Measurement and interpretation of hand hygiene compliance rates: importance of monitoring entire care episodes

M. Eveillard a,b,c,*, H. Hitoto a,b, F. Raymond b, A. Kouatchet d, L. Dubé e, V. Guilloteau f, M-T. Pradelle f, P. Brunel f, A. Mercat d, M-L. Joly-Guillou a,c

a Laboratoire de bactériologie-hygiène, Centre hospitalier universitaire, Angers, France
b Unité de prévention et de lutte contre les infections nosocomiales, Centre hospitalier universitaire, Angers, France
c Groupe d’étude des interactions hôtés-pathogènes (GEIHP, UPRES EA 3142), Université d’Angers, France
d Service de réanimation médicale, Centre hospitalier universitaire, Angers, France
e Service de réanimation chirurgicale, Centre hospitalier universitaire, Angers, France
f Réseau ANJELIN, Centre régional de rééducation et de réadaptation fonctionnelle, Angers, France

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KEYWORDS
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Summary Our objective was to assess the importance of monitoring hand hygiene compliance (HHC) during series of successive contacts with patients or surroundings for measurement and interpretation of the compliance rates. A direct observational study of HHC was performed in four intensive care units (ICUs) and four healthcare settings with non-intensive care wards (NICWs). Hand hygiene (HH) opportunities were differentiated into two categories: extra-series opportunities (ESOs) (before or after a single contact, and before the first contact or after the last contact of a series of successive contacts) or as intra-series opportunities (ISOs) (from the opportunity following the first contact to the opportunity preceding the last in the same series). In all, 903 opportunities of HH were performed in ICUs and 760 in NICWs. The proportion of ISOs was 46.0% in ICUs and 22.9% in NICWs. The overall HHC was significantly higher in NICWs than in ICUs (61.2% vs 47.5%, P < 0.00001). The HHC was significantly higher for ESOs than for ISOs (67.7% vs 28.5%, P < 0.00001). The HHC for ISOs was significantly higher in ICUs (32.2% vs 19.0%, P < 0.005). If the distribution of
categories of HH opportunities observed in NICWs had been the same as in ICUs, the overall HHC would have been similar in NICWs (46.4%) and in ICUs (47.5%). Monitoring HHC during entire care episodes in series of successive contacts is necessary to avoid a strong overestimation of the overall compliance rates. Concurrently, comparison of compliance data should take into account the proportion of ISOs included in the evaluation study. © 2009 The Hospital Infection Society. Published by Elsevier Ltd. All rights reserved.

Introduction

The effectiveness of hand hygiene (HH) has been demonstrated in a number of studies, in which decreased transmission of infection has occurred as HH compliance increases.1–3 Although healthcare worker compliance with HH guidelines is the cornerstone of infection prevention, the overall proportion of adherence remains unacceptably low, usually much less than 50% in most hospitals.4–7

Monitoring of practices and performance feedback represent one of the five components (with staff education, reminders in the workplace, adoption of an institutional safety climate and the preferential recourse to the use of alcohol-based hand rub instead of hand washing) which should be included in multimodal strategies implemented to improve compliance and decrease the rate of cross-transmission and infection.8 Approaches to monitoring HH include direct observation, self-reporting by healthcare workers, measurement of HH product usage, and electronic methods. However, no ideal method of monitoring HH compliance has been developed.9 Direct observation is usually considered to be the ‘gold standard’. This method has some well-known limits, such as the possibility that staff members change behaviour when they know that they are being observed (Hawthorne effect) or its labour intensiveness.10 Moreover, according to certain authors, monitoring compliance should be performed during complete care episodes including several successive contacts with patients and their environment, and not only before or after completing the entire care episodes.10

Our objective was to assess the importance of monitoring HH compliance during such series of successive contacts with patients or environment for measurement and interpretation of the global hand hygiene compliance in an evaluation study. Numerous studies have been devoted to adherence to HH among hospital staff, but less attention has been paid to the difference between the correct and incorrect use of alcohol-based hand rub before and after performance of a clinical procedure.11,12 Therefore, the correct use of hand rub was also evaluated and compared before and after single contacts and within series of successive contacts.

Methods

Study design

A direct observational study of compliance with HH was conducted. The measures reported were the number of HH episodes/number of HH opportunities and the quality of hand rubbing when that was the technique employed for HH.

Settings

The study was performed in four intensive care units (ICUs) (three medical ICUs and one surgical ICU) of a 1500-bed teaching hospital (Angers, France) and in four healthcare settings with rehabilitation units, medical wards and long-term care facilities, located in Angers or its surroundings, and belonging to an infection control network called ANJELIN. The teaching hospital does not belong to this network, but provides advice, and administrative or technical assistance.

Definitions

HH opportunities were defined according to the ‘Your 5 moments for hand hygiene’ leaflet from the World Health Organization (i.e. before patient contact, before aseptic task, after body fluid exposure risk, after patient contact, and after contact with patient surroundings).13 For each HH opportunity, HH was considered completed if hand washing or hand rubbing with an alcohol-based product (solution or gel) was performed.

Because all the steps of hand hygiene were not recorded to evaluate the correct use of alcohol-based hand rub, it was only defined as the use of an adequate amount of solution or gel [two dispenser pump strokes (2–3 mL)] and hand rubbing for ~30 s all over the hand surface.
Contacts were differentiated into simple contacts with the patient or environment (e.g., patient auscultation or any contact with the patient’s intact skin, contacts with hand touch sites near the hospitalised patient), contacts with body fluids, and contacts with critical anatomical sites (like an invasive device) for which any contamination can be the origin of colonisation and potentially subsequent infection.

To assess the impact of considering series of successive contacts for the interpretation of compliance data, HH opportunities were differentiated as extra-series opportunities (before or after a single contact, and before the first contact and after the last contact of a series of successive contacts) or as intra-series opportunities (from the opportunity following the first contact to the opportunity preceding the last contact of a series of successive contacts).

For a single contact, two HH opportunities (one before and one after contact) were considered whereas only one HH opportunity was considered between successive contacts.

### Organisation of the evaluation study

Practices were monitored by external observers who were infection control nurses, hospital epidemiologists or healthcare workers with an experience in the field of infection prevention. In practice, when a healthcare worker entered a patient’s room, HH opportunities were monitored until the worker left the room. Thus, the occurrence of a single contact or a series of successive contacts and the number of those contacts only depended upon the healthcare workers’ activities in the patient’s room, and therefore were not predetermined. Finally, data acquisition and analysis were centralised in the infection control unit of the teaching hospital.

### Data analysis

Data acquisition and analysis were performed with the Epi-Info software version 6.04 (Centers for Disease Control, Atlanta, GA, USA). A first analysis was performed with data recorded in the study. In a second analysis, the overall compliance of HH was recalculated by applying the distribution of hand hygiene opportunities recorded in ICUs according to their position around contacts or inside series of successive contacts. Compliance rates were presented with their 95% confidence intervals (CIs). Comparisons of compliance rates were performed by using the $\chi^2$-test or the Fisher exact test as appropriate.

### Results

In all, 1126 contacts representing 1663 opportunities of HH were observed. Among those opportunities, 903 (54.3%) were ICUs in the teaching hospital and 760 (45.7%) concerned non-intensive care wards in the other settings. In the NICWs, the proportion of simple contacts in all contacts observed was 63.2% whereas it was 59.8% in ICUs. The proportion of series of consecutive contacts was significantly higher in ICUs (49.2% vs 23.6%; $P < 0.00001$). Mean numbers of contacts by series were 3.9 for the observations performed in ICUs (range: 2–22) and 2.6 in NICWs (range: 2–8).

Finally, the proportions of intra-series opportunities were 46.0% in ICUs and 22.9% in NICWs.

Compliances with HH are presented in Table I. Overall, compliance in ICUs was 47.5% (95% CI: 44.2–50.8%) whereas it was 61.2% (57.7–64.7%) in NICWs ($P < 0.00001$). The compliance with HH was significantly higher for extra-series opportunities than for intra-series opportunities (67.7% vs 28.5%; OR: 0.19; 95% CI: 0.15–0.24; $P < 0.00001$). This difference was recorded for both ICUs and NICWs. The compliance in intra-series opportunities was significantly higher in ICUs (32.2% vs 19.0%; OR: 2.04; 95% CI: 1.30–3.21; $P < 0.005$). In ICUs, the compliance for intra-series opportunities was $\sim 30\%$ whatever the rank of the contact inside the series. In the other wards, this compliance increased after the fourth contact in series with four contacts or more (Figure 1). The proportion of series of successive

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**Table I** Hand hygiene compliance in single contacts and series of successive contacts

<table>
<thead>
<tr>
<th>Hand hygiene compliance</th>
<th>Intensive care units</th>
<th>Non-intensive care wards</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before a single contact</td>
<td>42.7% (53/124)</td>
<td>75.9% (170/224)</td>
<td>64.1% (223/348)</td>
</tr>
<tr>
<td>After a single contact</td>
<td>64.0% (80/124)</td>
<td>78.6% (176/224)</td>
<td>73.6% (256/348)</td>
</tr>
<tr>
<td>Before the first contact in a series of successive contacts</td>
<td>53.3% (65/120)</td>
<td>63.8% (44/69)</td>
<td>57.7% (109/189)</td>
</tr>
<tr>
<td>After the last contact in a series of successive contacts</td>
<td>79.5% (97/120)</td>
<td>60.9% (42/69)</td>
<td>73.5% (139/189)</td>
</tr>
<tr>
<td>Between two contacts in a series of successive contacts</td>
<td>32.2% (134/415)</td>
<td>19.0% (33/174)</td>
<td>28.5% (167/589)</td>
</tr>
</tbody>
</table>
contacts with a full hand hygiene compliance (compliance before the first contact, between each contact in the same series and after the last) was low in both ICUs (10.1%) and NICWs (11.4%) (Figure 2). Overall, there was a better full compliance for short series (three or fewer contacts) than for longer series (more than three contacts) (16.8% vs 1.4% respectively; \( P < 0.00001 \)).

In ICUs, 27.5% of HH opportunities concerned single contacts, 26.5% occurred before the first and after the last contact of a series of successive contacts, and 46.0% occurred between two contacts in a series of successive contacts (intra-series opportunities). If the distribution of HH opportunities according to their position around contacts (before or after a single contact, or before or after a series) or within series of successive contacts had been similar in both NICWs and ICUs, the overall compliance with HH in the former would have dropped from 61.2% to 46.4% (OR: 0.55; 95% CI: 0.45–0.68;
Discussion

This is the first study comparing HH compliance in single contacts and in series of successive contacts during entire care episodes. We identified a marked loss of compliance for contacts occurring within series (intra-series contacts). It is noticeable that among the 24 series containing more than three successive contacts in NICWs, full hand hygiene compliance was recorded in only one. This difference between extra- and intra-series contacts has some consequences for both the estimation of the risk of micro-organism dissemination and for the interpretation of overall compliance.

The risk of cross-transmission essentially depends upon the compliance of HH before and after a single contact or a series of successive contacts, whereas the compliance between contacts in the same series has a major role for the control of organism transmission from one anatomical site to another in the same patient, with a high risk of infection if critical sites such as invasive device are contaminated by micro-organisms carried by healthcare workers’ hands from sites naturally colonised. According to our data, there was a better control of the risk of cross-transmission in NICWs than in ICUs, because HH compliance was greater in the former group than in the latter. This could be explained in part by the high workload usually encountered in ICUs. Indeed, numerous studies have identified high workload as a factor associated with potential transmission of microorganisms and poor compliance with HH.14–16 In addition, Hugonnet et al. found that HH compliance decreased on average by 4.7% for an increase in 10 opportunities of HH per hour of patient care.17

Among the wards included in our study, it is probable that the density of HH opportunities was higher in ICUs than in NICWs. Concurrently, the prevention of the infectious risk from the patient’s own flora was more controlled in ICUs. This could be explained in part by a greater perception of the risk associated with invasive devices by healthcare workers in charge of patients in critical care, and by the absence of invasive device in the NICWs.
included in the study. In those latter wards, the strong difference in HH compliance between intra- and extra-series opportunities is consistent with the differences between inherent and in-hospital elective hand washing behaviours developed by Whitby et al. Indeed, according to these authors, elective hand washing is predicted by healthcare workers’ beliefs in the benefits of the activity for the patient’s outcome. In the NICWs participating in our study, the infectious risk associated with series of successive contacts in the same patient was probably less perceived by healthcare workers than the risk of cross-transmission from one patient to another. Therefore, in these wards, the compliance with HH between contacts with the same patient was probably more governed by inherent behaviour than by elective behaviour. The lack of difference concerning the quality of hand rubbing in intra- and extra-series opportunities in ICUs is consistent with this hypothesis.

Our results also demonstrated the necessity of differentiating single contacts or series of successive contacts and intra- and extra-series opportunities for the interpretation of the global compliance rates. In our study, the comparison of rates in ICUs and NICWs particularly highlights this requirement. Indeed, whereas there was a strong and significant difference between those two groups without any adjustment on the proportion of intra- and extra-series contacts, the overall rates were similar after such an adjustment. Similarly, a risk associated with a lack of observation of intra-series opportunities in an evaluation study is an overestimation of the global compliance.

One can argue that many simple contacts were observed within series of successive contacts. Those simple contacts often occurring with the patient’s environment certainly represented a lower risk for micro-organism acquisition than a contact with an invasive device, and perhaps could be considered as insignificant for the analysis of compliance. However, several studies demonstrated the importance of the environment in micro-organism acquisition, particularly for meticillin-resistant Staphylococcus aureus, Clostridium difficile or vancomycin-resistant enterococci. Bhalla et al. have demonstrated the acquisition of nosocomial pathogens on hands after contact with environmental surfaces near hospitalised patients. Thus, HH should be performed before and after such contacts, as recommended by the ‘Your five moments for hand hygiene’ programme.

One limitation of our study was that healthcare workers were aware of being observed. Therefore, the overall compliance was potentially overestimated. This probably had less influence on the difference recorded between intra- and inter-series adherences than on the level of overall compliance. Other disadvantages of monitoring hand hygiene compliance by direct observation (e.g. a labour-intensive technique, with potential interference with patient privacy) were encountered during the study, but probably had only a weak impact on the results.

In conclusion, monitoring HH compliance during series of successive contacts is relevant because patients probably do not benefit from partial compliance with HH procedures. Moreover, differentiating single contacts or intra- and extra-series opportunities in sequences of successive contacts is useful for improving the evaluation of the risks of cross-transmission or infection acquisition and is necessary for improving the interpretation of the global compliance rates, particularly when comparisons are envisaged in evaluative studies.

Conflict of interest statement
None declared.

Funding sources
None.

References
Monitoring hand hygiene compliance


