Reliability and validity of observed hand hygiene compliance performed by nurses: a quantitative observational study

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Background

The estimated prevalence of healthcare-associated infections (HAIs) in acute care hospitals varied in 2011 from approximately 5.7% in Europe to 7.4% in the Netherlands.[1] HAIs are infections that patients acquire during healthcare treatment.[2] These infections are burdensome to patients and have substantial effects on morbidity and mortality. They prolong hospital stays, increase resistance of microorganisms to antimicrobials, and raise healthcare costs.[3–5] In Europe, approximately 37,000 people die every year from HAIs.[6]

Hand hygiene (HH) is one of the most effective practices to reduce HAIs.[7,8] The World Health Organization (WHO) identifies five indications (i.e., moments) for HH: before patient contact, before performing an aseptic task, after exposure to body fluids, after patient contact, and after contact with a patient's surroundings.[7,9,10] An HH opportunity is the need to perform HH.[7] When multiple indications take place simultaneously, they are still considered a single HH opportunity. Subsequent HH action consists of washing with plain soap and water or hand disinfection.[7,9] Despite clear guidelines, HH compliance remains low in practice.[7,11] A systematic review of studies on HH compliance in hospitals in industrialised countries showed an overall median compliance rate of 40% among healthcare workers (HCWs).[12]

Measurement of HH compliance is an important component of infection control programs to assess HH practices and to provide performance feedback to professionals.[9] A number of methods have been developed to monitor HH practices, such as self-reporting of HH compliance, (electronic) measuring of HH product consumption, electronic motion sensors with computerized voice prompts, video surveillance, and surveillance of HAI rates.[11,13–16] In contrast, direct, valid observations provide more detailed information on HH practices, such as hand rubbing technique, application time, glove use, and compliance rates by HCW type.[7,14,15] Therefore, this method is considered the gold standard to assess HH practices.[9]

HH compliance monitoring requires training, skill, and experience in order to minimise potential bias.[7,9] Multiple causes of bias potentially arise from direct observation of HH. Selection bias and observer bias are the most important threats to the validity and reliability of direct observations. Validity, in this context, refers to the extent to which observations accurately record the behaviour of interest. Similarly, reliability is defined as the consistency of observations.[17] Observer bias occurs when observers systematically misinterpret the definitions for HH indications and actions and the observation method.[18,19] Possible explanations are insufficient training and a lack of competence and experience with performing HH assessments.[7,9,13,20] In addition, selection bias occurs when shifts and HCWs are not selected at random, such as oversampling day shifts.[13,14,20]

A possible reason is a lack of allocated time[7,9,20] or insufficient awareness of the need to collect a representative HH compliance rate.[20]

In 2013, a university medical centre in the Netherlands implemented a hospital-wide program to improve adherence to HH guidelines. Part of this program consists of monitoring HH compliance in daily practice by nurses with a focus on infection prevention. These nurses are assigned to perform HH compliance assessments by direct observations, using the Dutch version of the standardised WHO HH monitoring tool.[9]

Although much research has been performed on potential causes of bias related to direct observation of HH, few studies assessed the reliability of direct observations.[21–23] Validation of observations is essential for achieving valid and reliable data.[14,15] A clustered randomised trial, focusing on HH improvement strategies, validated observers by using parallel observation sessions with an experienced observer prior to performing HH assessments,[21] according to the HH observation guidelines of the WHO.[7] However, no studies were found regarding the reliability of HH assessments performed in daily practice, as part of an audit system. Therefore, little is known about the validity and reliability of direct observation of HH compliance in daily practice. Considering the potential bias arising from direct observation of HH, it is unknown whether the audit system, consisting of observing HH compliance by using a HH monitoring tool, is valid and reliable in daily practice.

Aim

The aim of this study was to evaluate the reliability and validity of the assessment of observed hand hygiene compliance performed by nurses in nursing wards of a university medical centre.

Method

Design

A quantitative observational study was conducted from January 2016 to April 2016. The actual performance of HH compliance assessments in daily practice was studied without interference by the reseacher.[24] Observation reliability was assessed by comparing quantitative observational data of HH practices performed by ward nurses with observational data of an experienced observer (i.e., gold standard). Furthermore, an online structured questionnaire was used to examine the validity of the HH compliance data collection method in practice. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement was used to report this study.[25] This research method did not require approval from the Medical Ethical Review Committee on Research on Humans.

Domain, Setting, and Participants

The population of interest consisted of nurses performing HH compliance assessments in daily practice. Nurses of a university medical centre in the Netherlands, performing HH compliance assessments in daily practice by using and HH observation tool, were invited to participate in the study.

Sample Size and Sampling

Since 2013, 28 nursing wards of the university medical centre have been obliged to observe 200 HH opportunities every three months. Within each ward, one nurse with a focus on infection prevention is assigned to perform these HH compliance assessments. Given the estimated current HH compliance rate of 50% to 80%, a sample size of 20 nurses and 20 HH opportunities per nurse was required in order to reach 80% power and a 5% two-sided significance level to detect a difference in compliance rates of at least 5% between the experienced observer and the nurses. Practice has shown that nurses also outsource HH compliance assessments to colleagues. However, since no precise figures are available, the sample size is based on one nurse performing HH compliance assessments per ward.

Stratified random sampling was used to provide a representative sample of nurses across the different types of wards.[24] To minimise differences in ward characteristics, the 28 wards of the university medical centre were categorised,[26] based on complexity (variety of HH indications) and intensity of care, into the following four types: intensive care units (n = 3), internal medicine wards (n = 13), paediatric wards (n = 2), and surgical wards (n = 10). Next, a random sample from each group, proportional to the population, was generated by a computer.

Primary and Secondary Outcomes and Measurements

The primary outcome was the reliability of HH compliance assessments performed by nurses and consisted of two elements. Firstly, the differences of observed HH compliance among the experienced observer and nurses was assessed. Secondly, the inter-observer agreement, i.e., the degree of agreement of HH indications reported by the experienced observer and the nurses was evaluated. Both reliability elements were assessed using the Dutch version of the standardised WHO HH monitoring tool (see Appendix 1). The results of both elements complement each other by measuring different aspects of the reliability of the HH compliance assessments: Observed HH compliance and recorded HH indications.

The secondary outcome was the validity of the HH compliance assessments in daily practice, operationalised as the presence of observer and/or selection bias. An online structured

questionnaire (see Appendix 2) was used to examine the validity of HH assessments. Observer bias was determined by asking questions about nurses' training, experience, and competence in performing HH assessments. Furthermore, nurses' knowledge of HH indications and actions was tested using practice-based questions, in which nurses were asked to determine whether an HH action was needed and the corresponding HH indication(s). Selection bias was determined by asking questions about the selection of observation times and allocated time for performing HH assessments.

The questionnaire was developed on the basis of several hand hygiene monitoring studies,[15,19,20,27] submitted to two independent researchers to establish the content validity of the questionnaire and presented to an HH measurement expert to assess the face validity.

Of the performed observation sessions, hours of observation and the number of observed HCWs (number of unique physicians/nurses) were reported.

Procedures

In preparation for the parallel observation sessions, the experienced observer was extensively trained in performing HH compliance assessments by an infection control expert and tested through the WHO training film.[28]

Nurses were recruited by e-mail and telephone. HH observation sessions were planned with nurses who agreed to participate and who signed the informed consent form. Each observation session lasted until the nurse observed 20 HH opportunities.

Participating nurses were asked to perform HH compliance assessments as usual, accompanied by the experienced observer. Both nurse and experienced observer used the WHO HH observation form and observed the same HCWs and care sequence. In order to pair the observations of both observers, the nurses were asked to signal the experienced observer after registering five HH opportunities. This process was repeated until the nurse registered 20 opportunities. By setting reference points, observations could be paired after the observation sessions. It was decided to signal every five HH opportunities, instead of after every opportunity, in order to minimally influence the nurses' actual performances and observed HCWs. Moreover, the experienced observer did not comment on the observations to avoid influencing the nurses' performances. Hour of observation and the number of observed HCWs were reported.

After all observation sessions were completed, the online structured questionnaire was distributed to participating nurses to ensure that the questions would not influence the nurses' performance

during the parallel observation sessions. A deadline of three weeks for a response was set. After two weeks, a reminder was sent to encourage a reply. Answers to the questionnaire were processed anonymously.

Data Analysis

The characteristics of the parallel observation sessions were summarised using descriptive statistics. Hours of observations were expressed as means and standard deviations and the number of observed HCWs (number of unique physicians/nurses) as frequencies. The compliance rate for every observation session was calculated as a percentage, by dividing the number of performed HH actions by the total number of HH opportunities,[9] for the nurse and experienced observer separately.

The normality of the HH compliance rates of both the nurses and the experienced observer, as well as their paired differences, were assessed using a Q-Q plot, a histogram, and the Shapiro-Wilk test.[29] For normally distributed data, the paired samples t-test was used to test whether there was a statistically significant difference between the HH compliance rates of the nurses and the experienced observer. For non-normally distributed data, the Wilcoxon signed rank-test was used.

Subsequently, the inter-observer agreement of recorded indications by the experienced observer and nurses was measured with Cohen's kappa,[9] by pairing every five recorded opportunities. Kappa (κ) values were identified as follows: 0 represents poor agreement, .01 to .20 slight agreement, .21 to .40 fair agreement, .41 to .60 moderate agreement, .61 to .80 substantial agreement, and .81 to 1.0 almost perfect agreement.[30] Missing data of parallel observation sessions were considered unobserved opportunities for HH. Results with $p < .05$ were considered statistically significant. All data were analysed using IBM SPSS Statistics, version 23.0 (IBM Corp., New York, USA). Responses from completed questionnaires were entered into SPSS and expressed as frequency counts and percentages.

Results

Participants

Twenty nurses were invited to participate in the study, of which three declined and two did not respond. Five additional nurses were recruited, so in total, 20 nurses from four different types of wards, in the intended proportions, participated. There were no dropouts.

A total of 140 HCWs were observed during almost 16 hours of observation spread over 20 parallel observation sessions of 20 participating nurses and the experienced observer. Further descriptive detail of hours of observations and observed HCWs are displayed in Table 1.

**Table 1*

Reliability

The distributions of the HH compliance data of both samples, as well as the paired differences of the experienced observer and nurses, were normally distributed. Therefore, the paired samples t-test was used. As shown in Table 2, no significant difference was found between the observed HH compliance of nurses and that of the experienced observer. The inter-observer agreement of recorded indications by the experienced observer and the nurses was moderate: $\kappa = .46$, 95% CI [.413, .514], $p < .001$.

**Table 2*

Validity

An online structured questionnaire was distributed to the 20 nurses of the parallel observation sessions. All 20 nurses responded, resulting in a response rate of 100%.

Observer bias.

Level of training, experience, competence, and knowledge.

Sixteen nurses (80%) received instructions from an infection control expert and/or colleague prior to performing HH compliance assessments. Four nurses (20%) received no instructions or could not recall whether they had received instructions or by whom. Of all nurses, 16 (80%) received verbal information, ten (50%) written instructions, and three (15%) practical exercises. Nine nurses (45%) had collected HH data for six or more quarters and three (16%) had never collected HH data. On a scale of 1 to 10 (i.e., not competent to highly competent), 17 nurses (85%) ranked their competence of performing HH assessments with a 7 or 8. Nine nurses (45%) reported facing problems in daily practice during monitoring, such as adequately recognising HH indications and/or assessing the need for HH actions (“grey” area).

Nurses’ knowledge of HH indications and actions was tested by five practice based-questions. One nurse answered all five questions correctly. None of the questions was answered correctly by more than 60% of the nurses. Multiple nurses reported the correct HH indication but also one

or more superfluous HH indications. All the answers to nurses' level of training, experience, competence, and knowledge are presented in Table 3.

**Table 3*

Selection bias.

Selection of observation times and allocated time.

Nine nurses (45%) formally allocated time for performing HH assessments, five (25%) allocated no time, and three (15%) allocated time only when workloads permitted. Four nurses (20%) mentioned that insufficient time is allocated to perform HH assessments or that unobtrusively observing HCWs was difficult during daily activities. Opinions were divided regarding the monitoring time investment. Six nurses (30%) reported that performing HH assessments took too much time. Of all nurses, 18 (90%) performed HH assessments between daily activities or during quiet periods and five (25%) for a consecutive half or full day. All nurses performed HH assessments during day shifts. Ten (50%) also performed assessments during the evening and four (20%) also during the night. Sixteen nurses (80%) submitted HH data to the infection control department, and 16 (80%) used HH data to set improvement goals and to inform HCWs of the team. All the answers to the selection of observation times and allocated time are presented in Table 4.

**Table 4*

Additional findings.

During the observation sessions, three nurses (15%) mentioned that the quality of HH practices was not monitored with the HH observation assessments. Furthermore, four (20%) expressed doubts about inter-observer consistency and the reliability of observations or stated that HH assessments were easier to perform and provided more reliable results (unobtrusive observations) when time was allocated. During 11 observation sessions, one or more opportunities occurred consisting of two or more indications, which nine nurses incorrectly reported as multiple opportunities, instead of a single opportunity.

Discussion

The purpose of this study was to evaluate the reliability and validity of the assessment of observed hand hygiene compliance performed by nurses. The findings suggest that the HH assessments are reliable since there was no significant difference between the observed HH compliance by the experienced observer and the nurses. However, inter-observer agreement of recorded indications

was moderate. Results of the questionnaire indicate that the validity of HH compliance assessments is affected by selection and observer bias caused by variation in the amount of nurses' training, the data collection process, and knowledge gaps regarding HH indications and opportunities.

Few studies have assessed the reliability of direct observations of HH compliance data.[21,23,31] However, to the best of our knowledge, this is the first study to investigate reliability and validity of HH compliance assessments performed in daily practice. In this study, the reliability of the HH compliance rates is considered the most clinically relevant aspect, compared to the reliability of HH indications, since these compliance rates provide insight into HH practices,[32] are directly linked to patient safety,[7] and are used to set improvement goals. Nevertheless, observers should have knowledge of HH indications to provide performance feedback to HCWs on why an HH action is needed and to understand the method of infection prevention.

The results of the questionnaire indicate the presence of observer bias, affecting the validity of HH compliance assessments. HH indications were frequently misinterpreted, and there is a lack of knowledge about the distinction between HH indications and opportunities. HH opportunities consisting of multiple indications were frequently reported by nurses as a single indication. Considering these misinterpretations, nurses' reported education, consisting of mainly written or verbal instructions, could be insufficient to understand the HH indications and to correctly apply the observation method. These findings are in line with a previous study, which reported a variation in observers' training and pointed to the need for formal training of observers to provide valid HH data.[20] Therefore, it is recommended to train observers in the principles of the WHO's five moments for HH and the HH observation method.[7,9,10,19]

Furthermore, nurses did not seem aware of their knowledge gaps regarding HH indications, as the majority ranked their competence of performing HH assessments with a seven or higher. These results are in line with studies demonstrating that HCWs overestimate their own HH compliance, knowledge, and skills.[33,34] A possible reason for this overestimation is the difficulty to objectively self-asses one's own competence.[35] This highlights the importance of validating observers in order to prevent observer bias.[7,9,13,14,20] The WHO guidelines of the standardised HH observation method recommends validating observers by parallel observation sessions with a validated observer or by testing the observer through the use of a WHO training film.[7,28] These sessions should be repeated until agreement is reached on reported HH opportunities.[9] However, none of the nurses included in this study had been validated, which can cause observer bias and can lead to either underestimation or overestimation of true compliance rates.[13]

Results of the questionnaire also raise questions concerning selection bias of direct observations. Previous studies note the importance of randomly selecting observation times and HCWs to obtain a representative HH compliance rate and to compare rates over time.[7,8,12,16] Despite the performance of HH assessments by nurses in this study during usual care activities, observations are predominantly performed when workloads permits and during day shifts because of insufficient allocated time. This has also been demonstrated in a previous study, in which the majority of observers collected data during quiet periods or in their breaks.[20] This lack of randomly selecting observation times potentially leads to biased results.[13,19] This has been confirmed by a previous study, which reported an association between an increased workload and decreased compliance.[22] Moreover, Tejada & Bearman[13] pointed to the importance of monitoring HH compliance at the direct point of care to observe the full spectrum of HH indications. Therefore, sufficient time should be allocated for randomly observing HH compliance, even during complex care activities, to provide a representative HH compliance rate.[9]

The majority of wards use the collected HH compliance data to set improvement goals to raise HH compliance rates. Some nurses mentioned that assessing HH techniques is not part of the assessments. However, in addition to performing HH actions when indicated, the use of the appropriate technique is essential to ensure reduction of the transmission of pathogenic microorganisms and the incidence of HAIs.[7] This is in agreement with Boyce,[15] who reported that in many institutions HH compliance is monitored by observing HH actions and opportunities but lacked reporting the HH technique. The assessment of HH technique should be part of the HH assessments in daily practice and can be operationalised by assessing the volume of HH product used, the required amount of time, and the technique of application.[36]

It should be noted that this study has some limitations. The study's main limitation is the unknown effect of the presence of the experienced observer during the parallel observation sessions. Observers could have changed their observation methods and, subsequently, influenced the recorded observations. However, the experienced observer did not comment on the observations to limit nurses' behavioural changes. Secondly, the representativeness of the sample can be criticized since only nurses who were known as auditors in the infection control department formed part of the sample, while in some wards multiple auditors perform HH assessments. However, this information was not known prior to the study and, therefore, could not be taken into account. Thirdly, the exact agreement of the indications could not be determined because of the inability to pair every observation. However, the method of pairing every five indications was used to minimally influence the actual performance of the nurses. A strength of this study is the use of a

single experienced observer, which decreased the observation variability to a minimum. Another strength is the large number of nurses participating in the parallel observation sessions, giving the study adequate power to achieve its objective. In addition, the response rate of 100% on the questionnaire gives a complete view of HH assessments in practice.

Replication of this study in multiple hospitals would strengthen the generalisability of the findings. Directly observing HH practices requires trained observers in order to obtain valid results. Therefore, it is recommended to train observers in the WHO's five moments for HH and learn to apply the HH observation method in daily practice. Moreover, nurses' observations should be validated by HH experts prior to performance of HH observations in daily practice. Observers should allocate time to consistently and validly perform HH assessments, consisting of a representative mix of shifts and HCWs, regardless of workload. Moreover, performance feedback on HH technique should be provided to HCWs during HH assessments to improve HH technique[37] in order to reduce the transmission of pathogenic microorganisms and the incidence of HAIs. However, future research is needed regarding assessments of HH technique by direct observations.

Conclusion

The present study indicates that the HH compliance assessments performed by nurses in daily practice are reliable. However, only a moderate agreement was found between recorded HH indications. Agreement can be improved by training observers on HH indications and opportunities. Furthermore, the validity of HH assessments is threatened by selection bias and observer bias. Selection bias is caused by an inconsistent data collection process and can be diminished by randomly selecting observation times, for which sufficient time should be allocated. Observer bias is caused by knowledge gaps of HH indications and opportunities and can be reduced by training observers as well as validating their observations. Future research is needed regarding the direct observation of HH technique during HH assessments in daily practice.

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Tables

Table 1

Characteristics of the parallel observation sessions (n = 20)

Specialism	Duration of observation session (min) Mean (SD)	Number of observed unique nurses (n)	Number of observed unique physicians (n)
Intensive Care (two wards)	25.5 (0.44)	12	4
Internal medicine (nine wards)	43.5 (15.31)	48	15
Paediatric (two wards)	48.3 (28.04)	12	3
Surgical (seven wards)	59.3 (20.59)	40	6

Note. SD = standard deviation.

Table 2

Comparison of observed HH compliance between the experienced observer and nurses (n = 20)

	Experienced observer	Nurses	Difference Experienced observer – Nurses	t	p
	Mean (SD)	Mean (SD)			
Observed HH compliance	62.2% (20.14)	63.8% (21.42)	-1.55%	-0.876	.392

Note. Paired samples t-test. SD = standard deviation; HH = hand hygiene.

Table 3

Nurses' self-reported level of training, experience, competence and knowledge regarding hand hygiene monitoring (n = 20)

Topic	n	%
Instructions by		
Colleague	7	35
Hygiene infection prevention expert	11	55
No instructions	2	10
Could not recall	2	10
Type of instructions		
Instructions on paper	10	50
Verbal	16	80
Practical exercises	3	15
Other	1	5
Experience in monitoring (quarters)		
0	3	15
2-5	8	40
6-9	3	15
10-13	4	20
> 13	2	10
Competence (rate, scale 1-10)[a]		
6	2	10
7	7	35
8	10	50
9	1	5
Problems with monitoring		
Difficult to recognise HH indications	4	20
Difficult to use HH monitoring tool	2	10
No	10	50
Other	7	35
Importance of hand hygiene assessments		
Very important	13	65
Fairly important	4	20
Moderately important	3	15
Practice based questions (correct answer)		
Question 1	8	40
Question 2	12	60
Question 3	4	20
Question 4	7	35
Question 5	8	40
Practice based questions (superfluous HH indications)[b]		
Question 1	12	60
Question 2	0	0
Question 3	2	10
Question 4	11	55
Question 5	4	20

Note. [a] Scale of 1 to 10 (not competent – highly competent). [b] Reporting both the correct and superfluous HH indication(s).

Table 4

Selection of observation times and allocated time for hand hygiene compliance assessments (n = 20)

Topic	n	%
Number of hand hygiene auditors per ward		
1	4	20
2	5	25
3	7	35
> 3	4	20
Allocated time for performing hand hygiene assessments		
No time	5	25
≥ ½ day per quarter	8	40
Other	7	33
Time investment assessments		
Cost too much time	6	30
A lot of time but not too much	10	50
Not a lot of time	4	20
Performing assessments		
Between daily activities	18	90
Consecutive period of half/one day	5	25
Other	2	10
Shift		
Day	20	100
Evening	10	50
Night	4	20
Follow-up hand hygiene data		
Submitting to the infection control department	16	80
Setting improvement goals	16	80
Unknown	1	5
Other	4	20

Abstract

Background: Healthcare-associated infections are burdensome to patients, increase antibiotic resistance, and raise healthcare costs. Hand hygiene is one of the most effective practices to prevent healthcare-associated infections. Direct observation of hand hygiene practices is considered the gold standard to assess hand hygiene compliance but requires training, competence, and experience to minimise potential selection and observer biases. It is unknown whether hand hygiene assessments by direct observation in daily practice are reliable and valid.

Aim: To evaluate reliability and validity of hand hygiene assessments performed by nurses.

Method: Twenty nurses of a university medical centre participated in a quantitative observational study. Reliability was determined by twenty parallel observation sessions with an experienced observer and a nurse, assigned to perform hand hygiene assessments**.** The experienced observer and the nurses observed the same healthcare workers and care sequence, using a structured observation form. Validity was assessed by the presence of selection and/or observer bias using a structured questionnaire about the observation method and nurses' knowledge.

Results: Reliability analysis, using paired samples t-test, showed no significant difference between the observed hand hygiene compliance of nurses and the experienced observer. Inter-observer agreement of hand hygiene indications was moderate ($\kappa = .46$). As for validity, variation was found in the data collection process, nurses' training, and knowledge gaps regarding hand hygiene indications and opportunities.

Conclusion and implications: The hand hygiene compliance assessments in daily practice are reliable. However, the validity of the assessments is affected by observer bias and selection bias. Observer bias can be reduced by training observers on hand hygiene indications, and the HH observation method in daily practice, as well as validating their observations. Selection bias can be diminished by random selection of observation times. Direct observation of hand hygiene technique should be part of the hand hygiene compliance assessments in daily practice.

Key words: Hand hygiene [MeSH], guideline adherence [MeSH], observation [MeSH], reliability, validity.

Dutch summary

Achtergrond: Ziekenhuisinfecties zijn belastend voor patiënten, verhogen antibioticaresistentie en leiden tot verhoogde zorgkosten. Handhygiëne is een van de meest effectieve maatregelen om deze infecties te voorkomen. Directe observatie van de uitvoering van handhygiëne wordt beschouwd als gouden standaard om de compliance te beoordelen. Deze observaties vereisen training, vaardigheden en ervaring om vertekening van resultaten door selectie- en observatorbias te minimaliseren. Het is onbekend in hoeverre de handhygiëne beoordelingen in de dagelijkse praktijk, middels directe observaties, betrouwbaar en valide zijn.

Doel: Evalueren van de betrouwbaarheid en validiteit van de door verpleegkundigen uitgevoerde handhygiëne compliance metingen.

Methode: Twintig verpleegkundigen van een universitair medisch centrum hebben deelgenomen aan een kwantitatief observationeel onderzoek. De betrouwbaarheid werd bepaald middels twintig dubbelmetingen door een ervaren observator en een verpleegkundige die in de dagelijkse praktijk handhygiëne metingen uitvoert. De observator en verpleegkundigen observeerden dezelfde zorgverleners en zorgsituaties, middels een gestructureerd observatieformulier. De validiteit werd beoordeeld op de aanwezigheid van selectie en/of observatorbias, met behulp van een gestructureerde vragenlijst over de observatiemethode en de verpleegkundige kennis.

Resultaten: Analyse van de betrouwbaarheid, middels een gepaarde t-toets, toonde geen significant verschil aan tussen de geobserveerde handhygiëne compliance van de verpleegkundigen en de ervaren observator. Interbeoordelaarsbetrouwbaarheid van de handhygiëne indicaties was matig (κ = .46). Analyse van validiteit toonde variatie in de dataverzamelingsmethode, de training van verpleegkundigen, en kennishiaten betreffende handhygiëne indicaties en gelegenheden.

Conclusie en aanbevelingen: De handhygiëne compliance beoordelingen in de dagelijkse praktijk zijn betrouwbaar. De validiteit van de beoordelingen wordt echter beïnvloed door selectiebias en observatorbias. Observatorbias kan verminderd worden door het trainen van observatoren omtrent handhygiëne indicaties en de observatiemethode in de praktijk, evenals het valideren van hun observaties. Selectiebias kan verminderd worden door het willekeurig selecteren van observatiemomenten. Het observeren van de techniek van handhygiëne moet een onderdeel worden van de handhygiëne compliance beoordelingen.

Trefwoorden: handhygiëne, naleving richtlijnen, observatie, betrouwbaarheid, validiteit.

Appendix 1. Dutch version of the standardised WHO HH monitoring tool (shortened version)

Obs.	Indicatie	HH Actie	Beroep	Obs.	Indicatie	HH Action	Beroep	Obs.	Indicatie	HH Action	Beroep
1	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	12	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	23	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
2	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	13	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	24	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
3	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	14	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	25	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
4	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	15	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	26	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
5	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	16	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	27	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
6	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	17	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	28	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
7	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	18	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	29	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
8	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	19	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	30	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
9	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	20	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	31	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
10	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	21	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	32	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP
11	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	22	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP	33	☐ Voor patiënt ☐ Voor asept. ☐ Na lich.vloei. ☐ Na patiënt ☐ Na pat.omg.	☐ **desinf.** ☐ **wassen** O **gemist** O handsch.	☐ Arts ☐ VP

Appendix 2. Online structured questionnaire

Hand hygiene compliance assessments

This questionnaire consists of 19 questions about the performance of the “hand hygiene compliance assessments”. This way, we hope to gain insight into your knowledge of the compliance assessments and the performance of the assessments in daily practice. It will take no longer than 10 minutes to complete the questionnaire. The results of the questionnaire will be processed anonymously.

Thank you for participating in this questionnaire.

*Required

1. What is your log-in code? *

……..

2. Did you receive any instructions prior to the performance of the hand hygiene compliance assessments in daily practice? (multiple answers allowed)*

- Yes, by a colleague
- Yes, by an infection control expert
- Do not recall
- No
- Other,……..

3. What type of instructions did you receive? (multiple answers allowed) ***

- Instructions on paper
- Verbal instructions
- Practical exercises
- E-learning
- Did not receive any instructions
- Other,……..

4. How many quarters have you already performed the assessments in this university medical centre?*

- □ 0, I have performed direct observations of hand hygiene practices in another healthcare institution
- □ 0-1
- □ 2-5
- □ 6-9
- □ 10-13
- □ > 13
- □ Do not know

5. How many people perform the assessments on your ward? (including yourself)*

- □ 1
- □ 2
- □ 3
- □ > 3
- □ Do not know
- □ Other,……..

6. How much time is allocated by your ward to perform the assessments?*

- □ No time
- □ ≥ ½ day per quarter
- □ Do not know
- □ Other,……..

7. What is the time investment of the assessments?*

- □ Costs too much time
- □ A lot of time but not too much
- □ Not a lot of time
- □ Other,……..

8. How do you perform the assessments? (multiple answers allowed)*

- ○ Between daily activities
- ○ For a consecutive period of half/one day
- ○ Other,……..

9. During which shifts do you perform the assessments? (multiple answers allowed)*

- ○ Day
- ○ Evening
- ○ Night

10. How important are the assessments?*

- □ Not important
- □ Moderately important
- □ Fairly important
- □ Very important

11. How is the compliance data followed up? (multiple answers allowed)*

- ○ Are submitted to the infection control department
- ○ Are used to set improvement goals
- ○ Do not know
- ○ Other,……..

12. How do you rate your competence of performing the assessments?*

Not competent ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9 ○10 Highly competent

13. Do you experience problems with performing the assessments? (multiple answers allowed)*

- ○ No
- ○ Yes, it is difficult to recognise HH indications
- ○ Yes, it is difficult to use the HH monitoring tool
- ○ Other,……..

14. Do you have any comments on the hand hygiene compliance assessments?

……

Practice-based questions

We will now ask you five practice-based questions. Assess whether an HH action is needed and the corresponding HH indication(s).

15. The doctor listens to the lungs with a stethoscope and then leaves the room. Do you need to disinfect your hands between these two situations? (multiple answers allowed)*


- Yes, before patient contact
- Yes, before performing an aseptic procedure
- Yes, after exposure to body fluids
- Yes, after patient contact
- Yes, after contact with patient's surroundings
- No

16. The nurse disinfects her hands, checks the infusion bandage, and helps the patient with putting on his bathrobe. Do you need to disinfect your hands between these two situations? (multiple answers allowed)*


- Yes, before patient contact
- Yes, before performing an aseptic procedure
- Yes, after exposure to body fluids
- Yes, after patient contact
- Yes, after contact with patient's surroundings
- No

17. The nurse removes the wound dressing, removes her gloves, and tends to the wound. Do you need to disinfect your hands between these two situations? (multiple answers allowed)*


- Yes, before patient contact
- Yes, before performing an aseptic procedure
- Yes, after exposure to body fluids
- Yes, after patient contact
- Yes, after contact with patient's surroundings
- No

18. The doctor measures the blood pressure and then prepares an injection. Do you need to disinfect your hands between these two situations? (multiple answers allowed)*


- Yes, before patient contact
- Yes, before performing an aseptic procedure
- Yes, after exposure to body fluids
- Yes, after patient contact
- Yes, after contact with patient's surroundings
- No

19. The nurse helps the patient with putting on his shoes. Afterwards, she puts clean bed linen on the bed. Do you need to disinfect your hands between these two situations? (multiple answers allowed)*


- Yes, before patient contact
- Yes, before performing an aseptic procedure
- Yes, after exposure to body fluids
- Yes, after patient contact
- Yes, after contact with patient's surroundings
- No