the burn unit. Strict hand hygiene shall be practiced before and after each patient contact with an appropriate antiseptic hand washing agent or an alcohol hand rub. HH shall be performed

immediately prior to donning or after doffing gloves and after contact with any contaminated surface (UTMB, 2008).

McBryde et al. (2007) reported that improvements in HH compliance have been associated with lower rates of acquisition of multidrug-resistant organisms, including MRSA and vancomycin-resistant *Enterococcus* within the hospital.

The aim of this work was to assess the improvement in HH compliance of HCWs in burn unit over a period of 12 months, after a multi-faceted training program, by using WHO HH observation forms and to evaluate the relationship between compliance rates and MRSA incidence rate as a secondary outcome. It was a direct observational before–after study to assess the improvement of HH compliance, through a multi-faceted training program. It was implemented at the burn, Ain Shams University Hospital. The unit consists of a ward with the capacity of 12 beds, an ICU with the capacity of 5 beds, emergency room with the capacity of 1 bed, and 1 operation theatre. It was carried out during the period from October 2008 till September 2009. The improvement intervention included lectures, on job training, distributing factsheets and reminders and providing HH supplies as alcohol hand rub dispensers.

Adherence to proper HH practice (compliance and technique) was assessed throughout the three phases of the study through direct observation by observers well trained on using WHO HH observation forms to register and calculate observed HH opportunities, actions and indications among different professional categories. Observation sessions were scheduled at varied times throughout weekdays and weekends to assure accurate estimation of the hand hygiene compliance. This was also postulated by Kakeya and Senda (2004) who examined nurses' compliance with hand washing in 6 clinical scenes using both a questionnaire and observation, and reported compliance rates of 83.5% based on the questionnaire conducted among 39 nurses, and 68.9% based on the observation of 20 nurses. Thus, since questionnaires resulted in a higher compliance rate than observation, an accurate estimation of the hand hygiene compliance rate should be made based on observation.

As regards average HH compliance, an overall increase was noticed from 39.8% during the baseline phase to 61.9% during the improvement phase ($P < .001$) after the start of the multidisciplinary training program. Furthermore, the improvement was sustained during the control phase (HH compliance was 60.6%).

This was in agreement with the study of Allegranzi et al. (2010), which revealed that, as a result of intervention including education, compliance increased from 8.0% at baseline to 21.8% at follow-up ($P<.001$). McLaws et al. (2009) reported an overall hand hygiene compliance rate improvement from 47% before the intervention to an average of 61%($P < 0.001$). Also hand hygiene compliance rate improvement from49% to 98% was observed by Lederer et al.(2009) , from 23.1% (268/1160) to 64.5% (2056/3187) ($P < .0001$) by Rosenthal et al.(2005) and from a pre-intervention mean of 21% to 42% 12 months post-intervention ($P < 0.001$) by Johnson et al. (2005).

It was also reported that implementation of a multifaceted interventional behavioral hand hygiene program resulted in an overall improvement in compliance with hand hygiene guidelines from 51 % to 83% ($P < 0.001$) (Creedon , 2005) and that compliance improved progressively from 48% in 1994, to 66% in 1997 ($p<0.001$) (Pittet et al., 2000).

However , Raskind et al. (2007) observed only an initial improvement in the rate of compliance at 1 month after the intervention from 89% [168 of 189 opportunities] to 100% [212 of 212 opportunities] ($P<.001$) followed by a decrease to the baseline rate of 89% [85 of 96 opportunities] after 3 months duration. Also after estimation of baseline compliance (20%), an intervention based on visual cues , in the form of 11" x 17" posters , resulted in a modest improvement of HH compliance to 37% during a 12-month study (Thomas et al., 2005). Similarly, a mild improvement in compliance from 44.2% before the first intervention, 42.3% between interventions, and 48% after the second intervention was reported by Brown et al. (2003).

Furthermore, in the study of Harbarth et al. (2002) baseline compliance decreased after the first 2 weeks of observation from 42.5% to 28.2% further decreased to 23.3% in the limited intervention phase and increased to 35.1% after the introduction of a hand gel . The rise in compliance persisted in the last phase (compliance, 37.2%); however, a gradual decline was observed during the final weeks.

On comparing the HH compliance percentage among different professional categories throughout the study, nurses showed a highly significant increase from baseline (42.8%) to improvement phase (63%) ($Z=8.136$, $p<0.001$) which continued throughout the control phase (65.8%) ($Z=8.968$, $p<0.001$). The same results were observed as regards doctors. On the other hand, among workers, the increased compliance noticed from baseline (31.4%) to improvement phase (62.9%) ($Z=3.5754$, $p<0.001$) was followed by a drop during the control phases (35.4%) ($Z=3.702$, $p<0.001$).

This was in accordance with the findings of

Saint et al.(2009) .They reported overall HCW hand hygiene increase from 31.5% to 47.4% (p<0.001). HH adherence among nurses increased from 33.7% to 47.9% (p<0.001); and among doctors from 27.5% to 46.6% (p<0.001). In another study the rate of compliance with hand washing and glove use was 34.0% with no significant differences between job types (Takahashi et al., 2009).

In a study conducted in three long-term-care facilities in Taiwan, Huang and Wu (2008) demonstrated that the nursing assistants had significantly more knowledge and better compliance three months after HH training than before intervention.

On the other hand McLaws et al. (2009) observed that all professional groups sustained improved compliance rates except medical staff, whose practices reverted to pre-intervention rates. Nursing staff maintained significantly improved compliance, with an average rate of 67% after the intervention. The same was demonstrated by the study of Duggan et al.(2008) in which nurses showed statistically significant improvement in their rate of hand hygiene compliance (91.3%) but no improvement was seen for attending physicians (72.4%; P<.001). Medical attending physicians had the lowest observed rate of compliance . Thus, an inverse correlation existed between the level of professional education and the rate of compliance. However , in another study, doctors were more likely to adhere to HH protocols than nurses (83.3% vs. 66%) (Samraj et al.,2008).

The present study also demonstrated that according to WHO 5 moments for HH indications , compliance related to before patient contact , before aseptic task and after patient contact indications showed a marked increase from baseline to improvement and control phases (p<0.001) . After contact with patient surroundings indication showed a less marked improvement (p<0.05) .On the contrary, compliance related to the after body fluid exposure indication was high from the start and didn't show significant increase throughout the study . This may reflect HCW's perception of the hazards of body fluid exposure.

Similar results were obtained by McLaws et al.(2009) where overall HH compliance before patient contact improved from 39% (pre-campaign) to 52% (P < 0.001) and after patient contact improved from 57% to 64% (P < 0.001) over the same period. It was also reported that compliance improvement with direct patient contact was sustained over time (49% at baseline versus 64% at last follow-up survey; P < .001) , however compliance with hand hygiene after contact with surroundings remained stable across the study (Pessoa-Silva et al.,2007).

In another study an increase in difference between the compliance after contacts and the compliance before contacts from the baseline phase of the study to the post-intervention phase was interpreted by Whitby et al. (2006) by a hypothesis that the motivation for performing HH was influenced more by an inherent desire to clean oneself when feeling dirty (after contact) than by an interest in protecting the patient (before contacts). Similarly, the study of Lam et al. (2004) demonstrated an overall hand hygiene compliance increase from 40% to 53% before patient contact and from 39% to 59% after patient contact.

The use of alcohol hand rub versus hand washing was compared during the three phases of the study. The use of alcohol hand rub during baseline phase represented 74.81% (no.=288) in comparison to hand washing which represented 25.19% (no.=97), however during improvement phase there was a drop in alcohol hand rub which represented 57.95% (no.=350) with corresponding increase in hand washing which represented 42.05%(no.=254). This was attributed to the increased perception of HCWs to the importance of hand washing in some situations in which it can't be substituted by alcohol hand rub, as in case of visibly soiled hand or after pilling up of powder due to repeated glove changes . However ,on comparing improvement and control phases , alcohol hand rub use increased from 57.95% (no.=350) during improvement phase to 66.97%(no.=369) during control phase , while hand washing dropped from 42.05%(no.=254) during improvement phase to 33.03%(no.=182) during control phase. This was related to the accessibility and less time consumption related to alcohol use.

This observation was supported by the previous study of Pessoa-Silva et al. (2007) who reported that hand-rubbing was used in 91% (2315 of 2550) of all hand hygiene actions. Overall compliance improved significantly across the 3 study phases and paralleled the increase in hand-rub consumption. Hand-rub use increased in phase 2 (intervention period) versus phase 1 (P = 0.025) and continued to increase in phase 3 (follow-up) versus phase 2 (P = 0.037). In another study, use of alcohol rose from 15.2% of HH indications to 25.2% between interventions and 41.5% after the second intervention (Brown et al., 2003). The same was observed by Harbarth et al. (2002) and Pittet et al. (2000) who declared that the frequency of hand disinfection substantially increased during his study period (p<0.001).

In the present study, nurses showed the greatest improvement as regards the number of personnel performing correct HH technique and the number of

personnel oriented with the WHO 5 moments for HH ($p<0.01$) . Doctors demonstrated a less marked improvement as regards orientation with WHO 5 moments for HH ($p<0.05$). No significant improvement was recorded among workers as regards the two parameters ($p>0.05$), this is due to the small sample size (4 workers). Knowledge was also found to be enhanced significantly after intervention ($P < .05$) by Allegranzi et al. (2010). Huang and Wu (2008) stated that three months after hand-hygiene training the nurse assistants had significantly more knowledge (from 13.82 to 15.41, $P<0.001$) and better compliance (from 9.34% to 30.36%, $P<0.001$) than before the intervention.

In the study done by Patarakul et al. (2005) almost all subjects (99.7%) claimed to know correct hand-hygiene techniques. Handwashing with medicated soap was perceived to be the best mean of hand decontamination (37.8%). Furthermore, healthcare workers believed that their skin condition improved ($P < 0.001$). An increase in knowledge about hand washing guidelines was also found (Creedon , 2005).

There was improvement in most aspects of hand-washing technique in the post-intervention stage (Lam et al., 2004). It was also observed that HH improved significantly among nurses and nursing assistants, but remained poor among doctors (Pittet et al., 2004).

As regards hand hygiene facility structure, supplies, availability of educational & training materials, & presence of monitoring& evaluation, educational & training materials, results of the present study showed significant improvement during the improvement phase with the start of the training program ($P<0.05$). However , the improvement in HH facility structure and supplies wasn't apparent till the control phase after installation of bedside wall mounted alcohol dispensers , providing single use hand towels and receptacles to collect used ones and establishing principles for proper use and maintenance of hand washing sinks that were defective during the baseline phase ($P<0.05$). Monitoring & evaluation showed a highly significant improvement during the control phase after training link nurses to use WHO observation forms and implementation of feedback approach between link nurses and HCWs.

Severe deficiencies in the infrastructure for hand hygiene were identified before the intervention by Allegranzi et al. (2010). Local hand-rub production and quality control proved to be feasible, affordable, and satisfactory. At follow-up, handrubbing was the quasi-exclusive hand hygiene technique (93.3%).

Unexpectedly, availability of alcohol dispensers was not associated with a significant improvement in use of alcohol products for HH in the study by Haas and Larson (2008). Greater success in sustaining increased HH compliance has been reported with use of multimodal approaches in which increased availability of HH alcohol products may be a part of the intervention. Introduction of alcohol hand rub without an associated behavioral modification program proved ineffective (Whitby et al., 2008).

The importance of monitoring the compliance of care staff with hand hygiene was emphasized as a means to maintain and improve the compliance rate. Evaluation of hand-washing activities was found to be a factor increasing hand hygiene rate as well. Hand washing can be evaluated by such methods as self-evaluation by a check sheet and direct observation (Pittet et al ., 2000).

MRSA infections are the most common HAI in the acute care setting. The major mode of transmission from patient to patient is through bedside care providers via contaminated hands (Lederer et al., 2009). Therefore, in the present study HA MRSA incidence rate per 1000 patient days was calculated to demonstrate the effect of the HH improvement program on HA MRSA acquisition. On comparing the three phases of the study as regards HA MRSA incidence ratio per 1000 patient days , a drop was observed from 10.3 during baseline phase to 8.2 during the improvement phase and 8.3 during the control phase , however the difference was statistically non significant . The study by Lederer et al. (2009) demonstrated that MRSA rates decreased from 0.52 HAIs per 1,000 patient days in 2005 to 0.24 HAIs per 1,000 patient days by year-end 2008. Similarly , Johnson et al. (2005) reported significant reductions in hospital-wide rates of total clinical MRSA isolates (40% reduction; $P < 0.001$) and patient-episodes of MRSA bacteraemia (57% reduction; $P = 0.01$). These findings were in agreement with the study of Pessoa-Silva et al. (2007) , in which the overall rates of health care–associated infection per 1000 patient-days across the HH improvement study phases were 11.1 (48 of 4322), 7.9 (70 of 8846), and 8.2 (32 of 3898) in phases 1, 2, and 3, respectively.

Conclusion; The multi-faceted training program, through different approaches, was successful to improve HH compliance among HCWs at the burn unit and to decrease HA MRSA incidence rate.

Recommendations; Continuous improvement efforts as regular training and persistent evaluation, monitoring and feedback are crucial to maintain and even enhance adherence to appropriate HH practice. Additional measures as prudent use of antibiotics, active surveillance for patients with a high risk of

MRSA carriage and management of nasal MRSA colonization are recommend for reduction of MRSA incidence rates.

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5/20/2011

Appendices
Appendix1
WHO observation tools and calculation forms (Form1, 2, 3)
Form1

WORLD ALLIANCE *for* PATIENT SAFETY

World Health Organization

ANNEX 34

OBSERVATION FORM

Country	City	Hospital	Site ID

Observer (initials)			
Date (dd.mm.yyyy)	. .	Period No.	Department
Start/End time (hh:mm)	: / :	Session No.	Service name
Session duration (mm)		Form No.	Ward name

Prof.cat. / Code / Number

Opp	Indication	Action
1	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
2	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
3	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
4	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
5	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
6	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
7	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed
8	☐ bef-pat. ☐ bef-asept. ☐ aft-bfluid ☐ aft-pat. ☐ aft-surr.	☐ rub ☐ wash ○ missed

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

OBSERVATION FORM

January 2007

Form 1 cont.

General recommendations (refer to chapter 2.2 of the Reference Manual for Observer)

1. Introduce yourself to the observed health-care workers and patients as appropriate and indicate the reason for your presence.
2. You may observe up to 3 health-care workers simultaneously if the density of action permits.
3. You may include more health-care workers sequentially during one observation session.
4. Find a convenient place to observe without disturbing care activities; you can move to follow the health-care workers, but never interfere with their work. However, you can provide feedback after the session.

How to use the form (refer to chapter 2.2 of the Reference Manual for Observer)

5. Use a pencil to fill in the form and a rubber to correct errors; use a rigid support to hold the form (during observations).
6. Complete the details at the top of the form (except end time and session duration).
7. As soon as you count the first opportunity for hand hygiene, indicate the corresponding information (indication(s), action) in the first of the numbered opportunity boxes that read from top to bottom. Enter it in the column corresponding to the professional category of the observed health-care worker.
8. Each opportunity refers to one line in each column; each line is independent from one column to another.
9. Put a cross in the small square or circle corresponding to the correct item (the square means several items can be chosen; the circle means only one item can be chosen).
10. In the case of several indications falling into one opportunity, cross the square corresponding to each indication.
11. Performed or missed actions must always be registered within the context of an opportunity.
12. Do not forget to note the end time, to calculate the session duration and to check data before returning the form.

Short description of items (refer to chapter 2.2 of the Reference Manual for Observer)

Country / City:	give in full (do not use abrevations)	
Hospital:	give in full (do not use abrevations)	
Site ID:	according to WHO codes (provided by co-ordinator).	
Observer:	initials (first name / family name).	
Date:	day / month / year.	
Start / End-time:	hour / minute.	
Session duration:	difference between start and end time, result in minutes.	
Period No:	according to the institutional counter.	
Session No:	according to the institutional counter.	
Form No:	number of pages.	
Department:	according to the following nomenclature:	
	medical (including dermatology, neurology, haematology, etc.)	surgical (including ENT, ophthalmology, eurosurgery, etc.)
	mixed (medical & surgical)	obstetrics (including related surgery)
	paediatrics (including related surgery)	ICU
	emergency unit	long term & rehabilitation
	outpatient clinic (including related surgery)	other (to specify)
Service / Ward name:	according to the institutional nomenclature.	
Prof. Cat. / Code:	**according to the following classification:**	
	1. nurse / midwife	1.1 nurse, 1.2 midwife, 1.3 student,
	2. auxiliary	
	3. medical doctor	3.1 in clinical medicine, 3.2 surgeon, 3.3 anaesthetist, 3.4 paediatrician, 3.5 other, 3.6 medical student
	4. other health-care worker	4.1 therapist (physiotherapist, occupational therapist, audiologist, speech therapist, etc.) 4.2 technician (radiologist, cardiology technician, operating room technician, cardiology technician, laboratory technician, etc.) 4.3 other (dietician, dentist, social worker and any other health-related professional involved in patient care)
Number:	enter the number of observed health-care workers belonging to the same professional category (same code) as they enter the field of observation	
Opportunity:	defined by at least one indication.	
Indication:	motivates the hand hygiene action	
	bef-pat.: before patient contact	aft-bfluid: after body fluid exposure risk
	bef-asept.: before an aseptic task	aft-pat.: after patient contact
		aft-surr.: after contact with patient surroundings
Action:	response to the hand hygiene indication(s)	
	rub: when hand hygiene is performed with an alcohol-based formulation	**missed:** when no action is performed
	wash: when hand hygiene is performed with soap and water	

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

OBSERVATION FORM

Form 2: calculation form for compliance % in each professional category

WORLD ALLIANCE *for* PATIENT SAFETY

World Health Organization

BASIC CALCULATION FORM

Country	City	Hospital	Site ID

Date (dd.mm.yyyy)	Period N°.	Department Service Ward

Session N°.	Professional categories (columns can be added according to the number of professional categories observed)								Total of sessions	
	Prof.cat. Code		Prof.cat. Code		Prof.cat. Code		Prof.cat. Code			
	Opportunity	Action	Opportunity	Action	Opportunity	Action	Opportunity	Action	Opportunity	Action
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
Total by categories										
Compliance										

$$\text{Compliance (\%)} = \frac{\text{Actions}}{\text{Opportunities}} * 100$$

Instructions for use

1. Check data collected in observation form. Calculate the sums of the opportunities and actions according to the professional category from each observation session and copy the results on the lines corresponding to the session number.
2. Calculate the sum of the opportunities and the sum of the actions along the lines to obtain the total sum of each session.
3. Calculate the sum of opportunities and actions of all sessions and the overall compliance by applying the equation above.
4. Calculate the sums of the opportunities and actions over all professional categories and calculate compliance by categories by applying the equation. Complete result on the «Compliance» line and in each «Total by categories» column.

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BASIC CALCULATION FORM

Form 3: calculation form for compliance % among professional categories for each indication

WORLD ALLIANCE *for* PATIENT SAFETY

World Health Organization

OPTIONAL CALCULATION FORM

(Indication related compliance with hand hygiene)

Country	City	Hospital	Site ID

Date (dd.mm.yyyy)	Period N°.	Department Service Ward

Session N°.	Hand Hygiene Indications									
	Before patient contact		Before an aseptic task		After body fluid exposure risk		After patient contact		After contact with patient surroundings	
	Number	Action	Number	Action	Number	Action	Number	Action	Number	Action
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
Total by indications										
Compliance										

$$\text{Compliance (\%)} = \frac{\text{Actions}}{\text{Indications}} * 100$$

Instructions for use

5. Check data collected in observation form. Calculate and copy the sums of indications and its regarding actions from each observation session.
6. If several indications occur within a same opportunity, each one should be considered separately as well as the related action.
7. Apply the compliance equation to calculate the compliance per indication and copy the results on the «Compliance» line and in the corresponding columns.

Note : This calculation is not exactly a compliance result, as the denominator of the calculation is an indication instead of an opportunity. Action is artificially over estimated according to each indication. However, the result gives an overall idea of health-care worker's behaviour towards each type of indication.

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OPTIONAL CALCULATION FORM

Appendix 2
Hand hygiene technique audit tool
Date…/…/… Time…… Staff category

		Score		
I- Hand Preparation		**0**	**1**	**2**
	No wrist watches, wrings or jewelry are worn by staff carrying out patient care			
	Staff nails are short, clean and free from nail varnish			
	Artificial nails are not worn			
	Total			**/ 6**
II- Hand washing technique	Regulates water temperature until it feels warm.			
	Allow warm water to flow over each hand			
	Dispenses appropriate amount of liquid soap into palm of one hand.			
	Rub palms together using friction and circular movement. with interlacing fingers			
	Rubs back of each hand 3-5 times with interlacing fingers			
	Rub back of fingers to opposite palm with fingers interlocked			
	Washes tips of fingers by rotational movement into the centers of the two palms			
	Washes both thumbs with rotational movements			
	Washes wrists			
	Rinses hands, wrists and nails under running water with fingertips pointed up.			
	Total			**/ 20**
III- Drying of Hands	Chooses single use towel.			
	Starts at fingers and move up to wrists to dry.			
	Uses the towel to turn off faucet			
	Places used towels into appropriate receptacle.			
	Total			**/ 8**
Hand Hygiene using Alcohol based hand rubs	Alcohol based hand rub is dispensed onto the hands			
	Alcohol hand rub is rubbed onto the hands ensuring all surfaces are covered by the alcohol for 30 sec			
	Hands are rubbed until the alcohol has evaporated			
	Total			**/ 6**

Appendix 3
Ward structures for hand hygiene audit tool
Ward…… Date…/…/… Time…… Fulfilled by…

		Score		
I-Structure of hand wash facilities		**0**	**1**	**2**
	1 sink is available for each 4-6 beds	0		
	Access to hand wash sinks is clear	0		
	Water is regularly available			2
	Running water is available			2
	Foot or elbow control is available for OR sinks			2
	Hand wash sinks are dedicated for that purpose only		1	
	The hand wash sinks are free from any inappropriate items or equipments		1	
	There is appropriate temperature control to provide suitable hand wash water at all sinks	0		
	There are no brushes on hand wash sinks in clinical areas			2
	Dispensers for soap or alcohol are available		1	
	If wall dispensers are available, they are placed within an arm reach from point of care	0		
	Dispensers are fully functioning		1	
	Total			**12/24**
II-Supplies for hand hygiene	Leaflet/liquid soap is available at hand wash sinks		1	
	Dispensers are appropriately cleaned & refilled when empty		1	
	Alcohol-based hand rub is available			2
	Single use towels are available at all hand washing sinks	0		
	Sterile towels are available at OR sinks		1	
	Appropriate receptacles are available for disposal of used towels		1	
	Patients are offered hand hygiene facilities		1	
	Total			**7/14**
III- Education & training	Regular educational sessions are organized on periodic basis		**1**	
	On job training is regularly performed		**1**	
	Promotional items on hand hygiene are distributed to health care providers	**0**		
	Reminders (Posters) promoting hand hygiene are available and displayed in areas visible to all		**1**	
	Written polices & procedures on hand hygiene are accessible to all staff			**2**
	Total			**5/10**
IV-Monitoring & Evaluation	Usage of Alcohol-based hand rub is measured		**1**	
	Direct observation audits of hand hygiene compliance are carried out on regular bases		**1**	
	There is a regular feedback of the audit results	**0**		
	Total			**2/6**

Appendix 4
Hand hygiene knowledge test for health-care workers

WORLD ALLIANCE *for* PATIENT SAFETY

World Health Organization

ANNEX 35

SITE ID:

Hand hygiene knowledge test for health-care workers

- The knowledge required for this test is specifically transmitted through the WHO hand hygiene training material and you may find the questions more difficult if you did not participate in this training.
- Tick **only one answer** to each question.
- Please read the questions carefully before answering. Your answers will be kept confidential.
- SHORT GLOSSARY:

Alcohol-based handrub formulation: an alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to kill germs.

Handrubbing: treatment of hands with an antiseptic handrub (alcohol-based formulation).

Handwashing: washing hands with plain or antimicrobial soap and water.

1. Personal ID: _____ 2. Date: _____
3. Hospital: _____ 4. Ward: _____
5. Service: _____ 6. City: _____
7. Country: _____
8. Nature of hospital: O Public O Private
9. Type of hospital: O General O Teaching O District O Acute care O Long-term care
10. Gender: O Female O Male
11. Age: _____ years
12. Profession*: O Nurse O Auxiliary nurse O Midwife O Medical doctor
O Technician O Therapist O Other

* **Students** must be included among nurse/midwife or medical doctor, according to the different professions
Technicians: radiologist, cardiology technician, operating room technician, laboratory technician
Therapist: physiotherapist, occupational therapist, audiologist, speech therapist
Others: dieticians, dentist, social worker

January 2007

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HAND HYGIENE KNOWLEDGE TEST FOR HEALTH-CARE WORKERS

13. Department (please select one department which is closest to yours):

O Internal medicine	O Surgery	O Intensive care unit	O Mixed medical/surgical
O Emergency unit	O Obstetrics	O Paediatrics	O Long-term/rehabilitation
O Outpatient clinic	O Other		

14. Did you receive a formal training in hand hygiene? O Yes O No

15. Is an alcohol-based handrub readily available at your institution? O Yes O No

16. Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a health-care setting? *(tick one answer only)*

a. O HCWs' hands when not clean
b. O Air circulating in the hospital
c. O Patients' exposure to colonised surfaces (i.e., beds, chairs, tables, floors)
d. O Sharing non-invasive objects (i.e., stethoscopes, pressure cuffs, etc.) between patients

17. What is the most frequent source of germs responsible for health care associated infections? *(tick one answer only)*

a. O Germs in the hospital's water system
b. O Germs in the hospital air
c. O Germs already present on or within the patient
d. O Germs in the hospital environment (surfaces)

18. What is the minimal time needed for alcohol-based handrub to kill most germs on your hands? *(tick one answer only)*

a. O 20 seconds
b. O 3 seconds
c. O 1 minute
d. O 10 seconds

19. Which of the following statements on the technique of hand hygiene with an alcohol-based handrub are "True"?

a. The handrub has to cover the entire surface of both hands	O True	O False
b. Hands have to be dry before care	O True	O False
c. You can dry your hands with a towel after handrubbing	O True	O False

20. Which of the following should be avoided as associated with a likelihood of hand colonisation?

a. Wearing jewellery	O Yes	O No
b. Damaged skin	O Yes	O No
c. Artificial fingernails	O Yes	O No
d. Regular use of a hand cream	O Yes	O No

21. Which type of hand hygiene method is required in the following situations?

a. Before writing in the patient record	O Rubbing	O Washing	O None
b. Before touching a patient	O Rubbing	O Washing	O None
c. When arriving on the ward after lunch	O Rubbing	O Washing	O None
d. Before giving an injection	O Rubbing	O Washing	O None
e. Before emptying a urinal	O Rubbing	O Washing	O None
f. Before opening a door to a patient room	O Rubbing	O Washing	O None

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HAND HYGIENE KNOWLEDGE TEST FOR HEALTH-CARE WORKERS

g.	After giving an injection	O Rubbing	O Washing	O None
h.	After emptying a bedpan	O Rubbing	O Washing	O None
i.	After removing protective gloves	O Rubbing	O Washing	O None
j.	When leaving the patient	O Rubbing	O Washing	O None
k.	After making a patient's bed	O Rubbing	O Washing	O None
l.	After visible exposure to blood	O Rubbing	O Washing	O None
m.	After touching a patient with diarrhoea	O Rubbing	O Washing	O None
n.	Before cleaning a bed after patient's departure	O Rubbing	O Washing	O None

22. Which of the following statements on alcohol-based handrub and handwashing with soap and water are true?

a.	Handrubbing is more rapid for hand cleansing than handwashing	O True	O False
b.	Handrubbing dries the skin more than handwashing	O True	O False
c.	Handrubbing is more effective against germs than handwashing	O True	O False

23. Which of the following hand hygiene actions prevents cross-transmission of germs to the patient?

a.	Hand hygiene before patient contact	O Yes	O No
b.	Hand hygiene after patient contact	O Yes	O No
c.	Hand hygiene immediately after a risk of body fluid exposure	O Yes	O No
d.	Hand hygiene after exposure to the immediate surroundings of a patient	O Yes	O No

24. Which of the following hand hygiene actions prevents infection of the patient by his or her own germs?

a.	Hand hygiene before patient contact	O Yes	O No
b.	Hand hygiene after patient contact	O Yes	O No
c.	Hand hygiene immediately after a risk of body fluid exposure	O Yes	O No
d.	Hand hygiene immediately before an aseptic procedure	O Yes	O No

25. Which of the following hand hygiene actions prevents infection of the health-care worker?

a.	Hand hygiene after patient contact	O Yes	O No
b.	Hand hygiene immediately after a risk of body fluid exposure	O Yes	O No
c.	Hand hygiene immediately before an aseptic procedure	O Yes	O No
d.	Hand hygiene after exposure to the immediate surroundings of a patient	O Yes	O No

26. Which of the following surfaces can contaminate your hands with germs that you might transmit to patients if you do not clean your hands before touching him/her ?

a.	Door handle of the patient's room	O Yes	O No
b.	The same patient's bed linen	O Yes	O No
c.	Another patient's intact skin	O Yes	O No
d.	The same patient's intact skin	O Yes	O No
e.	Patient medical record	O Yes	O No
f.	The walls in a patient's room	O Yes	O No
g.	Another patient's bedside table	O Yes	O No

Thank you very much for your time !

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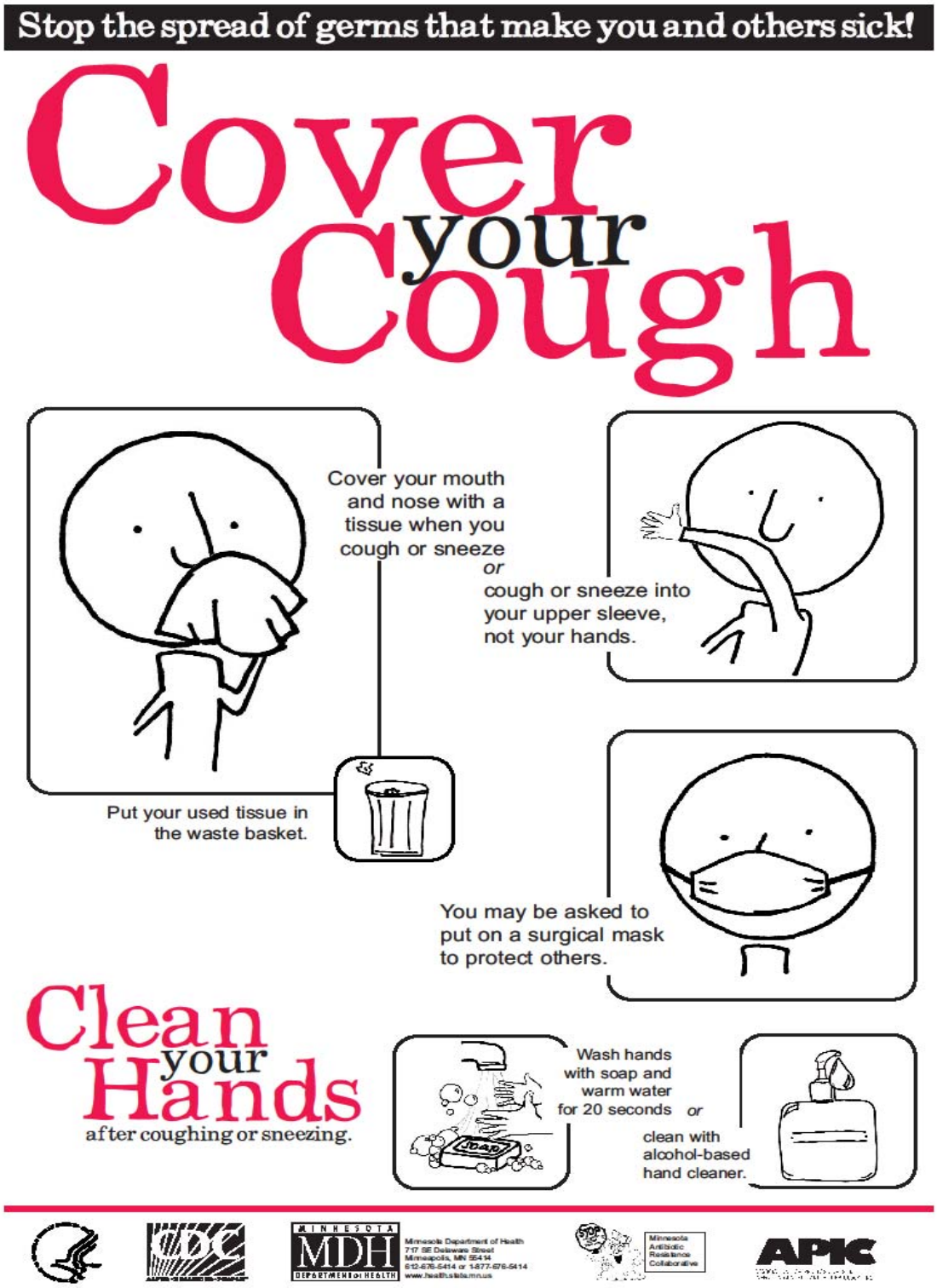
HAND HYGIENE KNOWLEDGE TEST FOR HEALTH-CARE WORKERS


Stop the spread of germs that make you and others sick!
Cover your Cough
Cover your mouth and nose with a tissue when you cough or sneeze
or
cough or sneeze into your upper sleeve, not your hands.
Put your used tissue in the waste basket.
You may be asked to put on a surgical mask to protect others.
Clean your Hands
after coughing or sneezing.
Wash hands with soap and warm water for 20 seconds
or
clean with alcohol-based hand cleaner.
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