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Healthcare personnel and hand decontamination in intensive care units: knowledge, attitudes, and behaviour in Italy

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Summary: The purpose of this study was to evaluate knowledge, attitudes, and behaviour regarding hand decontamination in personnel of intensive care units (ICUs) in Italy. All ICU physicians and nurses in 19 and five randomly selected hospitals in Campania and Calabria (Italy) were mailed a questionnaire focusing on demographics and practice characteristics; knowledge about prevention of hospital acquired infection; attitudes and behaviour with respect to hand decontamination; and use of gloves. A total of 413 questionnaires were returned giving a response rate of 66.6%. Overall, 53.2% agreed with the correct responses on knowledge related to infection control, and this knowledge was significantly higher in neonatal and medicine–surgery wards and in larger ICUs. A positive attitude was reported by the large majority who agreed that hand decontamination reduces the risk of infection in patients (96.8%) and personnel (86.2%), and the positive attitude was significantly higher among older and female personnel and in those with a higher level of knowledge. Only 60% always decontaminate hands at the start of a shift, and 72.5% before and after a patient contact. Higher compliance is reported for invasive manoeuvres, such as urinary catheters (96.5%) and intravenous lines (77.1%). Routine hand decontamination between each patient was significantly higher in females, and in neonatal and medicine-surgery ICUs. Our results suggest that interventions should not only be focused on predisposing factors (knowledge), but also on enabling (facilitating) and reinforcing (gratifying) factors.

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Keywords: Attitudes; behaviour; hand decontamination; hospital infection; intensive care units; Italy.

Introduction

It is well established that high rates of hospital-acquired infection (HAI) occurs in patients on intensive care units (ICUs) and because micro-organisms may be transmitted between patients via hands of healthcare workers, hand decontamination is the single most important measure to prevent HAIs.[1] This assumes greater importance in ICUs because of patients' increased vulnerability. Although there is agreement on the effectiveness of hand decontamination as a control measure, failure to comply with recommended standards have been reported in many healthcare settings. Hand decontamination knowledge and practices amongst ICU staff is therefore critical. The purpose of this study was to evaluate knowledge, attitudes and behaviour relating to hand decontamination in heathcare workers (HCWs) of (ICUs) in Italy.

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Materials and methods

From January to April 2000, all ICU physicians and nurses (including trainee nurses, working in a large teaching hospital) working in 19 and five randomly selected hospitals in Campania and Calabria (Italy) were surveyed. All physicians and nurses in the sample were sent a letter explaining the purpose of the study. A questionnaire (a copy is available upon request from the corresponding author) and a pre-paid, pre-addressed envelope was included to facilitate the return of the completed questionnaire. Second and third questionnaires for non-responders were also sent.

The questionnaire consisted of questions focusing on ICU healthcare staff demographics and practice characteristics; availability of hand decontamination facilities; knowledge about prevention and control of HAI; attitudes and behaviours with respect to hand decontamination and use of gloves. Criteria for judging accurate knowledge, main risk factors and prevention of HAIs and the correct practice of hand decontamination and use of gloves were derived from previously published standards.[2–8]

Knowledge and attitudes were assessed on a three-point Likert scale with options for 'agree', 'uncertain', and 'disagree'. Most of the questions on behaviours were in a five-answer format of 'never', 'rarely', 'sometimes', 'often', and 'routinely', whereas questions on time and ways to wash hands were open, with exhaustive options for answers. The head physician of the ICUs also received a questionnaire consisting of general questions, such as type and number of beds, physicians, nurses, and number of admissions. The questionnaire was pretested and modifications made to improve the validity of responses.

Statistical analysis

Multiple logistic regression analysis was performed. Three models were developed including those variables that were considered to be potentially associated with the following outcomes of interest: knowledge about prevention of infection and control procedures (definition of HAI, causal agents, modes of transmission, decontamination techniques; Model 1); attitudes towards hand decontamination [routine hand decontamination of healthcare staff reduces the risk of HAI, HCW are more motivated to practice hand decontamination when facilities (washbasins, antiseptic soaps, etc.) are available and easy to use, use of gloves is not alternative to hand decontamination; Model 2]; routine hand decontamination between patients (Model 3). For purposes of analysis, the outcome variables, originally consisting of multiple categories, were broken down into two levels. In Model 1, responders were divided into two groups: those who agreed totally with the correct responses versus all others; in Model 2, those who had a positive attitude about hand decontamination versus all others; in Model 3, according to whether they routinely decontaminated hands between each patient versus all others.

The following variables were included in all models: sex (0 = male, 1 = female); age, in years (1 = $\leq$30, 2 = 31–35, 3 = 36–40, 4 = 41–45, 5 = 46–50, 6 = 51–55, 7 = >55); education level (categorical, 0 = high school, 1 = college degree); number of years in practice (1 = $\leq$5, 2 = 6–10, 3 = 11–15, 4 = 16–20, 5 = 21–25, 6 = $\geq$26); type of ICU (1 = coronary, 2 = neonatal, 3 = medicine-surgery); profession (0 = physician, 1 = other). The variable on knowledge (0 = no, 1 = yes) was also included in Models 2 and 3 and that on positive attitudes (0 = no, 1 = yes) in Model 3.

The model building strategy suggested by Hosmer and Lemeshow[9] was used and included the following steps: (1) univariate analysis of each variable considered using the appropriate test statistic (chi-square test or *t*-test); (2) inclusion of any variable whose univariate test has a *P*-value lower than 0.25; (3) backward elimination of any variable that does not contribute to the model on the grounds of the Likelihood Ratio test, using a cut-off of 0.05 level significance; variables whose exclusion alter the coefficient of the remaining variables are kept in the model; (4) testing of interaction terms using a cut-off of 0.15 level significance. Adjusted odds ratio (OR) and 95% confidence intervals (CI) were calculated. The data were analysed using the Stata software program.[10]

Results

Of the original sample of 620, 413 questionnaires were returned giving a response rate of 66.6%. Table I shows the characteristics of the 31 sampled ICUs and of the study population. Most were medicine-surgery ICUs, with a mean number of beds of 8.1, a mean length of stay of 7.9 days aid an average nurse : patient ratio of 0.89 (range 0.2–2.9). Washbasins were available in al ICUs (range 1–17), despite 35.7% reporting no washbasins in the area reserved

Table I *Selected ICUs and study population characteristics*

Variables	*N*	Percentage	Mean(SD)
ICUs			
Type			
Coronary	4	12.9	
Neonatal	7	22.5	
Medicine-surgery	20	64.6	
Beds			8.1(5.1)
Admissions to ward per year			395.3(283.4)
Length of stay (days)			7.9(6.1)
Physician on duty per shift			2.2(1.2)
Nurses on duty per shift			4.3(2.6)
Presence of dressing room			
No	15	48.4	
Yes	16	51.6	
Separate clean/dirty walk			
No	26	83.9	
Yes	5	16.1	
Washbasins			4.7(3.3)
Hand decontamination devices			
Elbow control	18	58.1	
Hand drive	9	29	
Photocell control or stock control	4	12.9	
Antiseptic soap			
No	3	9.7	
Yes	28	90.3	
Study population			
Sex (412)*			
Male	212	51.5	
Female	200	48.5	
Age, years (408)*			42.6(7.8)
≤30	31	7.6	
31–35	49	12	
36–40	69	16.9	
41–45	102	25	
46–50	104	25.4	
≥51	53	13.1	
Education (409)*			
Primary school	13	3.2	
High school	237	57.9	
College degree	8	2	
Medical school degree	151	36.9	
Profession (412)*			
Nurse	249	60.4	
Physician	151	36.7	
Head nurse	12	2.9	
Years in practice (413)*			15.5(8.3)

*The number of participants responding to the questions is indicated in brackets.

for patients. Plain bar and liquid soap (i.e., products containing only detergents and not antimicrobial agents) were always or never available in 28.1 or 46.3% and 55.4 or 10.8% of ICUs, respectively. Antiseptic soaps [i.e., antimicrobial agents prepared in solution with detergents (soap) that need water rinsing after their use] and antiseptics (antimicrobial solutions prepared without detergents, that do not need water rinsing) were always or never available in 76.6 or 9.2% and 40.8 or 36.6% of ICUs, respectively. Disposable paper towels and electric dryers were available in 50.5 and 34% of ICUs. The mean age of the study population was 42.6 years (range 18–66 years), about half were head or ordinary nurses, and the mean duration of work activity was 15.5 years.

Respondents' knowledge about HAI risk factors and prevention are presented in Table II. More than 90% knew the definition of HAI, and were aware that inadequately decontaminated instruments and hands of HCWs increases the risk. Also that invasive manoeuvres and the patients' clinical condition are important determinants of HAI, and that their prevention can reduce mortality and costs in ICUs. The critical role of compliance with infection control protocols is recognized by 93.2% of personnel, whereas lack of knowledge regarding decontamination procedures was encountered in 38.9%. The majority (87.4%) of participants were aware that inappropriate use of antibiotics in ICU is related to a higher risk of infection, however, around 22% underestimated the importance of decontamination procedures as effective in reducing occupational risk of infection in personnel. A total agreement with the correct responses to the question on knowledge about infection prevention and control procedures was encountered in 53.2% of participants, and this knowledge was significantly higher in neonatal (OR = 2.39; 95% CI = 1.18–4.88; $P = 0.016$) and medicine-surgery (OR = 3.47; 95% CI = 1.79–6.71; $P < 0.001$) compared with the coronary ward, and in larger ICUs compared to smaller ones, as knowledge was significantly higher in personnel reporting to work in ICUs with a larger number of beds, (OR = 1.07; 95% CI = 1.02–1.13; $P = 0.004$) (Model 1 in Table III).

The ICUs HCWs' attitudes towards hand decontamination are shown in Table IV. A positive attitude was reported by the large majority of the sample who agreed that in ICUs routine hand decontamination reduces the risk of infection in patients (96.8%) and personnel (86.2%), and that guidelines should be used and maintained (93%). However this conflicts with the answer to another question investigating negative attitude that showed 41.2% of participants believed that routine hand decontamination can cause skin irritation. The results of the regression analysis indicated that the

Table II *Knowledge of respondents towards hospital acquired infection risk factors and prevention*

Statement	Agree (%)	Uncertain (%)	Disagree (%)
Hospital infection is contracted during hospital stay and is not clinically apparent or incubating on admission to hospital	91.6	6.2	2.2
Hospital infection is caused by micro-organisms that can be transmitted to other patients	95.3	3.5	1.2
Hospital infection can be caused by micro-organisms carried by hands of personnel	95.1	2.7	2.2
Hospital infection can be partially prevented by strict compliance to prophylaxis protocols	93.2	6	0.8
Use of inadequately decontaminated instruments can cause hospital infection in patients	90.2	6.4	3.4
Use of inadequately decontaminated instruments can cause hospital infection in personnel	77.2	12.3	10.5
Boiling results in decontamination of surgical instrument	18.1	20.8	61.1
Invasive device manoeuvres, such as urinary catheterization, increases the risk of hospital infection	94.1	2.7	3.2
Critical clinical condition of patient increases the risk of hospital infection	96.3	3.2	0.5
Inappropriate use of antibiotics increases the risk of hospital infection	87.4	9.9	2.7
Reduction of hospital infection in ICUs reduces mortality	91.3	7.2	1.5
Reduction of hospital infection in ICUs reduces cost	95.8	3.2	1

Table III *Results of the logistic regression models*

Variable	OR*	SE†	95% CI	*P*-value
Model 1: Knowledge about hospital infection prevention and control				
Log-likelihood = −255.27, chi-square = 33.67 (4 d.f.), $P = 0.0002$				
Education level	1.29	0.28	0.85–1.97	0.232
Type of ICU				
Coronary	1.0‡			
Neonatal	2.39	0.87	1.18–4.88	0.016
Medicine-surgery	3.47	1.17	1.79–6.71	<0.001
Number of beds	1.07	0.27	1.02–1.13	0.004
Model 2: Attitudes towards hand decontamination				
Log-likelihood = −171.70, chi-square = 16.23 (5 d.f.), $P < 0.0001$				
Sex	2.19	0.62	1.25–3.82	0.006
Age	1.60	0.24	1.19–2.14	0.001
Duration of work activity, years	0.81	1.11	0.61–1.07	0.132
Knowledge	2.14	0.59	1.24–3.67	0.006
Type of working activity	0.59	0.18	0.32–1.08	0.089
Model 3: Hand decontamination between each patient				
Log-likelihood = −204.61, chi-square = 50.25 (5 d.f.), $P < 0.0001$				
Sex	1.69	0.46	0.99–2.87	0.055
Education level	0.76	0.19	0.46–1.25	0.280
Attitudes	1.60	0.47	0.91–2.85	0.105
Type of ICU				
Coronary	1.0‡			
Neonatal	9.94	4.32	4.25–23.3	<0.001
Medicine-surgery	4.27	1.39	2.25–8.10	<0.001

*Odds ratio;
†Standard error;
‡Reference category.

positive attitude was significantly higher among older and female personnel and in those with a higher level of knowledge (Model 2 in Table III).

Behaviour of respondents showed that only 60% always wash their hands at the start of a shift, and 72.5% before and after patient contact. Higher compliance was reported for invasive manoeuvres such as urinary catheters (96.5%), intravenous lines (77.1%), and before each manoeuvre in the same patient (86.4%). Routine use of gloves was reported by 60% of respondents, and hand decontamination was practised before and after wearing gloves by 52.5 and 84.1%, respectively. Overall, 91.9% changed gloves between patients. Regarding the procedures

Table IV *Attitude of respondents towards hand decontamination and use of gloves*

Statement	Agree (%)	Uncertain (%)	Disagree (%)
Routine hand decontamination of ICU personnel reduces the risk of infection in patients	96.8	2.7	0.5
Routine hand decontamination reduces the risk of infection in personnel	86.2	10.8	3
Routine hand decontamination of personnel is supported by the availability of hand hygiene devices	93.9	3.7	2.4
Use of gloves is not an alternative to hand decontamination	87.4	6.4	6.2
Hand decontamination between each patient protects both personnel and patients	96.5	0.8	2.7
Long-term use of hands antiseptics can cause skin irritation	75.1	20.1	4.8
Routine hand decontamination can cause skin irritation	58.8	21.1	20.1
Guidelines are necessary for a correct practice of hand decontamination	93	6	1

reported by respondents for hand decontamination, 92.2% used antiseptic soap and 2% an antiseptic. Routine compliance to hand decontamination between each patient was significantly higher in female, and in neonatal and medicine-surgery compared with coronary ICUs (Model 3 in Table III).

Respondents mainly learnt about infection control measures from continuing education courses (46.6%); however, they also relied on scientific journals (36.4%) and colleagues (11.5%). Nonetheless, more than half (55.5%) felt they needed additional information.

Discussion

This survey reports detailed information on knowledge, attitudes, and behaviour of HCWs concerning prevention of HAI in ICUs. Of concern is the finding that only half the respondents agreed with the authors' interpretations regarding knowledge of HAI prevention and control procedures. It is notable that there were differences in knowledge associated with characteristics of ICUs, with better compliance in neonatal and medicine-surgery wards and ICUs with larger number of beds. This observation supports the need for more targeted education, particular to coronary care units and smaller ICUs.

We found that a substantial proportion of the sample consider skin irritation to be a probable outcome of antiseptic use. This is of concern as this perception has been reported to reduce strict adherence to hand decontamination.[11,12] Indeed this problem can be overcome by the use of alcohol gels and emollients that have been proven to be very effective in the reduction of microbial counts and less irritating to the skin. Therefore, their use should be encouraged as they are not very common in Italy. Finally, the significantly more positive attitude shown by older ICU HCWs may be related to their experience of the problems associated with infection in the past.

It is gratifying to note that hand decontamination and use of gloves seems to be more frequent in our sample compared with previous studies. Indeed, O'Boyle Williams *et al.*[13] in the USA, reported that 62% washed hands after contact with body fluids while wearing gloves. Angelillo *et al.*[14,15] in Italy reported 62.3 and 78.5% washing hands before glove placement and 72.8 and 77.3% after glove removal in dental hygienist and dentists, respectively, Zimakoff in Denmark and Norway reported only 33% after patient examination in ICUs, whereas 50 and 42% after urinary and intravenous catheter insertion;[16] an even lower prevalence in ICUs was reported in Australia, with baseline hand decontamination rates before and after patient contact of 12.4 and 10.6%, respectively.[17] A similar prevalence in ICUs was found in the UK by Sproat and Inglis[18] for intravenous lines (99% before and 94% after insertion) with lower ones for urinary catheters (26% before and 86% after). As expected however, hand decontamination was lower than that reported in operating theatre staff nurses before (98.2%) and after surgical procedure (95.4%).[19] Hand decontamination is more frequent after patient contact suggesting that this is perceived as protection for HCWs rather than for patients. Moreover, we agree with other authors[19,20] that these results should be interpreted cautiously as the data are self-reported and it is likely that compliance with guidelines is overestimated. It has also been noted that if self-reporting is substituted by observation, the presence of the observer will influence behaviour.[16,21] As our study is one of the first to be performed after publication of the APIC guidelines, recommending hand decontamination between every patient contact,[4] our results may have been influenced by dissemination of these guidelines.

The finding that bar soaps are still used in ICUs is unacceptable. It is well known that plain soap is

intended to remove dirt, organic material, and transient micro-organisms,[4] and that properly stored liquid soap is less prone to contamination compared with bar soap, and therefore should always be preferred.

We found that routine hand decontamination was significantly related to sex, as females showed a higher adherence to this procedure. We also noted that those working in our medicine–surgery ICU were significantly more likely to routinely wash their hands. Our findings are in accordance with a previous study.[22]

Several interventions have been suggested to improve compliance with hand decontamination in healthcare settings, such as increasing availability of hand decontamination facilities,[23–27] continuous evaluation of the possible detrimental effects of current hand decontamination agents,[12] and continuous reinforcing in-service education;[23] decontamination simple educational interventions do not seem to be effective.[25,28] This is in agreement with our results and with those of other authors.[11,29]

In conclusion, our results suggest that intervention relating to improving hand hygiene should not only be focused on predisposing factors (knowledge), but also on enabling (facilitating) and reinforcing (gratifying) factors.

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