Behavioral Determinants of Hand Hygiene Compliance in Intensive Care Units

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Background
Although hand hygiene is the most effective measure for preventing cross-infection, overall compliance is poor among health care workers.

Objectives
To identify and describe predictors and determinants of noncompliance with hand hygiene prescriptions in intensive care unit nurses by means of a questionnaire.

Methods
A questionnaire based on a behavioral theory model was filled out by 148 nurses working on a 40-bed intensive care unit in a university hospital. Subjects were asked to fill out the 56-item questionnaire twice within a 2- to 6-week period. During this period, no interventions to enforce hand hygiene occurred on the unit.

Results
Response rate for the test was 73% (108/148); response rate for the retest was 53% (57/108). The mean self-reported compliance rate was 84%. Factor analysis revealed 8 elementary factors potentially associated with compliance. Internal consistency of the scales was acceptable. Intraclass correlation was low (<0.60) for 2 subscales but acceptable (>0.60) for 6 subscales. A low self-efficacy was independently associated with noncompliance (β = .379; P = .001). After exclusion of this variable, a negative attitude toward time-related barriers was associated with noncompliance (β = -.147; P < .001).

Conclusions
Neither having good theoretical knowledge of hand hygiene guidelines nor social influence or moral perceptions had any predictive value relative to hand hygiene practice. A valid questionnaire to identify predictors and determinants of noncompliance with hand hygiene has been designed. Nurses reporting a poor self-efficacy or a poor attitude toward time-related barriers appear to be less compliant.

Although hand hygiene is the most effective measure to prevent cross-infection and as such limits the deleterious effect of health care–associated infection,1–4 overall compliance is unacceptably poor among health care workers. Barriers to appropriate hand hygiene practice have been studied and reported extensively, but even in settings with optimal environmental conditions, compliance appears to range from 50% to 60% at most.5–9 Furthermore, few interventions seem to result in a lasting effect.5,7,10 These findings suggest that behavioral determinants such as attitude, social influence, and self-efficacy may play a crucial role in compliance. A recent study by Whitby et al11 underlines the importance of understanding the dynamics of behavioral change in order to design a strategy to improve hand hygiene compliance.

In accordance with the attitude–social influence–self-efficacy model,12 which combines Fishbein and Ajzen’s theory of reasoned action13 and Bandura’s social learning theory,14 attitude, social influence, and self-efficacy are valid concepts in predicting one’s intention to change one’s behavior or even one’s actual change in behavior.5,10

Attitude is primordially based on earlier experiences: behavior that has led to success will be reinforced and vice versa. Although one’s general attitude toward a certain behavior is often the result of success and failure (or perceived advantage and disadvantage), not all attitudes are based on reason and logical sense. Some attitudes can be very rigid and based on highly irrational beliefs.

A compliment by a colleague or staff member as a reaction on adequate hand hygiene practice would be an example of social support on the intensive care unit (ICU). Although less interactive, being among high-compliance colleagues (ie, “role models”) is also a common example of a positive and valuable social influence.

Self-efficacy indicates one’s belief in one’s ability to behave as desired and to overcome certain barriers. In other words, self-efficacy is a person’s belief in his or her ability to succeed in a particular situation. Bandura17 described these beliefs as determinants of how people think, behave, and feel. Behavior that proves to be less successful or unsuccessful will be attributed to certain causes. Such attributions negatively influence self-efficacy.

The first objective of this study was to develop and validate a questionnaire by which determinants of noncompliance with hand hygiene can be identified in ICU nurses. The second objective was to identify and analyze determinants of noncompliance with hand hygiene prescriptions among nurses in a general ICU.

Methods

Questionnaire Development

Based on the literature, a questionnaire about hand hygiene was developed, including a self-reported compliance scale (12 items, based on the guidelines from the Centers for Disease Control and Prevention [CDC]18 and questions about attitudes toward hand hygiene (12 items), social influence (10 items), self-efficacy (10 items), and knowledge about hand hygiene (12 items).

Knowledge. The items on the knowledge scale were selected from a validated CDC questionnaire on hand hygiene.18 The remaining items were constructed on the basis of the literature. For each item, the respondent had to select 1 response from 4 alternatives. All 12 items were reviewed by an expert panel (n = 8) that consisted of 1 microbiologist, 2 infectiologists, 3 infection control nurses, 1 intensivist, and 1 researcher. As a result, some of the
items were slightly reworded. This method contributed to the content validity. In order to obtain an average difficulty level, all 12 items were given a difficulty label by the experts before the questionnaire was distributed. Levels ranged from “easy” to “quite difficult” to “difficult.”

For each correct response, the respondent received 1 point. The sum resulted in the respondent’s knowledge score on a scale from 0 to 12 (12 items).

**Attitude, Social Influence, and Self-efficacy.** The 12-item attitude scale included (1) questions on specific advantages and disadvantages associated with desired or undesired behavior and (2) questions to determine the respondents’ general attitude toward recommended hand hygiene practice.

Ten items were intended to define the social influence as experienced by the nurses and to provide us with an answer to the following questions: What is the ruling social norm? What is the frequency and importance of a role model’s presence? To what extent and in what ways are social support and social pressure experienced by the nurse?

Ten items were used to determine the nurses’ self-efficacy. These questions were intended to determine crucial barriers that lead to improper hand hygiene behavior.

All items were to be scored on a 5-point scale, going from 1 (“I completely disagree”) to 5 (“I completely agree”). Items were constructed on the basis of information gathered from our literature study.

**Hand Hygiene Compliance.** Compliance was to be self-reported on a 5-point numeric scale, ranging from 0% to 100% in steps of 25%. In order to include most situations in which hand washing or disinfection is recommended, we used an inventory as suggested by the Association for Professionals in Infection Control /CDC	extsuperscript{17} that contains 12 different opportunities in which hand hygiene is strongly recommended.

**Integrity of the Knowledge Test.** In order to determine the integrity of the knowledge test, its difficulty index and its discrimination index were calculated. The difficulty index ($p_{p_{optimal}}$) in case of 4 answering possibilities ($0.63$, $p$ ranging from 0.30 to 0.70) indicates the proportion of correct answers on a scale from 0.00 to 1.00.$^{19}$

The discrimination index ($d$) indicates the extent to which items on the questionnaire discriminate between high scorers and low scorers. The following formula was used to divide respondents into high scorers and low scorers,$^{19}$ with 40% of respondents in each group: (number of correct answers in the high-scorer group – number of correct answers in the low-scorer group)/total number of correct answers in both groups. Items with values of 0.35 and higher are discriminating (very) good, values from 0.25 to 0.35 are satisfying/good, values from 0.15 to 0.25 are mediocre/satisfying, and items with values less than 0.15 are bad/mediocre for discriminating between high scorers and low scorers.$^{20-23}$

**Setting**

The study was performed in the 40-bed ICU of the 1060-bed Ghent University Hospital, a tertiary care referral center.

**Procedure**

The questionnaire’s reliability was assessed by means of the test-retest method. For test purposes, the questionnaire was distributed (test) in April 2004 within a time lapse of 2 weeks ($T_{0}$ to $T_{+2}$). It was redistributed for retest purposes within a comparable period ($T_{+4}$ to $T_{+6}$). At $T_{+8}$ weeks, all questionnaires were collected. The study was approved by the institutional review board at Ghent University.

**Statistical Analysis**

Statistical analyses were performed by using SPSS version 12.0 (SPSS Inc, Chicago, Illinois). The items with the most severely skewed distribution (>97%) were discarded because they are not likely to be useful for a study on determinants. For the remaining items, factor analyses with varimax orthogonal rotation were conducted (data not shown). As the expert panel found 3 attitude items and 3 social influence items of rather poor quality, those items were deleted during the questionnaire’s development and validation process. The internal reliability of each factor was tested by using Cronbach $\alpha$. The test-retest reliability of the scales was assessed with the intraclass correlation coefficient. Systematic differences were investigated with a paired-samples $t$ test. To investigate the predictive validity, Pearson correlations were calculated between the psychosocial constructs and the self-reported compliance. Finally, a multiple linear regression was performed with the self-reported compliance as the dependent variable and the behavioral constructs as the independent variables. All 10 variables were included by using the stepwise selection method.
This questionnaire identified the impact of behavioral determinants on hand hygiene compliance.

Behavioral beliefs are of great importance in hand hygiene compliance.

Results

Response Rates and Population Surveyed

Response rate for the test was 73% (108/148). Response rate of the retest was 53% (57/108). Fifty-seven nurses (39% or 57/148) returned both questionnaires.

The study population was 72% female (n = 78) and 27% male (n = 29). Data were not available for 1 participant. The number of years of working experience varied from “less than 1 year” (12%) to “between 2 and 5 years” (22%), “between 5 and 10 years” (19%), “between 10 and 15 years” (23%), and “more than 15 years” (23%).

Item Clustering

Factor analyses on all attitude and social influence items led to 3 (AttTime, AttMoral, and AttUse) and 4 (SocNorm, SocSupp, SocPress, and SocRole) interpretable subscales, respectively (Table 1). For the determinant self-efficacy, no interpretable subscales could be found, leading to only 1 scale (EffTOT).

Questionnaire Reliability

The paired-samples t test proved the questionnaire to be stable. No systematic differences (data not shown) were found except for AttMoral (mean score before, 2.23 [SD, 0.81]; mean score after, 1.99 [SD, 0.69], P = .02, n = 54). Knowledge scores differed borderline significantly from before to after the test (mean score before 6.43/12 [SD, 1.65], mean score after 7.02/12 [SD, 2.19], P = .05, n = 56).

Finally, an intraclass correlation test indicated acceptable correlations for almost all determinants (≥0.60), except for AttUse (0.30), SocNorm (0.48), and KnowTOT (0.53).

Identification and Evaluation of Determinants

Self-reported Compliance. Overall compliance (12 questions) was scored at 92%. Because of extremely high scores (>97.8%), 4 items (ie, “blood contact,” “mucosal contact,” “macroscopically visible contamination/pollution,” and “direct contact with body fluids”) were removed from the questionnaire; the final compliance subscale thus consisted of 8 questions.

Data from an observational study24 in the same ICU enabled us to recalculate the self-reported compliance rates, taking into account the occurrence rate of each item. Thus, corresponding weights were given to the 8 remaining items. The recalculated overall self-reported compliance rate was 82.0% (SD, 15.09%; n = 105). Rates ranged from 79.2% (SD, 21.4%) for “contaminated surface contact” to 98.8% (SD, 6.8%) for “blood contact” and 98.8% (SD, 6.6%) for “macroscopic dirt contact.”

Behavioral Determinants of Attitude, Social Influence, and Self-efficacy. On a scale ranging from 1 to 5, the overall attitude toward hand hygiene scored 3.89. The overall social influence as experienced by the respondents scored 3.27. The global self-efficacy scored 3.55. We also calculated the scores for the different subscales (as shown and commented on in Table 1) and looked more closely at a number of scores on the item level. For example, work pressure did not prove to influence hand hygiene behavior. Also, nurses were convinced of the necessity and effectiveness of proper hand hygiene, but they clearly underestimated the consequences of poor compliance and tended to minimize the problem.

Knowledge of Hand Hygiene and Integrity of Knowledge Items. On average, the respondents scored 6.5/12 (SD, 1.76, n = 107) or 54% on the 12-item knowledge test. Integrity scores (p values) varied from 0.12 to 0.87 (12% to 87% correct answers). Two questions were found more difficult than expected: one item regarding the effectiveness of alcohol-based hand disinfection (p = 0.12, “Alcohol-based hand disinfection solution has good or excellent antimicrobial effect on the following organisms, except for … [answering possibilities]”) and a second item regarding contamination rates for Methicillin-resistant Staphylococcus aureus (MRSA, p = 0.26, “Which percentage of the population is represented by MRSA-contaminated? [answering possibilities]”). One question was found easier than expected (p = 0.87, “Most MRSA cases can be treated successfully with one of the following antibiotics: … [answering possibilities]”). Values of d were bad/mediocre (d = 0.09) for 2 items and mediocre/satisfying for another 2 items (d = 0.16). All other items had satisfying to very good d values.

Predictors of Noncompliance

Univariate analysis of the relationship between the psychosocial constructs and the self-reported compliance yielded 3 variables that were significantly correlated (Table 2). These variables were included in a multiple linear regression analysis (Table 3), which identified 2 major determinants as possible predictors of noncompliant hand hygiene behavior: self-efficacy (β = .379; P = .001) and AttTime (β = .147; P < .001). Hence, ICU nurses reporting poor self-efficacy or attitude toward time-related barriers appear to be less compliant.
Table 1
Description of dependent and independent variables of hand hygiene compliance

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full name</th>
<th>Explanation</th>
<th>No. of items</th>
<th>Test score, mean (SD) (n = 108)</th>
<th>Cronbach α (test) (n = 108)</th>
<th>Intraclass correlation (n = 57)</th>
<th>Item example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compliance</strong></td>
<td>ComTOT</td>
<td>Total compliance</td>
<td>8</td>
<td>82.0% (15.1%)</td>
<td>—</td>
<td>0.78</td>
<td>“How often do you wash or disinfect hands in the following situations: skin contact”</td>
</tr>
<tr>
<td><strong>Attitude</strong></td>
<td><strong>AttTime</strong></td>
<td>Time-related attitude items</td>
<td>5</td>
<td>2.14 (0.8)</td>
<td>0.74</td>
<td>0.86</td>
<td>“Washing hands whenever recommended would mean precious loss of time to me”</td>
</tr>
<tr>
<td></td>
<td><strong>AttMoral</strong></td>
<td>Morality-related attitude items</td>
<td>3</td>
<td>2.09 (0.8)</td>
<td>0.52</td>
<td>0.68</td>
<td>“Washing hands saves lives” “I feel bad when not being able to wash hands sufficiently”</td>
</tr>
<tr>
<td></td>
<td><strong>AttUse</strong></td>
<td>Usefulness-related attitude items</td>
<td>1</td>
<td>1.33 (0.6)</td>
<td>—</td>
<td>0.30</td>
<td>“I am not completely convinced of the usefulness and importance of hand hygiene”</td>
</tr>
<tr>
<td><strong>Social influence</strong></td>
<td><strong>SoCNorm</strong></td>
<td>Normative behavior social influence items</td>
<td>1</td>
<td>4.16 (0.8)</td>
<td>—</td>
<td>0.48</td>
<td>“Most of my colleagues think that hand hygiene prescriptions should be adhered to as well as possible”</td>
</tr>
<tr>
<td></td>
<td><strong>SoCSupp</strong></td>
<td>Support-related social influence items</td>
<td>1</td>
<td>3.80 (1.0)</td>
<td>—</td>
<td>0.63</td>
<td>“Good hand hygiene practice is appreciated by my professional environment”</td>
</tr>
<tr>
<td></td>
<td><strong>SoCPress</strong></td>
<td>Pressure-related social influence items</td>
<td>1</td>
<td>2.34 (1.1)</td>
<td>—</td>
<td>0.73</td>
<td>“I receive remarks from colleagues or superiors if noncompliant”</td>
</tr>
<tr>
<td></td>
<td><strong>SoCRole</strong></td>
<td>Role model-related social influence items</td>
<td>4</td>
<td>3.71 (0.62)</td>
<td>0.66</td>
<td>0.64</td>
<td>“Most of my colleagues are +50% compliant with hand hygiene”</td>
</tr>
<tr>
<td><strong>Self-efficacy</strong></td>
<td><strong>EffTOT</strong></td>
<td>Total self-efficacy</td>
<td>10</td>
<td>3.55 (1.01)</td>
<td>0.66</td>
<td>0.65</td>
<td>“I would wash hands more often when more sinks and dispensers were available”</td>
</tr>
<tr>
<td><strong>Knowledge</strong></td>
<td><strong>KnowTOT</strong></td>
<td>Total knowledge</td>
<td>12</td>
<td>6.5 (1.7)</td>
<td>—</td>
<td>0.53</td>
<td>“Hand disinfection by means of an alcohol-based hand rub is appropriate in the following situations except for...”</td>
</tr>
</tbody>
</table>

*a Dashes indicate data not reported.

**Discussion**

**Validation of the Questionnaire**

This article describes the development of a self-administered questionnaire on hand hygiene for ICU nurses. The questionnaire proved to be of use for its specific purpose but has some limitations. It is well known that when self-reporting behavior is used, respondents tend to overscore socially desirable behavior at up to 3 times the observed compliance rates. Respondents also seem to have unrealistic estimations of their own behavior. Compared with the direct observation...
The compliance was to be scored from 0% to 100% for 12 specific situations. One may question if these situations represent all possible situations in which hand hygiene is indicated. Hand hygiene prescriptions show great variations between different countries and therefore also between hospitals. Recalculation of the scores with adjustment for occurrence rate certainly contributed to diminishing the response bias to which our results were prone.

It can be assumed that the time interval between test and retest has led to communication and even discussion between the respondents on subjects related to hand hygiene. A small improvement in hand hygiene knowledge can therefore be attributed to the time frame of our study. In any event, general knowledge about hand hygiene practice appears to be rather low. An identical observation has been made previously in more specific areas of infection prevention, such as infections related to central venous catheters and ventilator-associated pneumonia. Also, one’s attitude toward the usefulness of hand hygiene or even the ruling social norm (what others think should be done) may not be insensitive to the effects of the interval period, which would explain the rather poor intraclass correlation coefficients.

The initial questionnaire was found too extensive and therefore somewhat boring to fill out. Our investigation allowed us to significantly reduce the number of items as well as the total length of the questionnaire.  

### Table 2

Univariate relationships between potential behavioral predictors and self-reported hand hygiene compliance (Pearson correlation)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>ComTOT</td>
<td>-0.410b</td>
<td>-0.259c</td>
<td>0.075</td>
<td>0.181</td>
<td>0.065</td>
<td>0.131</td>
<td>-0.010</td>
<td>0.507b</td>
<td>0.054</td>
</tr>
<tr>
<td>AttTime</td>
<td>1</td>
<td>0.133</td>
<td>0.111</td>
<td>-0.136</td>
<td>-0.063</td>
<td>-0.003</td>
<td>-0.040</td>
<td>-0.632c</td>
<td>-0.132</td>
</tr>
<tr>
<td>AttMoral</td>
<td>1</td>
<td>0.111</td>
<td>-0.244d</td>
<td>-0.179</td>
<td>-0.184</td>
<td>-0.143</td>
<td>-0.236d</td>
<td>-0.062</td>
<td></td>
</tr>
<tr>
<td>AttUse</td>
<td>1</td>
<td>-0.254d</td>
<td>-0.013</td>
<td>0.054</td>
<td>-0.137</td>
<td>-0.159</td>
<td>-0.310b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SocNorm</td>
<td>1</td>
<td>0.293c</td>
<td>0.161</td>
<td>0.669b</td>
<td>0.336b</td>
<td>0.065</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SocSupp</td>
<td>1</td>
<td>0.124</td>
<td>0.325b</td>
<td>0.151</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SocPress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.077</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SocRole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.274c</td>
<td></td>
</tr>
<tr>
<td>EffTOT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.144</td>
<td></td>
</tr>
<tr>
<td>KnowTOT</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** See Table 1 for an explanation of abbreviations.

**a** Correlation significant up to .001 level.

**b** Correlation significant up to .01 level.

**c** Correlation significant up to .05 level.

### Table 3

Linear regression analysis demonstrating adjusted relationships with total hand hygiene compliance

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>B</th>
<th>Standard error</th>
<th>Beta</th>
<th>t</th>
<th>P</th>
<th>P after exclusion EffTOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude toward hand hygiene: taking the “time” aspect into account (AttTime)</td>
<td>-.111</td>
<td>.082</td>
<td>-.147</td>
<td>-1.352</td>
<td>.18</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Attitude toward hand hygiene: taking the “moral” aspect into account (AttMoral)</td>
<td>-.120</td>
<td>.069</td>
<td>-.151</td>
<td>-1.737</td>
<td>.09</td>
<td>.02</td>
</tr>
<tr>
<td>Self-efficacy: perception of being able to behave as desired (EffTOT)</td>
<td>.412</td>
<td>.121</td>
<td>.379</td>
<td>3.414</td>
<td>.001</td>
<td></td>
</tr>
</tbody>
</table>
Analysis of Behavioral Determinants

We found that time-related attitude items and one’s self-efficacy were strong predictors of hand hygiene behavior. Neither social influence nor knowledge of hand hygiene guidelines seem to be of any predictive value.

Attitude. Our respondents’ overall attitude toward hand hygiene was rather positive. The ICU is known to be stressful and to have more opportunities for hand hygiene than other settings. However, increased work pressure in the ICU did not seem to have a direct influence on hand hygiene behavior. This finding contradicts several reports that identified a high pressure work environment as having a highly negative influence on hand hygiene.1,3,36-39 Hand hygiene compliance also seemed to be insensitive to the moment of care (not associated with a certain part of the day).

Use of irritating and drying solutions for hand disinfection was identified as a barrier to proper hand hygiene. Thus, as confirmed by many other studies37-40 providing sufficient and easy-to-access skin-friendly products might result in higher compliance with recommendations for hand hygiene.

Although the respondents’ attitudes proved to be at an acceptable level, further and ongoing improvement can be worthwhile. Improving one’s attitude on a long-term basis could be effective through intensive training and subsequent increase of one’s knowledge.3,4,5 According to Larson et al,9 focusing on knowledge in order to improve one’s attitude should not be effective. Recently a study91 showed that feelings of unpleasantness, discomfort, and/or disgust lead to emotional sensations that invoke self-protection and therefore can help in improving one’s attitude toward good hand hygiene practice.

Social Influence. The answers indicate an overall neutral to positive ruling social norm. Social pressure was low: the nurses reported that noncompliance does not easily lead to negative feedback or a remark from a colleague or from a staff member. Furthermore, in our study, social influence had no predictive value. According to Whitty et al,17 a focus on role modeling, peer pressure, education of health care workers, and ongoing “cues to action,” such as posters or easy access to hand rubs can lead to persistent behavioral change.

Sax et al92 identified highly ranked normative beliefs as well as perceived social pressure as predictors of compliance with guidelines for hand hygiene. In the same study, high self-reported rates of adherence to hand hygiene were independently associated with female sex, receipt of training, peer pressure, and perceived good adherence to guidelines for hand hygiene among colleagues.

Self-efficacy. Global hand hygiene self-efficacy was scored positively. As reported in other studies,3,11 self-efficacy can be improved by observational learning (ie, social learning, modeling) and practice.

According to Pittet and O’Boyle, positive feedback and subsequent remuneration play a crucial role in achieving higher self-efficacy.9,35,46-49 Although a recent study90 showed no significant improvement in hand hygiene through feedback of process measures, programs consisting of a combination of education and frequent performance feedback did lead to sustained improvement in hand hygiene compliance97 or improved behavior among health care workers.92 According to Sax et al,97 adherence is also driven by the perception of high self-efficacy, rather than reasoning about the impact of hand hygiene on patient safety.

Determinant Mixture? We believe that behavioral beliefs are of great importance in hand hygiene compliance. Most successful interventions appear to be ones that include different paths in achieving a behavioral change. A combination of educational programs, the formation of a multidisciplinary quality improvement team, compliance monitoring, and feedback has already proven effective.92 As confirmed in the same study, evidence-based behavioral interventions are of growing importance.

Instead of measuring compliance, it appears worthwhile to have a closer look at the rationale behind unacceptably low hand hygiene compliance.

Conclusions

We designed a valid questionnaire to identify the impact of behavioral determinants on compliance with recommendations for hand hygiene. This questionnaire can be used for further exploration.
Our preliminary results show that a low self-efficacy and a negative attitude toward time-related barriers are predictors of poor compliance with recommendations for hand hygiene.

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FINANCIAL DISCLOSURES
None reported.

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1. The questionnaire was based on which of the following models?
   a. Quality management model
   b. Stages of change model
   c. Consumer information processing model
   d. Behavioral theory model

2. Which of the following is the most effective measure to prevent cross-contamination?
   a. Transmission-based precautions
   b. Hand hygiene
   c. Personal protective equipment
   d. Appropriate disinfection of reusable equipment

3. Which of the following is the reported compliance with appropriate hand hygiene practices?
   a. 10% to 20%  c. 50% to 60%
   b. 30% to 40%  d. 70% to 80%

4. Which of the following refers to the belief in one's ability to behave as desired and to overcome certain barriers?
   a. Self-determination
   b. Self-efficacy
   c. Self-concept
   d. Self-actualization

5. The items on the knowledge scale were selected from a validated questionnaire on hand hygiene from which of the following organizations?
   a. Centers for Disease Control and Prevention
   b. World Health Organization
   c. The Joint Commission
   d. Institute for Healthcare Improvement

6. What was the recalculated overall self-reported compliance rate?
   a. 79.2%  c. 92.7%
   b. 82.0%  d. 98.8%

7. Which of the following was identified as one of the strongest predictors of hand-hygiene behavior?
   a. Self-efficacy
   b. Social influence
   c. Moral perceptions
   d. Knowledge of hand hygiene guidelines

8. What did researchers find related to attitude and hand hygiene?
   a. Increased work pressure had a highly negative influence on hand hygiene.
   b. Hand hygiene compliance was associated with a certain part of the day.
   c. No barriers to proper hand hygiene were identified.
   d. Respondents' overall attitude toward hand hygiene was rather positive.

9. Which of the following was a study finding about social influence and hand hygiene behavior?
   a. Social pressure was high among respondents.
   b. Social influence was a strong predictor of compliance.
   c. Answers indicated an overall neutral to positive ruling social norm.
   d. Noncompliance easily led to negative feedback.

10. "Washing hands saves lives" is an item example of which variable?
    a. Morality-related attitude
    b. Total compliance
    c. Time-related attitude
    d. Usefulness-related attitude

11. Which of the following social influence variables is explained as the ruling norm?
    a. Support-related
    b. Pressure-related
    c. Normative behavior
    d. Role model-related

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**Program evaluation**

<table>
<thead>
<tr>
<th>Objective 1 was met</th>
<th>Objective 2 was met</th>
<th>Objective 3 was met</th>
<th>Content was relevant to my nursing practice</th>
<th>My expectations were met</th>
<th>This method of CE is effective for this content</th>
<th>The level of difficulty of this test was:</th>
<th>To complete this program, it took me hours/minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>4 easy/medium/difficult</td>
<td>5.5 hours/minutes.</td>
</tr>
</tbody>
</table>

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Behavioral Determinants of Hand Hygiene Compliance in Intensive Care Units
David De Wandel, Lea Maes, Sonia Labeau, Carine Vereecken and Stijn Blot

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