ORIGINAL ARTICLE

Assessing hand hygiene compliance among healthcare workers in six Intensive Care Units

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Keywords

Intensive care unit • Hand hygiene compliance • Hand washing technique • Healthcare workers

Summary

Introduction. *Healthcare associated infections (HAIs) are a cause of high morbidity, disability and reduced quality of life, as well as mortality and rising costs for health systems. Preventing the HAI risk by planning and implementing effective preventive strategies is important to safeguard patient health.*

Methods. *The study aimed to evaluate the presence of procedures and protocols for infection control, to assess the adhesion to the different aspects of hand hygiene (HH) and hand washing technique by healthcare workers in six ICUs. A perspective observational study was conducted in six ICUs. In each ICU, the adherence by health care workers to both hand hygiene practices and standard precautions was assessed, as well as the presence of procedures and written protocols.*

Results. *The findings showed that in all the involved ICUs, 73 of 142 required protocols and procedures were available. Specifically, 59 of 79 were available for general measure of risk control, 12 of 15 for hand hygiene, and 24 of 48 for standard precautions and isolation measures. Also, the results showed highly variable levels of adherence to the best hygiene practices in all the ICUs involved in the study, with compliance rates ranging from 3% to 100%, and 73 of 142 required protocols were available at the study time.*

Conclusions. *Overall, the involved ICUs showed low levels of adherence to best hygiene practices. This suggests the need to implement immediate strategies for infection control in the ICUs. A multidisciplinary intervention could be effective in preventing and control the HAI risk.score was reached only by the third year students with regard to the proper HH. The level of knowledge about HAI was inadequate.*

A periodically check of nursing students' knowledge would be advisable in order to fill any gaps, improve training, reduce HAI and increase prevention measures compliance.

Introduction

Healthcare associated infections (HAIs) are caused by environmental pathogens or patient's endogenous flora [1]. HAIs are related to both pathogens and host characteristics. Virulence, infectious load, and multiple resistances against antibiotics are the aspects related to the pathogen. The factors associated with the host characteristics include age, chronic diseases, iatrogenic or pathological immunosuppression. Furthermore, the use of invasive diagnostic and therapeutic procedures is an additional risk factors contributing to HAIs. In intensive care unit (ICU), these risk factors are very common, making ICUs the hospital wards with the highest incidence of HAI [2]. Health care workers (HCWs) hands are the more frequent carriers for the responsible microorganisms. For these reasons, infections are often associated to inadequate hand hygiene practices among health care workers and poor clinical conditions during hospitalization.

Scientific literature shows significant differences among Countries and among departments of the same Country with regard to the rates of infection, microorganisms, sites of infection, and antibiotic resistance profiles [3]. Such discrepancies denote the need for aligning with and disseminating knowledge and skills for healthcare workers regarding best practices for preventing infections at the European and Italian levels [4, 5], as well as the importance of an adequate surveillance system.

HAIs are not all preventable. Nevertheless, research has shown that the majority of infections are preventable through interventions based on effectiveness evidences [6]. The vascular catheter-related and urinary catheter-related avoidable infections percentage has been estimated to be 65% to 70%. The determinants of HAIs on which it is possible to intervene for improving quality of care are: a) deficiencies in technology (e.g. appropriate safety devices) and structural work environment; b) poor human resources management and work organization related to poor quality of interpersonal relationship, emotional disorder, and inadequate communication among staff members; c) health care practices that do not meet gold standards in reducing the infection risk (e.g. inappropriate application of standard precautions for spe-

cific diseases, and use of antibiotics) d) lack of information for workers about infection control systems, and poor participation in interventions for preventing or reducing the infection risk. Promoting these aspects would mean improve capacity in measuring and managing the HAI risks. Fostering a correct adhesion to hand hygiene (HH) and to the use of personal protective equipment, could be a simple, efficacious and cost-effective strategy. Despite it is well documented that compliance with HH can reduce HAI rates and the antibiotic-resistant pathogens cross-transmission [7, 8], non-compliance is still a main problem in hospital care. In both developed and developing Countries, health care workers have difficulty in adhering to hand hygiene practices [5, 9]. An association was found between workload, infections and poor adherence to HH practices. In fact, a Swiss study showed that adherence to HH practices before device contact was 25% during understaffing and workload period, but increased to 70% at the end of this period [10]. Therefore, a way to reduce the HAI risk is to achieve enduring improvements in HH by implementing effective programs able to increase compliance with best practices in healthcare workers.

This study aimed to measure the adhesion to the best practice in HH in six ICUs from four Italian hospitals. Specifically, we considered the presence of procedures and protocols for infection control and assessed the adhesion rate to different aspects of HH by HCWs, as well as the hand washing technique.

Methods

A perspective observational study was conducted in six ICUs from six hospitals in the Centre and North of Italy, which voluntarily participated in the research. Each ICU had mixed (medical and surgical) patients with a separate ICU team (physicians, nurses, and nurse aide). Table I shows the descriptive characteristics of the units involved in the study.

A multidisciplinary work group was created to perform the study. The study was carried out from October 2012 to June 2013.

In a first step, we developed a compendium of best practice in preventing infection named "Standard", according to the National and International scientific literature. The Standard was adopted by the ICUs and used to create a check list in order to assess the presence of procedures and protocols in each unit, as well as compliance with both HH practice and technique by HCWs. Specifically, the check list consisted in two parts. The first part (check list A) aimed to verify the existence of required protocols for infection control, guidelines, and standardized procedures reported by head physician or head nurse of the ICU. The second part (check list B) aimed to verify by direct observations the adherence by HCWs to the best evidence-based practices of HH during the clinical practice [10]. The observations took into account physicians, nurses and nurse aides.

The check list A data were collected by the research team in two times: (1) at the beginning of the study and (2) after six months in order to identify a baseline and consequently analyze potential improvements in terms of procedures and protocols for infection control.

The check list B data were collected from February to May 2013 for two weeks by two external expert observers who were known by all other healthcare workers. Specifically, data were collected in the morning shift under suggestion of both head physician and head nurse, due to high workload in the shift. From January to February 2013, a pilot phase was performed to validate the check list.

HCWs were observed during the recommended HH practices including standard hand washing with soap and water, or with an alcohol-based solution. As recommended by WHO, the study analyzed five HH steps: (1) HH before touching a patient, (2) HH before clean/aseptic procedures, (3) HH after body fluid exposure risk, (4) HH after touching a patient, and (5) HH after touching patient surroundings. Furthermore, we evaluated hand washing technique by considering different steps: (I) wetting the hands with water, (II) applying the required amount of product (e.g. soap or alcohol solution) (III) covering all surfaces of the hands, (IV) rubbing the hands with a rotary movement, (V) rinsing the hands with water and drying them with a disposable towel, (VI) using the towel to close the faucet.

To assess potential statistical differences in compliance by HCWs, Chi-square test (χ^2) was used.

Results

Results from Check list A

General measures

At the beginning of the study, the required protocols for infection control were 79. At the time of the assessment, 75% (59 of 79) of them were available in the units. Among the available protocols we found: protocols for environment cleaning, written procedures for verifying the cleaning techniques, and written directions for refraining from direct contact with equipment or patient for HCWs with exudative dermatitis.

Hand hygiene

The protocols required at the beginning of the study were 15. At the time of the assessment, 80% (12 of 15) of them were available. Among the available protocols we found: written procedures for HCWs and visitors for hand hygiene with hydro alcoholic gel solution, written directions for adequate techniques of hand washing with alcohol solution, and indications for the use of gloves.

Standard precautions and isolation measures

The protocols required were 48. At the time of the assessment, 50% (24 of 48) of them were available. Among the

available protocols we found: written directions for do not routinely using gloves when entering the room or the box in which the patient is located, do not putting on gloves before contact with the intact skin of the patient or do not using gloves before contact with surfaces and objects (e.g. equipment, bed protections, etc.) placed in close contact with the patient, and using gloves whenever it is expected to come into contact with blood or other potentially infectious materials (i.e. mucous membranes or non-intact skin).

Results from Check list B

A total of 347 workers were involved in the study. Among these, 34% (118) were physicians, 56% (195) were nurses, and 10% (34) were nurse aide. A total of 17 items were analyzed and 332 hours and 67 days of observation were performed.

Considering the overall results, we found that compliance rates with HH procedures and standard precautions was significantly different among HCWs ($\chi^2 = 17.56$, $p < 0.001$). Nurse aides had the higher compliance rates compared to nurses and physicians (Tab. II).

Hand washing (with soap and water or antiseptic soap or with an alcohol-based product) before handling medication and before preparing or serving food ranged from 30% to 100%). Hand washing after contact with inanimate objects including medical equipment in the immediate proximity of the patient ranged from 28% to 45%. Hand washing before direct contact with the patient and after direct contact with the patient ranged from 37% to 42% and from 55% to 97%, respectively (see Tab. III for the results).

Regarding the hand washing technique, ICUs workers showed high compliance in all the phases of the hand washing process, even if we found variability among the ICUs (ranging from 47.6% to 100%). Finally, we found poor adhesion (ranging from 3.1% to 5%) regarding using a towel to close faucet after hands washing with soap and water (Tab. IV).

Discussion

The main aim of this study was to assess the adherence to the best preventive practices by HCWs in different ICUs.

The focus on ICUs is due to the specific epidemiology and the risk profile of patients in these units, in which use of invasive devices, aging, unstable immunological conditions are common. This study emphasizes the need to reduce the infection risk in ICU by addressing control systems on the best evidence-based practices. In the ICUs involved in our study, 73 of 142 protocols and procedures were available. Hence, standard precautions and isolation measures were weak points of the infection control system of the studied ICUs. This result denotes the need to constantly verify and update indications, procedures and protocols as a way to improve the infection control system. In this sense, the check list A was a useful and practical instrument for identifying problems, stimulating solutions, and encouraging cooperation between hospital management and both head physician and nurse in the units. Finally, available and updated protocols and procedures are also important in case of litigation to safeguard the organization under the jurisdiction of a medical examiner.

Furthermore, the results suggest orienting the efforts of the ICUs towards a system of continuous monitoring in order to increase compliance with best practice by workers, thus safeguarding patient health. In the ICUs involved in the study, the level of adherence to the hygiene practices was highly variable, with a range from 3% to 100%. Among the analyzed procedures, "Hand hygiene after contact with inanimate objects including medical equipment"which is the most studied moment according to WHO showed a compliance range from 28% (i.e. physicians) to 86% (i.e. nurse aide). This result is in line with the findings from a recent study [11] in which the rate of compliance by HCWs was 38.7% in the absence of specific interventions. The excessive variability in the results of our study can be explained by the fact that the ICUs were different in terms of number

Tab. I. Characteristics of the ICUs included in the study.

ICU	Room type	Number of beds for each ICU	Number of beds for each Hospital
ICU 1	Single room	5	649
ICU 2	Single room	7	380
ICU 3	Single room	9	630
ICU 4	Bay room and single room	5	396
ICU 5	Single room	14	1357
ICU 6	Bay room and single room	13	1700

Tab. II. Contingency table for Chi-square test.

	Physicians	Nurses	Nurse aide	Total
Observations	1014 (951.55) [4.10]	1843 (1888.49) [1.10]	154 (170.96) [1.68]	3011
Adhesions	550 (612.45) [6.37]	1261 (1215.51) [1.70]	127 (110.04) [2.61]	1938
Total	1564	3104	281	4949

Note. Observed values, expected values in parenthesis, and chi-square statistic for each cell in square bracket.

Tab. III. Compliance with hand hygiene procedures and standard precautions for the different HCWs.

Hand hygiene procedure	HCW	%
(CI 95%)		
Hand hygiene with soap and water or antiseptic soap when hands are visibly dirty or contaminated with biological fluids	Physicians	63.9
(58.4- 69.4)		
	Nurses	95.5
(93.5-97.5)		
	Nurse aide	100.0
(100.0-100.0)		
Hand hygiene before direct contact with the patient	Physicians	38.4
(31.3-45.6)		
	Nurses	42.4
(36.4-48.5)		
	Nurse aide	37.0
(18.8-55.3)		
Hand hygiene after direct contact with the patient	Physicians	55.1
(47.3-62.8)		
	Nurses	81.6
(77.2-86.1)		
	Nurse aide	96.9
(90.8-100.0)		
Hand hygiene after removing gloves	Physicians	60.9
(53.1-68.7)		
	Nurses	71.0
(66.3-75.7)		
	Nurse aide	82.9
(71.4-94.4)		
Hand hygiene before using invasive devices for patient care	Physicians	63.0
(50.1-75.8)		
	Nurses	63.8
(51.4-76.2)		
	Nurse aide	100.0
(100.0-100.0)		
Hand hygiene after contact with fluid or bodily excretions, mucous or non-intact skin, or wound medications	Physicians	67.3
(54.2-80.5)		
	Nurses	63.2
(53.1-73.4)		
	Nurse aide	100.0
(100.0-100.0)		
Hand hygiene when moving from a contaminated body site to a clean	Physicians	56.8
(40.8-72.7)		
	Nurses	57.7
(46.7-68.7)		
	Nurse aide	100.0
(100.0-100.0)		
Hand hygiene after contact with inanimate objects including medical equipment	Physicians	28.0
(18.3-37.8)		
	Nurses	40.1
(33.0-47.2)		
	Nurse aide	85.7
(67.4-100.0)		
Hand hygiene before manhandle drugs	Physicians	40.0
(15.2-64.8)		
	Nurses	30.3
(20.8-39.9)		
	Nurse aide	Not recorded
Hand hygiene before manhandle food	Physicians	Not recorded
	Nurses	94.7
(84.7-100.0)		
	Nurse aide	100.0
(100.0-100.0)		

Tab. IV. Compliance with hand hygiene techniques and standard precautions for the different HCWs.

Hand washing technique	HCW	%
(CI 95%)		
Applying a quantity of sufficient product to cover the whole surface of the hands	Physicians	86.0
(79.2-92.8)		
	Nurses	95.6
(92.9-98.2)		
	Nurse aide	97.6
(92.8-102.3)		
Rubbing hands and fingers with alcohol solution, until hands are dry	Physicians	70.2
(61.0-79.5)		
	Nurses	76.9
(71.4-82.5)		
	Nurse aide	53.5
(38.6-68.4)		
Washing hands with soap and water: wet the hands with water	Physicians	47.6
(36.9-58.3)		
	Nurses	100.0
(100.0-100.0)		
	Nurse aide	100.0
(100.0-100.0)		
Washing hands with soap and water: apply a quantity of sufficient product to cover the whole surface of the hands	Physicians	97.4
(93.8-100.0)		
	Nurses	92.1
(88.1-96.1)		
	Nurse aide	92.3
(77.8-100.0)		
Washing hands with soap and water: rub the palm and the back of the hands with a rotatory movement, including the fingers between them to cover all the surfaces of the hands and the fingers	Physicians	59.3
(48.6-70.0)		
	Nurses	68.9
(62.1-75.7)		
	Nurse aide	84.6
(65.0-100.0)		
Washing hands with soap and water: rinse the hands with water and mop up with a disposable towel	Physicians	95.3
(90.9-99.8)		
	Nurses	99.5
(98.6-100.0)		
	Nurse aide	100.0
(100.0-100.0)		
Washing hands with soap and water: use the towel to close the faucet	Physicians	3.1
(2.9-9.2)		
	Nurses	4.4
(0.6-8.2)		
	Nurse aide	5.0
(4.6-14.6)		

of beds, quality of fan and air conditioning systems, as well as to have a water-alcohol solution dispenser hanging at the wall. These differences could have been a risk source and have determined the variability. Furthermore, we found differences in the levels of adherence to the HH practices among HCWs. Specifically, physicians had lower compliance rates than other HCWs especially "After direct contact with the patient", "After contact with inanimate objects including medical equipment", and "Hand hygiene with soap and water or antiseptic soap when hands are visibly dirty or contaminated with biological fluids". These results are in line with data from literature[16] and may be partially explained by a lack in basic training in HH and preventive measures by physicians. Differently from nurses, the university programs for physicians do not include a specific training in infection prevention. In addition, some studies [12] refer some inappropriate physicians' attitudes regarding

HH, because they consider HH as a practice to protect themselves and not to protect patients. In our study we analyze the compliance results for "Hand hygiene before direct contact with the patient" (38.4%) and "Hand hygiene after direct contact with the patient" (55.1%), confirming that finding.
Regarding the hand washing technique, ICUs workers show a considerable compliance in all the stages of the hand washing process, although some variability among the ICUs was found. Regarding the rubbing hands and fingers with alcohol solution and with soap and water technique, the compliance rate is quite poor (from 53.5% to 70.2% for hand washing with alcoholic solution and from 59.3% to 84.6% for hand washing with water and soap), but in line with findings in recent studies [13]. These data suggest that even if HCWs are familiar with all the steps of hand washing technique, solicitations to improve the overall process is always required like a continuous training system. In fact, a recent study [14] showed that 72% of staff implicated in a HH education and assessment program achieved a satisfactory coverage. This denotes a real difficulty to comply with all the required procedures. Thus, ICU Managers should encourage their workers towards a behavioral change by clarifying the importance to complete correctly all the steps of the hand washing technique to guarantee high HH quality.

Limitations

In line with several studies [5, 9, 15], we used an observational method to assess compliance with HH, which is considered by WHO the "gold standard". Nevertheless, this method can represent a limitation because of the "observer effect" (Hawthorne effect). It concerns an individual's psychological response that generates an improvement in performance due to the awareness of being observed. A way to reduce the Hawthorne effect is to increase the observation time so that HCWs may become accustomed to the presence of the observers. In this study, the HCWs of each ICU were observed for five consecutive days and five hours per day. In this way, we tried to undergo the effect, thus helping workers in perceiving the observers as be part of the staff and displaying their natural behavior.

Conclusions

Although "zero risk" cannot be achieved in ICUs, the infection risk can be easily assessed with simple instruments and efficaciously managed by implementing adequate protocols and procedures to increase quality of care. The results of our research suggest that even if HH is still the main action line in reducing infection risk, its importance is not yet well known among the studied ICUs staff. In this sense, multidimensional hand hygiene intervention programs [16] based on specific needs of the ICUs, should sensitize the staff on the importance to adhere to the best clinical practices. Finally, the results of this study suggest that a good way to increase compliance by HCWs is to provide continuous improvements in quality of protocols and procedures, and to support them in terms of communication, education and training.

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Authors' contributions

MM and AL equally contributed to the study design and drafting the article. NMM drafted the article and analyzed data. MFP and LS drafted the article. MG analyzed data regarding chi-square test, edited the manuscript and performed critical revision. MC, MT, MVM, SC, PM, and RCC made considerable contributions to critical revision for important intellectual content. All authors read and approved the final article.

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