

# Hand Hygiene among Physicians: Performance, Beliefs, and Perceptions

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**Background:** Physician adherence to hand hygiene remains low in most hospitals.

**Objectives:** To identify risk factors for nonadherence and assess beliefs and perceptions associated with hand hygiene among physicians.

**Design:** Cross-sectional survey of physician practices, beliefs, and attitudes toward hand hygiene.

**Setting:** Large university hospital.

**Participants:** 163 physicians.

**Measurements:** Individual observation of physician hand hygiene practices during routine patient care with documentation of relevant risk factors; self-report questionnaire to measure beliefs and perceptions. Logistic regression identified variables independently associated with adherence.

**Results:** Adherence averaged 57% and varied markedly across medical specialties. In multivariate analysis, adherence was associated with the awareness of being observed, the belief of being a role model for other colleagues, a positive attitude toward hand

hygiene after patient contact, and easy access to hand-rub solution. Conversely, high workload, activities associated with a high risk for cross-transmission, and certain technical medical specialties (surgery, anesthesiology, emergency medicine, and intensive care medicine) were risk factors for nonadherence.

**Limitations:** Direct observation of physicians may have influenced both adherence to hand hygiene and responses to the self-report questionnaire. Generalizability of study results requires additional testing in other health care settings and physician populations.

**Conclusion:** Physician adherence to hand hygiene is associated with work and system constraints, as well as knowledge and cognitive factors. At the individual level, strengthening a positive attitude toward hand hygiene and reinforcing the conviction that each individual can influence the group behavior may improve adherence among physicians. Physicians who work in technical specialties should also be targeted for improvement.

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Hand hygiene is recognized as the leading measure to prevent cross-transmission of microorganisms and to reduce the incidence of health care-associated infections (1, 2). Despite the relative simplicity of this procedure, adherence to hand hygiene recommendations is unacceptably low, usually well below 50% (1-4). Risk factors for nonadherence have been extensively studied (1, 4-7), and physicians have been repeatedly observed as being poor compliers (1, 3, 4, 8, 9).

At our hospital, physician behavior did not improve substantially despite a hospital-wide hand hygiene promotion campaign that had a positive and marked effect on adherence among all other health care workers (1). That study highlighted the need for improved knowledge of behavior determinants among physicians.

Promotion of hand hygiene behavior is a complex issue (7, 10-12). Adherence to hand hygiene recommendations is influenced by knowledge; awareness of personal and group performance; workload; and type, tolerance, and accessibility of hand hygiene agents (2, 4, 12). Over the past 50 years in particular, the assumption that an individual's perceptions have a strong effect on his or her behavior gave birth to social cognitive models of human behavior (13). Some of these models have been applied to individual factors (that is, knowledge, attitude, intentions, beliefs, and perceptions) to help build strategies that improve specific health behaviors (14). To date, individual

cognitive factors related to hand hygiene have not been adequately studied among physicians. Our study aimed to investigate risk factors for nonadherence among physicians and to identify beliefs and perceptions associated with hand hygiene in this population.

## METHODS

### Setting

The University of Geneva Hospital is an acute care center that provides primary and tertiary medical care for residents of Geneva, Switzerland, and the surrounding area. Hand-washing facilities are conveniently located throughout the center; each patient room and all lavatories have 1 to 3 sinks, unmedicated soap, and paper towels (4). Individual bottles of an alcohol-based liquid hand disinfectant (Hopirub, B. Braun Medical AG, Sempach, Switzerland) are available in all areas, and pocket carriage of these bottles by each health care worker is strongly encouraged to facilitate bedside hand antisepsis (1). Infection-control structures and activities have been described elsewhere (15-17).

### Study Design

We performed a cross-sectional study of physician hand hygiene practices and of physician beliefs and attitudes toward hand hygiene. Individual physicians were directly observed during routine patient care, and each phy-

**Context**

Why do physicians fail to practice good hand hygiene?

**Contribution**

This observational study of 163 physicians in a university hospital found that overall adherence to hand hygiene guidelines was 57%. Factors associated with poor adherence included having busy workloads, performing activities with high risks for cross-transmission, and being in technical specialties (such as surgery and anesthesiology). Adherence was higher when hand-rub solutions were easily accessible and when physicians valued hand hygiene and considered themselves role models.

**Implications**

Providing easy access to cleansing materials and improving attitudes toward hand hygiene, particularly among physicians working in technical specialties, merit emphasis.

—The Editors

sician completed a self-report questionnaire administered immediately after patient contact. All physicians at the University of Geneva Hospital were informed by mail about the upcoming study and were eligible for inclusion. At the time of the study, 1266 physicians were practicing at the University of Geneva Hospital: 440 staff physicians, 767 fellows and residents, and 59 medical students. Anonymity was guaranteed. The institutional review board approved the protocol as a Continuous Quality Improvement project.

A hospital epidemiologist recorded all potential opportunities for hand hygiene among selected physicians. Observations were distributed throughout the hospital over a 6-month period in such a way that the observer would obtain a balanced distribution of observation periods throughout the entire institution. On entry to the predetermined ward, the investigator observed the first-encountered physician, provided he or she was involved in patient care activities. Each physician was included only once in the study. Although no physician declined to participate, 10 did not return the questionnaire. Multiple opportunities for hand hygiene (4) were observed during a single observation that varied in length, according to the physician's activity. As described elsewhere (4), the observer was trained and validated before the study during 40 monitoring sessions in which 2 observers worked simultaneously; at the time of the study, interrater agreement was high for all variables ( $\kappa = 0.94$  [range, 0.83 to 1.0]).

**Instruments and Variables****Observation**

We assessed opportunities for hand hygiene and adherence as described elsewhere (1, 4, 18, 19) and according to published guidelines (2). Opportunities were stratified into 3 categories (1, 4, 18, 19): high risk for cross-transmission

(before direct patient contact; between care of a dirty and a clean body site; before intravenous or arterial care; before urinary, respiratory, or wound care); medium risk for cross-transmission (after direct patient contact; after intravenous or arterial care; after urinary, respiratory, or wound care; and after contact with biological body fluid); and low risk for cross-transmission (other conditions). Of note, we considered both hand hygiene after patient contact to prevent contamination among patients and hand hygiene between a dirty and a clean body site in the same patient to prevent cross-transmission as opportunities for hand hygiene (1, 2, 4, 18, 19). Failure to remove gloves after patient contact or between a dirty and a clean body site on the same patient was considered nonadherence (1, 4, 18, 19). Hand hygiene action, whether by hand-washing or alcohol-based hand-rubbing, was the main outcome variable. Hand-washing refers to washing hands with plain soap and water or water alone, and hand-rubbing refers to the application of an alcohol-based solution on hands (2).

Study variables included sex, medical specialty, type of hand hygiene opportunity (high, medium, or low risk for cross-transmission), availability of the hand-rub solution at the bedside or in an individual bottle for pocket carriage, glove use, activity index, and duration of the observation period. The activity index (1, 4, 18, 19) was estimated by the number of observed opportunities for hand hygiene per hour of patient care for each physician observation. Since the activity index represents the hand hygiene workload (1, 4, 18, 19), it is called the *workload* throughout the paper.

At the end of the observation period, the observer asked the physician whether he or she was aware of being observed.

**Self-Report Questionnaire**

Immediately after physicians were observed, we gave them a self-report questionnaire to collect data on cognitive factors related to hand hygiene. We followed guidelines from social cognitive theories applied to health-related behaviors (14, 20–23) in the construction of the questionnaire. By using single items for measures and a 7-point scale for answers, we assessed cognitive factors, that is, intention to adhere to hand hygiene, perception of knowledge of hand hygiene indications, attitude toward hand hygiene, perception of social norms concerning hand hygiene (both behavioral and subjective norms) (24), perception of difficulty of adhering to hand hygiene, and perception of the risk for cross-transmission linked to nonadherence (Table 1) (25). The last 2 points of the scale closest to the positive perceptive evaluation were considered positive answers; all other points were considered negative answers (25). Motivation to improve hand hygiene was assessed by using a 3-point scale, and only the answer “yes” was considered a positive answer (Table 1). We measured knowledge of hand hygiene indications for 4 types of contact, according to standard definitions (2, 26), with

**Table 1. Assessment of Physicians' Individual Cognitive Factors Related to Hand Hygiene**

Cognitive Factor	Question	Measure
Intention to adhere	"Do you perform hand hygiene as recommended during patient care?"	7-point scale (never/always)
Perception of knowledge about hand hygiene indications	"Do you know the recommended indications for hand hygiene?"	7-point scale (not at all/entirely)
Attitude toward hand hygiene	"Do you perceive hand hygiene as a useless/useful measure to prevent healthcare-associated infections in the following situation: (. . .)?"	7-point scale (useless/useful)
Perceived behavioral norm*	"Do your colleagues perform hand hygiene according to the recommended guidelines?"	7-point scale (never/always)
Perceived subjective norm†	"Do you think that your behavior toward hand hygiene is taken as an example by your colleagues?"	7-point scale (not at all/certainly)
Perception of difficulty to adhere	"Is it difficult/easy to comply with hand hygiene according to recommended guidelines?"	7-point scale (always/never)
Perception of risk for cross-transmission	"Does non-compliance with hand hygiene in the following situation (. . .) imply a risk of cross-transmission to the patient?"	7-point scale (no risk/major risk)
Motivation	"Do you feel that you can improve your compliance with hand hygiene?"	3-point scale (yes/possibly/no)

\* Defined as the individual's perception of others' behavior.

† The belief of being a role model for other colleagues or other professional categories was used as a surrogate for the perceived subjective norm, defined as the individual's perception of social pressure to perform a behavior (24).

structured questions. Good knowledge was defined as a correct answer to all 4 questions. Age, sex, professional status (medical student, resident, fellow, attending physician, or professor) and type and duration of medical practice were also recorded.

### Statistical Analysis

We investigated factors associated with adherence to hand hygiene (1, 4). Variables included were those collected during the observation periods and related to patient care activities, as well as cognitive factors gathered by the questionnaire.

We performed all group comparisons by using logistic regression, with generalized estimating equations (27) to account for interdependence of clustered observations; each observed physician was included as a cluster. We built 2 forced-entry models: The first included only variables gathered during the observations, and the second included all variables (collected through the observations and the questionnaire). For both multivariate models, all observations related to 1 physician were excluded when any of the variables included in the model had missing values. The magnitude of the association between adherence and explanatory variables was measured by odds ratios and corresponding 95% CIs. All tests were 2-tailed, and a *P* value less than 0.05 was defined as statistically significant. We conducted all analyses with Stata software, version 7 (Stata Corp., College Station, Texas).

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The funding source had no role in the collection, analysis, or interpretation of the data or in the decision to submit the manuscript for publication.

## RESULTS

### Study Group

We observed 163 physicians during 573 patient-care episodes, which provided 887 opportunities for hand hy-

giene over more than 125 hours of observation. The median number of opportunities per physician was 4 (range, 1 to 28; interquartile range, 2 to 7; mean [ $\pm$ SD],  $5.4 \pm 4.8$ ).

Table 2 summarizes selected characteristics of the participants. The sample of observed physicians and medical students corresponded to 13% of those practicing at the University of Geneva Hospital at the time of the study. The median age was 34 years (range, 23 to 62 years), and the median duration of employment in the hospital was 2 years (range, 0 to 26 years).

### Adherence and Risk Factors for Nonadherence

Overall adherence was 57%, and adherence differed markedly depending on medical specialty (from 87% among internists to 23% among anesthesiologists) and professional status (Table 2). Adherence was significantly higher when a hand-rub solution was easily accessible.

Adherence was higher (61%) when physicians were aware of being observed (61%;  $n = 117$ ) than when they were not aware of being observed (44%;  $n = 46$ ) (odds ratio for adherence, 2.24 [95% CI, 1.35 to 3.74]). High workload and opportunities for hand hygiene related to a high risk for cross-transmission were associated with reduced adherence.

Most observed physicians (94%;  $n = 153$ ) responded to the questionnaire. Average adherence to hand hygiene was similar among responders (57%) and nonresponders (64%;  $n = 10$ ) ( $P > 0.2$ ). Six nonresponders (60%) and 111 responders (73%) knew they were being observed.

### Beliefs and Perceptions toward Hand Hygiene

Table 3 describes beliefs and perceptions related to hand hygiene. Most physicians reported that they were aware of a risk for cross-transmission to the patient resulting from nonadherence (85%), that they intended to adhere to hand hygiene (77%), and that they were motivated to improve their adherence level (74%). A high proportion

Table 2. Distribution of Opportunities and Adherence with Hand Hygiene among Physicians at University of Geneva Hospitals

Variable	Physicians	Opportunities for Hand Hygiene	Adherence to Hand Hygiene	P Value
	n (%)		%	
<b>Sex</b>				0.076
Male	103 (63)	617 (70)	53.2	
Female	60 (37)	270 (30)	67.0	
<b>Age</b>				>0.2
21–30 y	49 (33)	175 (21)	62.3	
31–40 y	75 (51)	457 (56)	56.9	
≥41–50 y	24 (16)	185 (23)	51.4	
<b>Professional status</b>				0.024
Professor or attending physician	18 (12)	146 (18)	49.3	
Fellow or resident	115 (76)	630 (76)	57.1	
Medical student	18 (12)	52 (6)	78.9	
<b>Medical specialty</b>				<0.001
Internal medicine	32 (20)	134 (15)	87.3	
Surgery	25 (15)	173 (19)	36.4	
Intensive care unit	22 (14)	91 (10)	62.6	
Pediatrics	21 (13)	109 (12)	82.6	
Geriatrics	10 (6)	59 (7)	71.2	
Anesthesiology	15 (9)	120 (14)	23.3	
Emergency medicine	16 (10)	42 (5)	50.0	
Other	22 (14)	159 (18)	57.2	
<b>Hand-rub solution at bedside</b>				0.12
No		156 (18)	46.8	
Yes		727 (82)	59.4	
<b>Hand-rub solution in pocket</b>				<0.001
No		729 (83)	52.1	
Yes		152 (17)	81.6	
<b>Hand-rub solution available (bedside or pocket)</b>				0.004
No		118 (13)	34.8	
Yes		759 (87)	60.5	
<b>Use of gloves</b>				>0.2
No		749 (84)	59.2	
Yes		138 (16)	47.8	
<b>Activity index*</b>				0.03
≤5 opportunities/h		425 (48)	63.3	
>5 opportunities/h		462 (52)	52.0	
<b>Level of risk for cross-transmission</b>				<0.001
Low–medium		700 (79)	62.9	
High		187 (21)	36.9	

\* Refers to opportunities for hand hygiene per hour of patient care (4) and represents the hand hygiene workload (1, 4, 18, 19).

indicated a positive attitude toward hand hygiene before or after 3 types of action related to patient care: contact with the patient's skin, manipulation of intravenous devices, and contact with different body sites on the same patient during the sequence of care. However, less than 30% had a positive attitude toward hand hygiene after glove removal.

Although 65% of the respondents had a good knowledge of indications, 67% perceived hand hygiene as a difficult task, and only 35% considered that they knew the recommended guidelines on hand hygiene.

By bivariate analysis (Table 3), the intention to adhere, a positive attitude toward hand hygiene after patient contact, the belief of being a role model for other colleagues and the perception of hand hygiene as being a behavioral norm, the perception of knowledge of the risk for cross-transmission, and both the perception and measured knowledge of hand hygiene indications were significantly associated with adherence.

### Variables Predicting Adherence

In multivariate analysis, high workload and opportunities associated with a high risk for cross-transmission were independently associated with nonadherence (Table 4). Adherence was higher in internal medicine, geriatric medicine, and pediatric medicine than in other specialties. There was a trend toward better adherence among medical students compared with qualified physicians. Pocket carriage of the hand-rub solution was associated with adherence. After consideration of variables exploring physician beliefs and perception toward hand hygiene (Table 4; all variables model), a positive attitude toward hand hygiene after patient contact, the belief of being a model for other colleagues, and the awareness of being observed were independently associated with adherence.

### DISCUSSION

Although the hand hygiene procedure is simple, its application by health care workers is a complex phenome-

non that is not easily explained or changed (7, 12, 28). To our knowledge, our study is the first to concurrently evaluate the association of determinants of hand hygiene behavior, such as work conditions (accessibility of hand hygiene supplies and workload), demographic characteristics of health care workers, and individual cognitive factors, with actual hand hygiene adherence. Observed physician adherence was predicted mainly by variables related to the environmental context, social pressure, and the actual and

perceived risk for cross-transmission and to a positive individual attitude toward hand hygiene.

Because the study was not conducted with volunteers but rather with a purposive sample of individuals representing all sectors of the hospital, we believe that our results accurately reflect the situation at our institution. However, physician behavior at our institution might differ from that in other institutions. In particular, our hospital features a high degree of sensitivity to the issue of

**Table 3. Beliefs and Perceptions Associated with Hand Hygiene Adherence among 153 Physicians at University of Geneva Hospitals**

Belief or Perception	Physicians	Opportunities for Hand Hygiene	Adherence to Hand Hygiene	Odds Ratio (95% CI)
	<i>n</i> (%)		%	
<b>Intention to adhere to hand hygiene</b>				
No	35 (23)	164 (20)	43.9	1
Yes	116 (77)	656 (80)	61.1	1.81 (1.05–3.11)
<b>Perception of knowledge about hand hygiene indications</b>				
No	98 (65)	497 (60)	50.3	1
Yes	53 (35)	327 (40)	68.5	1.66 (1.04–2.65)
<b>Positive attitude toward hand hygiene after patient contact</b>				
No	12 (8)	82 (10)	26.8	1
Yes	138 (92)	737 (90)	61.2	3.98 (1.72–9.18)
<b>Positive attitude toward hand hygiene before manipulation of intravenous devices</b>				
No	12 (8)	64 (8)	48.4	1
Yes	139 (92)	749 (92)	58.7	2.09 (0.92–4.76)
<b>Positive attitude toward hand hygiene after contact with different sites on the same patient</b>				
No	18 (12)	85 (10)	61.2	1
Yes	133 (88)	728 (90)	57.6	0.76 (0.37–1.56)
<b>Positive attitude toward hand hygiene after removal of gloves</b>				
No	109 (72)	556 (67)	57.0	1
Yes	43 (28)	276 (33)	56.9	1.19 (0.72–1.99)
<b>Positive perception of behavioral norms toward hand hygiene</b>				
No	69 (51)	406 (57)	52.7	1
Yes	65 (49)	312 (43)	70.8	1.96 (1.21–3.18)
<b>Perception of being a role model for other colleagues</b>				
No	84 (56)	426 (52)	47.9	1
Yes	65 (44)	398 (48)	67.1	1.85 (1.17–2.93)
<b>Perception of being a role model for other professional categories</b>				
No	104 (69)	534 (64)	52.4	1
Yes	46 (31)	294 (36)	65.7	1.47 (0.89–2.41)
<b>Perception of difficulty or ease in adhering to hand hygiene</b>				
No	51 (34)	283 (35)	63.3	1
Yes	97 (66)	530 (65)	55.1	0.95 (0.59–1.55)
<b>Perception of risk for cross-transmission</b>				
No	22 (15)	125 (15)	43.2	1
Yes	129 (85)	695 (85)	60.3	2.19 (1.16–4.16)
<b>Motivation to improve adherence to hand hygiene</b>				
No	40 (26)	207 (25)	55.6	1
Yes	111 (74)	623 (75)	57.5	1.23 (0.73–2.06)
<b>Measured knowledge about hand hygiene indications*</b>				
Not good	53 (35)	304 (36)	47.7	1
Good	100 (65)	531 (64)	62.3	1.61 (1.01–2.58)

\* Knowledge of hand hygiene indications for 4 types of contact, according to standard definitions (2, 22), was measured by structured questions.

**Table 4. Factors Associated with Hand Hygiene Adherence among Physicians at University of Geneva Hospitals (Multivariate Analysis)**

	Odds Ratio (95% CI)	
	Observation*	All Variable†
Sex	1.04 (0.65–1.67)	1.28 (0.74–2.20)
Age	1.02 (0.98–1.06)	1.00 (0.95–1.05)
Professional status		
Professor or attending physician	1	1
Fellow or resident	1.16 (0.52–2.62)	1.91 (0.66–5.48)
Medical student	3.92 (0.94–16.30)	5.63 (0.96–32.97)
Medical specialty		
Internal medicine	1	1
Surgery	0.17 (0.08–0.38)	0.18 (0.07–0.43)
Intensive care unit	0.49 (0.21–1.17)	0.32 (0.12–0.88)
Pediatrics	0.99 (0.38–2.60)	1.18 (0.39–3.59)
Geriatrics	0.42 (0.14–1.22)	0.43 (0.13–1.37)
Anesthesiology	0.09 (0.03–0.25)	0.20 (0.06–0.66)
Emergency medicine	0.20 (0.07–0.54)	0.13 (0.04–0.43)
Other	0.37 (0.16–0.85)	0.28 (0.10–0.79)
Hand-rub solution in pocket	2.35 (1.24–4.44)	1.96 (0.98–3.93)
High risk for cross-transmission	0.59 (0.39–0.90)	0.51 (0.31–0.84)
Activity index (opportunities for hand hygiene/h of patient care)	0.92 (0.86–0.98)	0.86 (0.79–0.94)
Use of gloves	1.00 (0.62–1.62)	0.88 (0.49–1.58)
Aware of being observed		3.55 (2.00–6.28)
Intention to adhere to hand hygiene		0.99 (0.48–2.03)
Perception of knowledge about hand hygiene indications		1.59 (0.91–2.78)
Positive attitude toward hand hygiene after patient contact		5.19 (2.17–12.4)
Positive attitude toward hand hygiene before manipulation of intravenous devices		1.60 (0.53–4.80)
Positive attitude toward hand hygiene after contact with different sites on the same patient		0.46 (0.17–1.25)
Positive attitude toward hand hygiene after removal of gloves		0.93 (0.56–1.53)
Positive perception of behavioral norms toward hand hygiene		0.65 (0.38–1.10)
Perception of being a role model for other colleagues		1.89 (1.03–3.47)
Perception of being a role model for other professional categories		1.26 (0.65–2.45)
Perception of difficulty or ease in adhering to hand hygiene		1.23 (0.73–2.07)
Perception of risk for cross-transmission		1.54 (0.78–3.04)
Motivation to improve adherence to hand hygiene		1.23 (0.71–2.13)
Good measured knowledge about hand hygiene indications		1.25 (0.77–2.03)

\* Variables collected during the observation periods and related to patient care activities. Model characteristics: number of physicians, 146 (17 missing values); number of observations, 807 (80 missing values);  $P < 0.001$ .

† Includes cognitive factors collected through the questionnaire. Model characteristics: number of physicians, 122 (41 missing values); number of observations, 657 (230 missing values);  $P < 0.001$ .

hand hygiene as a result of the hospital-wide promotion strategy initiated in 1995 (1). Easy access to hand-rub solutions, adherence measurement, and performance feedback, as well as institutional commitment to hand hygiene promotion as a priority for patient safety, might have contributed to physician sensitivity to hand hygiene at the University of Geneva Hospital (1, 2, 4, 10, 12). Furthermore, although the observer was as unobtrusive as possible, the observation may have influenced both the level of adherence and responses to the self-report questionnaire. Of importance, however, the proportion of nonresponders was extremely low (6%), and adherence to hand hygiene was similar among questionnaire responders and nonresponders, thus excluding the possibility of a major participation bias. To what extent long-standing institutional commitment to hand hygiene promotion and possible observation bias would limit the generalizability of the study findings remains to be tested.

System constraints were strongly associated with phy-

sician adherence. As shown for health care workers in general and consistent with previous observations in different patient-care settings, high workload was associated with nonadherence. Although this has been repeatedly observed (1, 4, 18, 19, 29), we believe our study is the first to highlight its importance at the individual level. Conversely, easy access to hand hygiene in the form of the immediate availability of a hand-rub solution at the time of patient contact strongly predicted physician adherence. This factor was also individually measured and confirms previous observations in general (1) and in intensive care wards (18, 19, 29–32). This observation also strengthens and accurately captures recommendations from recently developed guidelines (2), which propose alcohol-based hand-rubbing as the new standard of care.

Of note, physician performance varied strongly among specialties, independent of other risk factors for adherence. This observation is consistent with our previous reports of variations in average adherence rates among health care

workers in different hospital settings (1, 4, 18, 19). Whether this might be related to individual variables, group behavior, or system constraints remains to be tested.

By investigating the possible association of cognitive factors with hand hygiene adherence, O'Boyle and colleagues (23) found that motivational factors predicted intention, and intention was related to the self-reported estimate of adherence, but this model did not predict observed adherence. In our study, both subjective norms and attitude toward hand hygiene and those related to work and system constraints were independently associated with observed adherence. Our findings reinforce previous observations (4) that some work conditions are independently associated with hand hygiene adherence but also disclose possible cognitive factors that may explain differences in adherence among health care workers sharing similar working conditions (18, 19, 32).

Awareness of being observed was strongly associated with adherence. This finding supports the notion that social pressure influences hand hygiene behavior. Only 44% of physicians in our study considered that they could be perceived as role models by their colleagues—a proportion close to a previous observation (33). Of importance, this perception predicted adherence, independent of system constraints and hand hygiene knowledge. Evidence from the medical and lay literature suggests that the role model could play a pivotal role in changing human behavior (15, 34). By contrast, negative role models could also be influential; poor practice can also be learned at the bedside (11, 35). Junior staff and students who were taught to hand-wash abandoned their habit when others, especially more senior staff, did not bother (36). Furthermore, because nurses have higher adherence rates than physicians and because poor physician adherence to hand hygiene is among the reported reasons by nurses for the difficulty in ensuring sustained adherence, improvement in physician compliance might improve overall adherence among all health care staff.

The fact that we identified multiple predictors of hand hygiene suggests that intervention strategies to promote this behavior should be multimodal (1, 2, 6, 10, 12). Possible actions may include education, system change, and motivation. In addition to previously identified and tested elements, strategies to promote hand hygiene should include attempts to reinforce the importance of the role model.

Hand hygiene promotion is a major challenge worldwide. The present study identifies important new variables, analyzed them concurrently with previously recognized risk factors for nonadherence, and found them to be independently associated with hand hygiene adherence. Promotion strategies among physicians should account for environmental issues and cognitive factors. In particular, regarding the latter aspect, reinforcement of the idea that each individual can influence the behavior of colleagues may prove to be a fruitful intervention.

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