Ann Ig. 2024 May 23. doi: 10.7416/ai.2024.2642. Online ahead of print.

Prevalence and predictors of hand hygiene compliance in clinical, surgical and intensive care unit wards: results of a second cross-sectional study at the Umberto I teaching hospital of Rome

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Received: 2024 March 6
Accepted after revision: 2024 April 28
Published online ahead of print: 2024 May 23

Keywords: Hand hygiene compliance; public health; patient safety
Parole chiave: Compliance all'igiene mani; sanità pubblica; sicurezza del paziente

Abstract

Introduction. *Hand hygiene is the most cost-effective procedure for the prevention of healthcare-associated infections, but healthcare worker compliance is often insufficient.*
Research design. *The objective of this second cross-sectional study was to quantify hand hygiene compliance among the healthcare workers of a large teaching hospital, to explore associated factors and to compare results to those of the 2021 study.*
Methods. *In 2022, educational sessions were conducted within each hospital department during which hospital healthcare workers received tailored feedback on the hand hygiene compliance registered in the previous year. Then, one month later, direct observations of hand hygiene compliance with five World Health Organization recommendations were collected again by anonymous observers in each ward. Data were grouped by healthcare area (clinical, surgical and intensive care), and three multivariable logistic regression models were built to identify predictors of hand hygiene compliance.*
Results. *Overall, 5,426 observations were collected by 73 observers in three weeks. Hand hygiene compliance was 79.7%, 73.5% and 63.1% in clinical, surgical and intensive care areas, respectively, increasing in clinical wards but decreasing in surgical departments compared to the 2021 study. The multivariable analyses showed that hand hygiene compliance after patient contact was consistently higher than before patient contact, while there was some variability in compliance with other factors across the three areas.*
Conclusion. *The study found suboptimal adherence to good hand hygiene practice, with the lowest rates observed before patient interaction, which, together with the variability recorded across departments, underscores the challenges involved in achieving a uniform level of compliance. Hence, additional training is essential to raise awareness among healthcare workers, while repeating this survey over time will also be crucial, so that hand hygiene compliance can be monitored and any major issue identified.*

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Annali di Igiene : Medicina Preventiva e di Comunità (Ann Ig)
ISSN 1120-9135 https://www.annali-igiene.it

Introduction

The prevention and control of healthcare-associated infections (HAIs) is fundamental to the maintenance of patient safety and the quality of care in hospitals (1,2). Because most nosocomial infections are often spread through direct contact, particularly on the hands of healthcare workers (HCWs), targeted efforts to reduce the frequency and burden of these infections have focused on improving hand hygiene (HH) practice (3,4). Indeed, handwashing is considered the simplest, cheapest and least expensive measure to minimize the spread of pathogens and thus control and prevent HAIs (5,6). Although adherence to good HH practice has the potential to prevent up to 50% of HAIs (7) and reduce the cross-transmission of antibiotic-resistant pathogens (8,9), non-adherence is still a major issue in hospital care. Several studies document that HH remains insufficient, with compliance levels as low as 9% reported in low-income countries, while compliance levels rarely exceed 70% even in high-income countries (10).

Within this context, research suggests that the HH monitoring systems can produce measurable improvements in HH adherence among HCWs, with a consequent lower incidence of HAIs (11–13). Furthermore, HH monitoring allows us to understand the determinants of HH compliance, which may differ depending on the settings and the role of healthcare personnel (14). For instance, a recent systematic review reported that HH compliance was lower in ICUs (30–40%) than in other departments (50-60%), lower among physicians (32%) than nurses (48%), and before (21%) rather than after (47%) touching a patient, with an overall median compliance rate of 40% (15). Numerous factors may contribute to poor compliance, including physical infrastructure and institutional support, availability of materials and human resources, and professional behaviour (16,17).

Thus, it is essential to monitor the reasons for HH non-adherence in healthcare institutions to allow strategies for the improvement of HH compliance among hospital staff to be formulated (18). In Italy, several studies have monitored adherence to HH guidelines in different healthcare settings, reporting HH compliance rates among HCWs usually between 60% and 70% (19–21), values slightly lower than the 71.9% registered at the Umberto I teaching hospital of Rome in 2021 (22). In this study, we now report the results of a second cross-sectional study conducted in the same hospital using the same methodology a year after the previous one, in 2022, with the aim of estimating HH compliance again, analysing its determinants and highlighting any changes (23).

Methods

Study design and observation strategy

This study included two phases: a first phase during which feedback sessions were conducted with hospital HCWs, and a second phase of three weeks to elaborate data collection on HH compliance. Specifically, in the first phase, ten educational sessions were carried out (one within each hospital department) between September and October 2022, during which the hospital staff attended a lecture on the definition, impact and burden of HAIs, and were presented with both the methodology and the results of the data collected during the previous study (22) on hospital and ward HH compliance.

The second phase was conducted between November 28th and December 19th, 2022, as part of the annual plan for HAIs at the Umberto I teaching hospital of Rome. As previously, two HCWs on each hospital ward served as anonymous observers of HCWs' compliance with HH guidelines. They were recruited from those who had been previously identified by formal communication with the hospital management and who had taken part in the previous study (22). Each participant was asked to carry out up to 100 direct observations of HH compliance (i.e., 200 observations per ward) through the completion of a multiple-choice paper checklist, designed according to World Health Organization (WHO) guidelines (3): this checklist was the same as that used for the 2021 data collection and is described in (22). Briefly, it consisted of two sections (the first to determine information on the observer, and the second relating to the observations), with a total of 11 items. The observations covered the five moments where appropriate HH is critical according to WHO guidelines: before touching a patient (indication I), before a clean/aseptic procedure (indication II), after body fluid exposure (indication III), after touching a patient (indication IV) and after touching a patient's surroundings (indication V) (3). The study protocol was approved by the Ethics Committee of the hospital (reference number: 4707/2021).

Statistical analysis

Data collected were analysed according to the type of care delivered. Specifically, taking into

account the potential influence of the intensity and complexity of care on HH opportunities (23), and considering the past research that showed differences in adherence between ward types (24,25), the analysis was conducted separately for each ward category, i.e., distinguishing between clinical, intensive care and surgical areas. Mean and standard deviation (SD) were calculated for continuous variables, while proportions were used for dichotomous and categorical variables. HH compliance – overall and stratified by factors of interest – was calculated as the proportion of recorded opportunities for HH in which HCWs followed the guidelines (i.e., the sum of the number of HH actions performed using soap and water plus those performed using an alcohol-based formulation against the total number of opportunities recorded). For each area, changes in HH compliance between the 2021 and 2022 studies were tested using the Z-test for proportions and expressed as percentage difference, overall and by stratified analyses. Then, three multivariable logistic regression models were built, one for each area, to identify factors independently associated with overall HH compliance. The following variables were included in the models, based on expert knowledge (26): HH indication (I to V), observed HCW gender, observed HCW job category, observed HCW type (internal or external), work shift, day of the week, observer gender, and observer job category. Adjusted odds ratios (aORs) and their 95% confidence intervals (CIs) were estimated. The Hosmer-Lemeshow test was used to evaluate the goodness of fit of the models. A two-tailed p-value less than 0.05 was considered statistically significant. Statistical analyses were performed with Stata version 17.0 (StataCorp LLC, 4905 Lakeway Drive, College Station, Texas, USA).

Results

Key characteristics of observers and observations by area

Of 48 wards included in the study, 56.2% belonged to the clinical area, 25.0% to the surgical area and 18.8% to the intensive care area (Table 1). Observations were carried out by 52 observers in the clinical, 12 in the surgical and 9 in the intensive care areas, with an average of 1.7 observers per ward. In each area, the majority of the observations were performed by female staff and nurses. A total of 5426 observations were collected, 3008 in the clinical area, 1602 in the surgical area and 816 in the intensive care area, with the highest number of observations per ward in intensive care units (approximately 134).

Regarding HH indications, those before and after touching a patient were the most observed (for indication I: 40.7% in clinical, 36.6% in surgical and 46.1% in intensive care wards; and for indication III: 28.8% in clinical, 30.7% in surgical and 25.5% in intensive care wards) (Supplementary Table 1). Hospital staff were more likely to use an alcohol-based formulation to perform HH in clinical wards (41.5%) and intensive care units (38.0%), whereas in surgical areas they used soap and water more frequently (38.6%). Gloves were worn without performing HH in 12-15% of cases across all areas, whereas no action (i.e., neither HH nor glove use) was recorded mostly in intensive care units (21.3%), followed by surgical (11.4%) and clinical (7.7%) wards. In all the three areas, physicians and nurses were the subject of approximately three-quarters of the observations, followed by healthcare assistants (16.4% and 13.4% among clinical and surgical staff, respectively) and others in intensive areas (5.0%). The HCWs observed were mostly females (from 58.1% in intensive care units to 62.0% in clinical areas) and internal to the ward (from 81.9% to 87.4% in surgical and clinical areas, respectively). In all areas, observations were mostly collected during weekdays (80-90%) and morning shifts (around 60%) by female HCWs (approximately 75%), who were more often nurses in surgical and intensive care areas (52.4% and 58.6%, respectively), but were more likely to be physicians in clinical wards (51.4%).

HH compliance and comparison to the previous study by area

In the clinical area, overall HH compliance was 79.7% (Table 2). Regarding HH recommendations, indications III (after touching a patient) and IV (after body fluid exposure) were found to have the highest HH compliance: 90.6% and 96.6%, respectively. Midwives were the most compliant among HCWs (93.5%), followed by nurses (82.2%), physicians (79.5%) and healthcare assistants (77.7%). Moreover, HH compliance was higher for female staff (81.5%) and internal staff (80.8%), and during the afternoon work shift (80.8%) and weekdays (81.6%). In comparison with the 2021 study, we found that there was a significant 17.0% increase in HH compliance ($p<0.001$) in the clinical area. Moreover, indication I, “before touching a patient”, showed the greatest increase (+46.2%, $p<0.001$) among the five WHO recommendations, going from 50.0% to 73.1%. In general, there was a significant improvement of more

Table 1 - Key characteristics of observers and observations by area. Results are expressed as numbers (percentage) or mean ± standard deviation.

	Clinical area	Surgical area	Intensive care area
Wards	27	12	9
Observers	52	22	15
Observers per ward, mean ± SD	1.7 ± 0.6	1.8 ± 0.4	1.7 ± 0.5
Observer gender, n (%)			
Male	16 (30.8)	7 (28.0)	3 (20.0)
Female	36 (69.2)	18 (72.0)	12 (80.0)
Observer role, n (%)			
Physician	24 (46.2)	11 (44.0)	6 (40.0)
Nurse	27 (51.9)	12 (48.0)	9 (60.0)
Midwife	0 (0.0)	1 (4.0)	0 (0.0)
Healthcare assistant	1 (1.9)	1 (4.0)	0 (0.0)
Observations	3008	1602	816
Observations per ward, mean ± SD	111.4 ± 63.3	90.7 ± 56.8	133.5 ± 53.8

SD: standard deviation

than 15% in most of the variables analyzed, except for indication V, which showed a decrease of 11.3% (p=0.006) (Table 2).

In the surgical area, overall HH compliance was 73.5% (Table 2). Regarding the specific recommendations, indication III ("after touching a patient") and IV ("after body fluid exposure") were again found to have the highest HH compliance (88.4% and 89.1%, respectively). Nurses were the most compliant among HCWs (76.7%), followed by healthcare assistants (75.6%), physicians (73.0%) and midwives (69.2%). Similarly to the clinical area, HH compliance was higher for females (75.4%) and internal staff (75.0%) and during weekdays (73.7%), while on the contrary morning work shifts showed the highest compliance (74.2%). Compared to 2021, in 2022 there was a significant reduction in overall compliance (-5.6%, p=0.007), especially in indications I (-12.1%, p=0.006), IV (-8.0%, p=0.004) and V (-19.0%, p=0.005), while for indication II there was an increase of 18.4% (p=0.022). HH compliance during night shifts showed the largest decrease (-21.2%, p=0.006), but a decrease was also found in the compliance rates of physicians (-9.1%, p=0.003), male staff (-7.3%, p=0.040) and during weekend days or holidays (-19.7%, p<0.001) (Table 2).

Finally, in the intensive care area, the overall HH compliance was 63.1% (Table 2). Indications II and IV showed the highest HH compliance rates (73.5% and 83.6%, respectively). Nurses were the most compliant HCW category (69.3%), while the other job categories had HH compliance rates lower than 60%. Like other areas, female staff were the most compliant (70.3%), along with internal staff (67.1%), while higher compliance was reached during night shifts (67.9%) and weekend days or holidays. In 2022 there were no significant changes compared to 2021 in total HH compliance (p=0.185), as well as in the various indications. By contrast, a significant reduction in HH compliance from 2021 to 2022 was found among nurses (-12.2%, p=0.005), male staff (-23.4%, p<0.001) and during night shifts (-30.4%, p<0.001) (Table 2).

Predictors of hand hygiene compliance by area

The multivariable analysis (Table 3, Model 1) showed that, in clinical areas, compared to physicians, being a midwife was associated with higher HH compliance (aOR=4.7, 95% CI: 1.2-18.8). Likewise, indications III and IV were associated with a higher likelihood of HH compliance compared to indication I (aOR: 3.3, 95% CI: 1.9-5.5; aOR: 14.7, 95% CI: 5.4-40.2, respectively). The observer's gender and role, the gender and staff type of the HCWs observed, day type and work shift showed no association with the outcome.

Conversely, in surgical areas (Table 3, Model 2), being a midwife was associated with a lower HH compliance (aOR=0.3, 95% CI: 0.1-0.8), while indications III and IV and being female were positively associated with the outcome (aOR=5.7,

Table 2 - Hand hygiene (HH) compliance - 2022 versus 2021

	Clinical area				Surgical area				Intensive care area			
	2021 n/N (%)	2022 n/N (%)	Δ	*p-value*	2021 n/N (%)	2022 n/N (%)	Δ	*p-value*	2021 n/N (%)	2022 n/N (%)	Δ	*p-value*
Overall HH compliance	1522/2235 (68.1)	2398/3008 (79.7)	+ 17.0	<0.001	1006/1292 (77.9)	1178/1602 (73.5)	- 5.6	0.007	369/554 (66.6)	515/816 (63.1)	- 5.3	0.185
HH Indication												
Indication I	407/814 (50.0)	895/1225 (73.1)	+ 46.2	<0.001	318/469 (67.8)	350/587 (59.6)	- 12.1	0.006	139/235 (59.2)	195/376 (51.9)	- 12.3	0.078
Indication II	106/138 (76.8)	152/222 (68.5)	- 10.8	0.088	106/168 (63.1)	124/166 (74.7)	+ 18.4	0.022	40/53 (75.5)	61/83 (73.5)	- 2.6	0.797
Indication III	502/656 (76.5)	786/868 (90.6)	+ 18.4	<0.001	286/316 (90.5)	435/492 (88.4)	- 2.3	0.349	121/166 (72.9)	152/208 (73.1)	+ 0.3	0.968
Indication IV	178/201 (88.6)	308/318 (96.9)	+ 9.4	<0.001	183/189 (96.8)	164/184 (89.1)	- 8.0	0.004	38/46 (82.6)	61/73 (83.6)	+ 1.2	0.892
Indication V	329/426 (77.2)	257/375(68.5)	- 11.3	0.006	113/150 (75.3)	105/173 (61.0)	- 19.0	0.005	31/54 (57.4)	46/76 (60.5)	+ 5.4	0.721
Observed HCW role												
Physician	629/927 (67.9)	843/1061 (79.5)	+ 17.1	<0.001	469/584 (80.3)	422/578 (73.0)	- 9.1	0.003	118/201 (58.7)	157/266 (59.0)	+ 0.5	0.945
Nurse	526/755 (69.7)	977/1188 (82.2)	+ 17.9	<0.001	330/420 (78.6)	427/557 (76.7)	- 2.4	0.479	206/261 (78.9)	302/436 (69.3)	- 12.2	0.005
Midwife	2/2 (100.0)	29/31 (93.5)	- 6.5	0.711	20/22 (90.6)	18/26 (69.2)	- 23.9	0.065	NA	1/2 (50.0)	NA	NA
Healthcare assistant	193/310 (62.3)	379/488 (77.7)	+ 24.7	<0.001	91/128 (71.1)	158/209 (75.6)	+ 6.3	0.361	8/29 (27.6)	12/32 (37.8)	+ 37.0	0.410
Observed HCW gender												
Male	586/920 (64.0)	873/1139 (76.7)	+ 19.8	<0.001	352/461 (76.4)	453/640 (70.8)	- 7.3	0.040	121/172 (70.4)	182/338 (53.9)	- 23.4	<0.001
Female	914/1287 (71.0)	1515/1858 (81.5)	+ 14.8	<0.001	654/829 (78.9)	722/958 (75.4)	- 4.4	0.077	247/381 (64.8)	329/468 (70.3)	+ 8.5	0.090
Observed ward staff												
Internal	1416/2065 (68.6)	2068/2561 (80.8)	+ 17.8	<0.001	918/1174 (78.2)	964/1286 (75.0)	- 4.1	0.059	326/466 (70.0)	431/642 (67.1)	- 4.1	0.319
External	106/170 (62.4)	265/369 (71.8)	+ 15.1	0.028	88/118 (74.6)	190/285 (66.7)	- 10.6	0.118	43/88 (48.9)	52/125 (41.6)	- 14.9	0.294
Day type												
Weekday	1291/1911 (67.6)	2079/2548 (81.6)	+ 20.7	<0.001	812/1068 (76.0)	1052/1428 (73.7)	- 3.0	0.180	344/524 (65.6)	419/684 (61.2)	- 6.7	0.117
Weekend day / holidays	231/324 (71.3)	232/295 (78.6)	+ 10.2	0.035	194/224 (86.6)	105/151 (69.5)	- 19.7	<0.001	25/30 (83.3)	96/132 (72.7)	- 12.7	0.228
Work shift												
Morning	844/1274 (66.3)	1479/1865 (79.3)	+ 19.6	<0.001	505/657 (76.9)	713/961 (74.2)	- 3.5	0.221	247/381 (64.9)	299/479 (62.4)	- 3.9	0.466
Afternoon	566/806 (70.2)	798/988 (80.8)	+ 15.1	<0.001	413/526 (78.5)	399/541 (73.8)	- 6.0	0.068	81/130 (62.3)	173/276 (62.7)	+ 0.6	0.942
Night	105/142 (74.0)	114/147 (77.6)	+ 4.9	0.474	79/95 (83.2)	61/93 (65.6)	- 21.2	0.006	39/40 (97.5)	38/56 (67.9)	- 30.4	<0.001

Indication I: before touching a patient; Indication II: before clean/aseptic procedure; Indication III: after touching a patient; Indication IV after body fluid exposure; Indication V: after touching a patient's surroundings.
HCW: Healthcare workers; NA: not assessable; Δ: percentage difference between 2022 and 2021 study.

95% CI: 2.5-13.2; aOR=6.5, 95% CI: 2.9-14.4 and aOR= 1.4, 95% CI: 1.1-1.7, respectively). Regarding the observer's job category, compared to physicians, both nurses and midwives were more likely to report compliant observations (aOR=2.9, 95% CI: 1.3-6.3; and aOR=7.7, 95% CI: 4.6-12.9, respectively), while the observer's gender, the HCW staff observed, day type and work shift did not affect the likelihood of the outcome.

Lastly, the multivariable model for intensive care areas (Table 3, Model 3) showed a higher HH compliance for female staff (aOR=1.9, 95% CI: 1.2-2.9) and during weekends or holidays (aOR=1.8, 95% CI: 1.0-3.1), while external staff showed a lower compliance than internal staff (aOR=0.4, 95% CI: 0.2-0.8). Compared to indication I, indication III (aOR=2.9, 95% CI: 1.9-4.5), indication IV (aOR=4.7, 95% CI: 1.6-13.9) and indication V (aOR=2.5, 95% CI: 1.2-5.2) were all associated with higher HH compliance. The observer's gender and job category, the job category of the staff observed and work shift showed no association with the outcome.

Discussion

In this second cross-sectional study, we found HH compliance rates of 79.7%, 73.5%, and 63.1% in the clinical, surgical and intensive care wards, respectively, values that align with the literature in underlining the difficulty, even in developed countries, of achieving the 80% adherence rate recommended by the WHO (27). Notably, albeit slightly surpassing the literature's reported rate of 59.6% (28), intensive care units exhibited the least satisfactory compliance level (28). Potential explanations for this result may include factors such as an elevated workload and a high patient-to-nurse ratio, which make it difficult for HCWs to uphold proper HH practices (29). However, these findings are of particular concern, especially considering the increase in HAIs observed during the COVID-19 pandemic (30,31), and they advocate a strengthening of hygiene practices in these wards, which, together with other measures such as actively monitoring HAIs (2), will contribute to a reduction in infection rates and to an improvement in the quality of care.

Compliance with good HH practice was not uniform across the five moments defined by the WHO. Indeed, multivariable analyses consistently showed that HCWs were more compliant after touching a patient (indication IV) and after body fluid exposure (indication III), suggesting that these actions were more likely to be directed at safeguarding themselves rather than patients, as already shown (4). By contrast, the lowest levels of compliance were recorded before patient contact (indication I), which was as low as 52% in intensive care units. Likewise, the compliance rates before aseptic procedures (indication II) did not exceed 75.0% in any area, findings that together are particularly worrisome, considering they are those that require the utmost caution to prevent cross-contamination (32). Regarding the characteristics of the HCWs observed, no job category was associated with higher HH compliance, apart from midwives, who - despite the limited number of observations - were found to be more compliant than physicians in clinical wards. However, midwives were less compliant than physicians in surgical departments, perhaps due to the more intense workload that midwives experience in the surgical area, potentially impacting the quality of care (33); nevertheless, the result is difficult to interpret. It is clear that our results do not align with the existing literature, which usually reports higher adherence rates in nurses than physicians (34,35), at least before the COVID-19 emergency. Indeed, as previously hypothesized (36), the COVID-19 pandemic may have made HH compliance rates more similar across HCW job categories, in particular increasing the awareness of physicians of correct HH practice (37). Interestingly, and in accordance with previous research demonstrating that females in the general population show a higher level of knowledge and a more appropriate HH behaviour than males (38), our findings also suggest that female staff, particularly from surgical and intensive care wards, are more likely to pay attention to good HH practice. Again, in line with previous research (19), we found that in intensive care areas the external staff had a lower HH compliance than internal HCWs, a factor that may be explained by a lower psychological commitment (39) or awareness of the extreme importance of performing HH practices in critically ill patients (40).

Notably, HH compliance did not seem to change in relation to the day and shift of observation in any area except for intensive care units, in which HCWs were found to perform HH routines more frequently during weekend days or holidays, indicating a potentially positive effect of reduced workload and fewer external consultations, which allowed more time for HH procedures (41). In addition, across all three areas there was no association between HH compliance and gender or job category of the observers with the sole exception of surgical wards, where nurses and

Table 3 - Multivariable logistic regression model for compliance with hand-hygiene (HH) procedures by area

	Model 1 (Clinical area) HH compliance		**Model 2** (Surgical area) HH compliance		**Model 3** (Intensive care area) HH compliance	
	aOR (95% CI)	p-value	aOR (95% CI)	p-value	aOR (95% CI)	p-value
Indication						
Indication I	Ref.		Ref.		Ref.	
Indication II	0.7 (0.4-1.4)	0.354	1.6 (0.9-2.8)	0.117	2.3 (1.0-5.4)	0.051
Indication III	3.3 (1.9-5.5)	<0.001	5.7 (2.5-13.2)	<0.001	2.9 (1.9-4.5)	<0.001
Indication IV	14.7 (5.4-40.2)	<0.001	6.5 (2.9-14.4)	<0.001	4.7 (1.6-13.9)	0.005
Indication V	0.7 (0.4-1.3)	0.251	1.2 (0.6-2.4)	0.656	2.5 (1.2-5.2)	0.019
Observed HCW role						
Physician	Ref.		Ref.		Ref.	
Nurse	0.9 (0.7-1.3)	0.769	1.0 (0.7-1.4)	0.884	1.1 (0.7-1.9)	0.688
Midwife	4.7 (1.2-18.8)	0.028	0.3 (0.1-0.8)	0.010	1.5 (0.2-15.9)	0.714
Healthcare assistant	0.7 (0.4-1.0)	0.060	0.8 (0.4-1.4)	0.408	0.5 (0.2-1.2)	0.138
Student	2.0 (0.5-8.0)	0.314	1.2 (0.5-3.1)	0.658	3.2 (0.5-21.5)	0.232
Relative	0.6 (0.2-2.2)	0.452	0.2 (0.0-3.3)	0.249	0.6 (0.2-1.6)	0.320
Other	0.8 (0.3-2.0)	0.641	0.7 (0.2-2.5)	0.598	0.6 (0.2-2.6)	0.541
Observed HCW gender					-	-
Male	Ref.		Ref.		Ref.	
Female	1.1 (0.9-1.5)	0.278	1.4 (1.1-1.7)	0.002	1.9 (1.2-2.9)	0.007
Observed ward staff						
Internal	Ref.		Ref.		Ref.	
External	0.6 (0.3-1.2)	0.130	0.6 (0.3-1.5)	0.294	0.4 (0.2-0.8)	0.011
Day						
Weekday	Ref.		Ref.		Ref.	
Weekend day/Holiday	0.9 (0.4-1.7)	0.708	0.9 (0.5-1.7)	0.866	1.8 (1.0-3.1)	0.037
Work shift						
Morning	Ref.		Ref.		Ref.	
Afternoon	1.0 (0.7-1.5)	0.836	0.8 (0.6-1.2)	0.308	1.0 (0.5-2.0)	0.969
Night	1.0 (0.6-1.7)	0.997	0.4 (0.2-1.1)	0.084	1.0 (0.5-1.9)	0.930
Observer gender						
Male	Ref.		Ref.		Ref.	
Female	2.0 (0.8-5.3)	0.137	0.5 (0.3-1.0)	0.063	1.6 (0.7-3.3)	0.240
Observer role						
Physician	Ref.		Ref.		Ref.	
Nurse	1.0 (0.5-2.3)	0.967	2.9 (1.3-6.3)	0.007	1.1 (0.5-2.4)	0.851
Midwives	-	-	7.7 (4.6-12.9)	<0.001	-	-
Healthcare assistant	-	-	1.1 (0.7-1.7)	0.787	-	-

Indication I: before touching a patient; Indication II: before clean/aseptic procedure; Indication III: after touching a patient; Indication IV: after body fluid exposure; Indication V: after touching a patient's surroundings; Ref.: Reference

midwives more frequently observed good HH practice. This result suggests some inter-observer variability in the surgical area.

In comparison to the previous study, while we witnessed an increase in observer participation compared to 2021, we did not collect the expected 200 observations per ward, meaning that additional training is needed to improve the commitment of observers to the study. However, we found a significant improvement in overall HH rates in clinical wards. Conversely, we recorded a decline in overall HH compliance (5.6%) in surgical departments, that may be linked to the rising workload in these units following the pandemic (42) and the resumption of surgical worklists (29). Lastly, our study allowed us to highlight the indications for which there was a decrease in compliance compared to the previous year, namely the indications "before touching a patient" and "after touching a patient's surroundings". These results underscore how important it is to structure specific training interventions, both to return feedback from the surveys conducted and to improve behaviours that recorded lower HH compliance by diversifying them for different areas (43–45). To effectively control infections in healthcare settings, it's crucial to provide detailed and ongoing training along with continuous guidance (46). Solid leadership and a flexible organizational culture are necessary to overcome resistance to change (47). Given that patients have diverse medical conditions, adopting personalized infection control strategies is vital rather than a standardized approach (46). This requires a deep understanding of diseases and their modes of transmission. Investing in ongoing training and education for healthcare workers is essential to ensure effective infection control.

However, caution is strongly warranted in interpreting the changes in compliance rates between 2021 and 2022, due to both the cross-sectional nature of the study and the methodology used to observe HH compliance (22).

This study has some strengths and limitations. The major strength is that we adopted a consolidated methodology to quantify HH compliance one year after the previous study. Furthermore, we were able to closely examine predictors of HH compliance across three distinct types of wards, accounting for the different settings, and to highlight any differences with the previous year. The main limitation of this study is that, like most HH observational studies, both observer bias and inter-observer variability may have affected the accuracy of our results. For example, internal observers may have been more inclined to rate their co-workers differently than external observers would (43). In addition, despite direct observation being considered the "gold standard" method of monitoring HH compliance, our results may suffer from the observer effect, whereby HCWs may improve their practice under observation (14). For this reason, we recruited the same observers as the previous study, who had been trained to maintain anonymity, so that the HCWs did not know the identities of the observers and which practices were recorded. While this should reduce these biases, annual training is still needed to make HH observations more consistent across observers and to promote their commitment to the study.

Conclusion

This second study found suboptimal HH compliance rates in all healthcare areas, with values that were lower before approaching patients than after patient contact. Some variability across department types was registered for other predictors, underlining the difficulty in achieving uniform HH compliance rates. For these reasons, despite recording some improvements compared to the previous year, especially in relation to observers' participation, additional training is needed to increase HCW awareness of the topic and to improve the observation strategy of observers. Finally, it will be crucial to repeat this survey regularly, so as to enable monitoring of HH compliance and allow the identification of any major issues.

Acknowledgments: We thank the residents of the Residency School of Hygiene and Preventive Medicine, Department of Public Health and Infectious Diseases, Sapienza University of Rome, 00185 Rome, Italy for their cooperation.

Riassunto

Prevalenza e fattori predittivi della compliance all'igiene delle mani nei reparti medici, chirurgici e di terapia intensiva: risultati del secondo studio trasversale presso il Policlinico Umberto I di Roma

Introduzione. L'igiene delle mani è la procedura più efficace dal punto di vista dei costi per prevenire le infezioni correlate all'assistenza, ma la compliance degli operatori sanitari è spesso insufficiente.

Disegno dello studio. L'obiettivo di questo secondo studio trasversale è stato quello di quantificare la compliance all'igiene delle mani tra gli operatori sanitari di un grande ospedale universitario,

esplorare i fattori associati e confrontare i risultati con quelli di uno studio del 2021.

Metodi. Nel 2022 sono state tenuti incontri educativi con ogni reparto dell'ospedale, durante i quali gli operatori sanitari hanno ricevuto un feedback personalizzato sulla compliance all' igiene delle mani registrata nell'anno precedente. Poi, un mese dopo, sono state raccolte osservazioni dirette della compliance dell'igiene delle mani nei cinque momenti dell'Organizzazione Mondiale della Sanità da parte di osservatori anonimi in ogni reparto. I dati sono stati raggruppati per area sanitaria (medica, chirurgica e terapia intensiva) e sono stati costruiti tre modelli di regressione logistica multivariabile per identificare i fattori predittivi della compliance all'igiene delle mani.

Risultati. Complessivamente, sono state raccolte 5.426 osservazioni da 73 osservatori in tre settimane. La compliance all'igiene delle mani è stata del 79,7%, 73,5% e 63,1% rispettivamente nell'area medica, chirurgica e di terapia intensiva, aumentando nei reparti medici e diminuendo in quelli chirurgici rispetto allo studio del 2021. Le analisi multivariabili hanno dimostrato che le indicazioni all'igiene delle mani dopo il contatto con il paziente erano associate a una maggiore compliance rispetto alle indicazioni prima del contatto con il paziente, mentre c'era una certa variabilità tra le aree in alcuni degli altri fattori.

Conclusioni. Lo studio ha rilevato un'aderenza non ottimale alle pratiche dell'igiene delle mani con bassi tassi di compliance osservati prima dell'interazione con il paziente e che, insieme alla variabilità registrata tra i vari reparti, sottolinea le difficoltà nel raggiungere un livello uniforme di conformità. Pertanto, è essenziale una formazione aggiuntiva per sensibilizzare gli operatori sanitari, mentre la ripetizione dell'indagine nel tempo è fondamentale per monitorare la conformità all'igiene delle mani ed identificare eventuali problemi.

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Supplementary Table 1. Characteristics of observations by area

		Clinical area (n= 3008) N (%)	**Surgical area** (n=1602) N (%)	**Intensive care area** (n=816) N (%)
HH Indication				
	Indication I	1225 (40.7)	587 (36.6)	376 (46.1)
	Indication II	222 (7.4)	166 (10.4)	83 (10.2)
	Indication III	868 (28.8)	492 (30.7)	208 (25.5)
	Indication IV	318 (10.6)	184 (11.5)	73 (8.9)
	Indication V	375 (12.5)	173 (10.8)	76 (9.3)
Action type				
	Soap and water	1149 (38.2)	619 (38.6)	205 (25.1)
	Alcohol-based formulation	1249 (41.5)	559 (34.9)	310 (38.0)
	Gloves	378 (12.6)	242 (15.1)	127 (15.6)
	Nothing	232 (7.7)	182 (11.4)	174 (21.3)
Observed HCW role				
	Physician	1061 (35.6)	578 (37.1)	266 (33.7)
	Nurse	1188 (39.8)	557 (35.8)	436 (55.2)
	Midwife	31 (1.0)	26 (1.7)	2 (0.3)
	Healthcare assistant	488 (16.4)	209 (13.4)	32 (4.0)
	Students	71 (2.4)	91 (5.8)	12 (1.5)
	Relative	5 (0.2)	4 (0.3)	2 (0.3)
	Other	138 (4.6)	93 (5.9)	40 (5.0)

		Clinical area (n= 3008) N (%)	Surgical area (n=1602) N (%)	Intensive care area (n=816) N (%)
Observed HCW gender				
	Male	1139 (38.0)	640 (40.1)	338 (41.9)
	Female	1858 (62.0)	958 (59.9)	468 (58.1)
Observed ward staff				
	Internal	2561 (87.4)	1286 (81.9)	642 (83.7)
	External	369 (12.6)	285 (18.1)	125 (16.3)
Day				
	Weekday	2548 (89.6)	1428 (90.4)	684 (83.8)
	Weekend day/holidays	295 (10.4)	151 (9.6)	132 (16.2)
Work shift				
	Morning	1865 (62.2)	961 (60.3)	479 (59.1)
	Afternoon	988 (32.9)	541 (33.9)	276 (34.0)
	Night	147 (4.9)	93 (5.8)	56 (6.9)
Observer gender				
	Male	695 (23.1)	376 (23.5)	208 (25.8)
	Female	2313 (76.9)	1226 (76.5)	608 (74.5)
Observer role				
	Physician	1545 (51.4)	661 (41.3)	338 (41.4)
	Nurse	1458 (48.5)	839 (52.4)	478 (58.6)
	Midwife	0 (0.0)	97 (6.1)	0 (0.0)
	Healthcare assistant	5 (0.2)	5 (0.3)	0 (0.0)

Indication I: before touching a patient; Indication II: before clean/aseptic procedure; Indication III: after touching a patient; Indication IV: after body fluid exposure; Indication V: after touching a patient's surroundings.

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