



# Hand hygiene after touching a patient's surroundings: the opportunities most commonly missed

G. FitzGerald, G. Moore, A.P.R. Wilson\*

Department of Microbiology & Virology, University College London Hospitals NHS Foundation Trust, London, UK

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## SUMMARY

**Background:** Healthcare workers generally underestimate the role of environmental surfaces in the transmission of infection, and compliance with hand hygiene following contact with the environment is generally lower than following direct patient contact. To reduce the risk of onward transmission, healthcare workers must identify the need to wash hands with specific tasks or events.

**Aim:** To observe the movement of staff in critical care and general wards and determine the routes most commonly travelled and the surfaces most frequently touched with and without appropriate hand hygiene.

**Methods:** Fifty-eight 90 min sessions of unobtrusive observation were made in open bays and isolation rooms. Link analysis was used to record staff movement from one location to another as well as the frequency of motion. Hand-hygiene audits were conducted using the World Health Organization 'five moments for hand hygiene' observational tool.

**Findings:** In critical care, the majority of movement occurred within the bed space. The bedside computer and equipment trolley were the surfaces most commonly touched, often immediately after patient contact. In the general ward, movement between bed spaces was more common and observed hand hygiene ranged from 25% to 33%. Regardless of ward type, observed hand-hygiene compliance when touching the patient immediately on entering an isolation room was less than 30%.

**Conclusions:** Healthcare workers must be made aware that bacterial spread can occur even during activities of perceived low risk. Education and intervention programmes should focus on the potential contamination of ward computers, case notes and door handles.

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## Introduction

During routine patient care, the hands of a healthcare worker can become heavily contaminated.<sup>1,2</sup> Inadequate hand hygiene when caring for a single patient or when moving between

patients can lead to the cross-transmission of pathogens.<sup>3</sup> To interrupt microbial transmission effectively, hand hygiene is required at pivotal points during the patient care sequence. These have been defined by the World Health Organization (WHO) as being the 'five moments for hand hygiene' and they emphasize the importance of hand hygiene before and after patient contact, before performing a clean/aseptic technique and after exposure to body fluids. The 'fifth moment for hand hygiene' occurs after touching a patient's surroundings.<sup>4</sup>

Patients contaminate their immediate environment and the ease with which bacteria can be acquired from environmental

\* Corresponding author. Address: Department of Microbiology & Virology, University College London Hospitals, 60 Whitfield Street, London W1T 4EU, UK. Tel.: +44 (0) 20 344 79516; fax: +44 (0) 20 344 79211.

E-mail address: [peter.wilson@uclh.nhs.uk](mailto:peter.wilson@uclh.nhs.uk) (A.P.R. Wilson).

surfaces by the hands or gloves of healthcare workers has been demonstrated.<sup>5,6</sup> If these include potential pathogens, the reservoirs that develop on nearby surfaces represent a risk factor for onward transmission. Although the role of environmental surfaces in the transmission of infection is acknowledged within the 'five moments', this knowledge may not be sufficiently widespread among healthcare workers.<sup>7,8</sup> Studies have demonstrated that whereas the majority of hand-hygiene opportunities occur after contact with a patient's surroundings, these opportunities are also those most commonly missed (i.e. are associated with the lowest levels of compliance).<sup>9–11</sup>

To improve hand-hygiene compliance, interventions should provide the cues healthcare workers use to identify the need to clean their hands while also providing the ability to perform hand hygiene – for example, locating alcohol gel dispensers en route to a task where hand hygiene is required.<sup>12</sup> These cues should be tied to specific events or tasks rather than to general behaviour.<sup>12</sup> As a result, appropriate cues/interventions may differ with ward type, isolation precautions and/or professional group. The aim of this investigation was to observe the movement of staff in critical care and general wards and, with a view to focus hand-hygiene training, to determine the routes most commonly travelled and the surfaces most frequently touched together with associated hand-hygiene compliance.

## Methods

### Study setting

The study was performed on the medical–surgical intensive care unit (ICU) and on a gastrointestinal ward of a London teaching hospital between August and December 2009. The ICU comprised 11 single rooms; four bays of five beds and one bay of four beds. The median bed centre to bed centre distance was 3.6 m. The gastrointestinal ward comprised seven single rooms; three bays of five beds and 10 bays of four beds with 2.7 m bed spacing. All bed spaces had ready access to a handwash sink, paper towels and alcohol hand rub.

### Observation of staff movement and hand hygiene

During the 17-week study period, fifty-eight 90 min sessions of unobtrusive observation were made in open bays and isolation rooms. Observation of activity in ICU was problematic for the most ill patients because of the number of staff involved. In some cases only a specific bed area could be observed at one session.

Link analysis is a straightforward technique used to record and visualize staff movement from one location to another as well as the frequency of motion.<sup>13</sup> A map of the observed area (bay; bed space; isolation room) was made, and, as staff moved from one location to the next, an activity log was generated detailing the time of observation, the physical location where the task/activity occurred and the associated hand-hygiene opportunity.

Hand-hygiene audits were conducted using the WHO 'five moments for hand hygiene' observational tool.<sup>4</sup> Alcohol is ineffective against *Clostridium difficile*.<sup>14</sup> As such, if the patient had a diarrhoeal disease and alcohol gel was used rather than soap and water, this was recorded as a missed opportunity. Covert observation was not practicable as the

research nurse was known to the staff on the wards and his role in observing hand hygiene was clear to all.

### Analysis of results

The link analysis was used to describe the movement of staff within the bay or bed space in terms of sequential events (e.g. equipment trolley → patient; patient → computer; computer → patient; patient → sink). Pivot tables were constructed in Microsoft Excel 2007 and used to determine the routes most travelled and the surfaces of highest contact with and without appropriate hand hygiene.

## Results

### Intensive care unit

Fourteen 90 min observation sessions were conducted within an ICU bay. Hand-hygiene compliance was 60% (based on observable outcomes). Of the 255 hand-hygiene opportunities identified, 101 (40%) occurred after contact with the environment. The sites most frequently touched were within the patient zone (i.e. the patient's immediate surroundings) and included the equipment trolley (211 contacts) and the computer keyboard (170 contacts). Movement between an equipment trolley and a patient was observed on 50 occasions (Table I). Hand-hygiene compliance when moving from a patient to a trolley was 11% (based on observable outcomes; 1/9). Observed hand-hygiene compliance when moving from a trolley to a patient was 43% (12/28). Healthcare workers were also observed to regularly move from a patient to the bedside computer (electronic records); the observed hand-hygiene compliance associated with this movement route was 14% (1/7).

Seventeen 90 min observation sessions were conducted within a single isolation room. Hand-hygiene compliance was 62% (169/271). In all, 154 people were observed to enter the room and 137 people were observed to leave; contact with the inner or outer door handle was thus observed on 291 occasions. Inside the room, the sites most commonly touched were the equipment trolley (183 contacts) and the computer keyboard (159 contacts). As in the bay, most movement was between the equipment trolley and the patient and observed hand-hygiene compliance was higher when moving from trolley to patient (68%) than from patient to trolley (29%; Table I). Observed hand-hygiene compliance when moving from a patient to the bedside computer was 22% (2/9).

### Gastrointestinal ward

Twenty 90 min observation sessions were conducted within an open bay on the gastrointestinal ward. Hand-hygiene compliance was 34% (106/310). Of those opportunities that were missed, 102 (50%) occurred after contact with a patient's surroundings. The sites most commonly touched were the bed (207 contacts) and the medical notes trolley (165 contacts). The nurse-to-patient staffing ratio in the ICU and gastrointestinal ward was 1:1 and 1:8 respectively and, as a consequence, staff movement between patients and/or bed spaces was more frequent in the gastrointestinal ward. Observed hand-hygiene compliance associated with these journeys was between 25% and 33% (Table II). Unlike in the ICU, most staff movement in

**Table I**

Staff movement within the intensive care unit: routes most travelled and associated hand-hygiene compliance

Route	Observed	Hand-hygiene	
Origin	no. of times route travelled	compliance <sup>a</sup>	
<b>Five-bedded bay</b>			
Equipment trolley	Patient <sup>b</sup>	38	43%
Apron dispenser <sup>b</sup>	Equipment trolley	23	33%
Patient	Bin <sup>b</sup>	16	90%
Patient <sup>b</sup>	Equipment trolley	12	11%
Patient <sup>b</sup>	Computer	10	14%
Bed <sup>b</sup>	Bay door (exit bay)	10	70%
<b>Single isolation room</b>			
Equipment trolley	Patient <sup>b</sup>	36	68%
Door (enters room)	Door (exits room) <sup>b</sup>	29	50%
Patient	Bin <sup>b</sup>	22	53%
Door (enters room)	Patient <sup>b</sup>	20	29%
Door (enters room)	Equipment trolley	17	NA
Door (enters room)	Computer	16	NA
Patient <sup>b</sup>	Computer	13	22%
Patient <sup>b</sup>	Door (exits room)	13	75%
Patient <sup>b</sup>	Equipment trolley	13	29%
Computer <sup>b</sup>	Door (exits room)	11	75%

NA, not applicable.

<sup>a</sup> Compliance based upon observed outcomes.<sup>b</sup> Hand-hygiene opportunity.

and around the gastrointestinal ward was observed to take place outside the patient zone (i.e. within the wider ward environment) and did not require hand hygiene (Table II). Movement between the patient toilet/shower facilities and the patient bed was observed on 26 occasions. However, the movement of patients in and around the ward was not the focus of the study and as such was underestimated.

Seven 90 min observation sessions were conducted within a single isolation room on the gastrointestinal ward. Activity levels were considerably less than that observed in the bay or in ICU. Sixty people were observed to enter the room and 34 people were observed to leave; contact with the inner or outer door handle was thus observed on 94 occasions. Staff activity within the isolation room was limited. Healthcare workers were most commonly observed to enter the room and to exit almost immediately, with or without first touching the patient (Table II). Hand-hygiene compliance after touching the patient's surroundings was 37.5% (9/24).

## Discussion

In the ICU and gastrointestinal ward, hand-hygiene compliance was 60% and 36% respectively. As in previous studies, the

**Table II**

Movement within the gastrointestinal ward: routes most travelled and associated hand-hygiene compliance

Route	Observed	Hand-hygiene	
Origin	no. of times route travelled	compliance <sup>a</sup>	
<b>Four-bedded bay</b>			
Patient toilet <sup>b</sup>	Bed	26	Unobserved
Medical notes trolley	Nurses' station	18	NA
Patient <sup>b</sup>	Patient <sup>b,c</sup>	13	33%
Medical notes trolley	Bay desk	13	NA
Nurses' station	Medical notes trolley	13	NA
Patient record folder <sup>b</sup>	Bay desk	12	14%
Bed <sup>b</sup>	Bed	12	25%
Patient <sup>b</sup>	Sluice room	11	50%
<b>Single isolation room</b>			
Door (enters room)	Door (exits room) <sup>b</sup>	16	50%
Door (enters room)	Patient <sup>b</sup>	12	20%
Patient	Bin <sup>b</sup>	4	25%
Patient <sup>b</sup>	Door (exits room)	2	0

NA, not applicable.

<sup>a</sup> Compliance based upon observed outcomes.<sup>b</sup> Hand-hygiene opportunity.<sup>c</sup> Hand hygiene indicated after patient contact and before next patient contact, although one episode of hand hygiene would fulfil both indications.

majority of missed hand-hygiene opportunities occurred after contact with a patient's surroundings.<sup>10,11</sup> The aim of this study was to determine which surfaces were most likely to be touched without appropriate hand hygiene.

The results of this study demonstrate how the movement patterns of staff differ in critical care and general wards. In the ICU, the one-nurse-per-bed policy reduced staff movement between bed spaces. In the gastrointestinal ward, movement from patient to patient or from bed to bed was more frequent. The observed hand-hygiene compliance associated with these movement routes was low (25–33%; Table II) and may have been due to the perceived low risk of the activity being performed (e.g. taking blood pressure; reading case notes).<sup>15</sup> Healthcare workers consistently misjudge the danger of surfaces.<sup>8</sup> However, extensive contamination of blood pressure cuffs can occur either through direct patient contact or inadequate staff hand hygiene.<sup>16,17</sup> Case records are unlikely to be cleaned and during a concurrent microbiological survey the record folders in the gastrointestinal ward were found to harbour high numbers of bacteria including meticillin-resistant *Staphylococcus aureus*, *Enterococcus* spp., *Escherichia coli* and *Acinetobacter baumannii* (unpublished data).

In the gastrointestinal ward, the nurse-to-patient staffing ratio was 1:8. Two nurses were observed to have particularly poor compliance with hand hygiene. Pharmacists frequently entered the patient zone to read medication charts and moved

from bed to bed without performing hand hygiene. Non-compliant peripatetic healthcare workers (i.e. healthcare workers with a large number and/or diverse number of contacts) may play a disproportionate role in disseminating pathogens in and around a hospital ward.<sup>18,19</sup> Education and raising the awareness of the risk of bacterial transfer from surfaces, even when conducting seemingly innocuous tasks, is important in rectifying such issues. Case record folders could be illustrated in such a way as to prompt healthcare workers to perform hand hygiene, and, where possible, ward rounds should be conducted using electronic means rather than moving from bed to bed.

In the ICU, patient records, notes and observation charts were stored and displayed electronically. A computer keyboard was located within every bed space – this piece of equipment and the bedside equipment trolley were the surfaces most frequently touched, often immediately after patient contact. The associated hand-hygiene compliance (Table I) suggests that significant bacterial transfer may occur from patient to either surface, which, if inadequately cleaned, could act as a source from which healthcare workers might contaminate their hands.

Several studies have reported heavy contamination of computer keyboards.<sup>20,21</sup> The keyboards in the ICU were designed to be easy-to-clean and incorporated a visual alarm to promote cleaning compliance.<sup>22</sup> However, a visual alarm is easy to ignore, and, if cleaning compliance is poor, even 'easy-to-clean' keyboards can become heavily contaminated. In an attempt to improve cleaning compliance, software that causes a cleaning reminder to appear on the monitor screen has been developed and is currently under trial. A similar strategy could be used to remind healthcare workers to perform hand hygiene after using ward computers.

In the ICU and gastrointestinal ward, observed hand-hygiene compliance when touching the patient immediately after entering an isolation room was 29% and 20% respectively (Table I and II). Hand hygiene should be performed before touching a patient.<sup>4</sup> Standard contact precautions require adequate hand hygiene to be performed before entering an isolation room. Although not observed (the research nurse was stationed inside the isolation room) the majority of staff probably washed/decontaminated their hands before entering the room and, because of this, considered the hand-hygiene opportunity fulfilled. However, studies have demonstrated that the handles used to enter an isolation room can become contaminated.<sup>23</sup> Hands decontaminated outside the room could become re-contaminated on entry, potentially leading to pathogens being transferred to the patient or to surfaces inside the room. Frequent and effective cleaning of door handles, particularly those associated with busy isolation rooms, is essential. Healthcare workers should be encouraged to perform hand hygiene before and after entering an isolation room. Alternatively, consideration should be given to alternative entry/exit systems [e.g. foot-operated or automatic (non-contact) doors].

Much emphasis has been placed on improving staff hand-hygiene compliance but patient hand hygiene must also be encouraged.<sup>24</sup> Previous studies have suggested that patient mobility can contribute greatly to the spread of bacteria within a ward.<sup>25</sup> In the gastrointestinal ward, the movement of patients between toilet/shower facilities and bed was frequent. Patients should be encouraged to clean their hands after using the toilet and when leaving and returning to their

bed space.<sup>24</sup> Appropriate hand-hygiene products should be visible and accessible. Providing each patient with hand sanitizer could be considered and would be acceptable to patients, but visual and verbal reminders are needed.<sup>24,26</sup>

Hand hygiene is central to the campaign to reduce hospital-acquired infection, and encouraging compliance is the main focus of infection control education within hospitals. Hand-hygiene compliance following contact with the environment is generally lower than that following other aspects of patient care. This study has recorded frequently performed contact patterns that may result in the spread of hospital pathogens, and the results could help focus hand-hygiene training and/or behaviour change. However, there were some limitations.

Staff were observed for 90 min sessions during the working day. The optimal period for monitoring hand-hygiene compliance is 60 min but it has been recommended that observations are timed to capture a complete picture of 24 h activity.<sup>27,28</sup> The number of staff and level of activity within the gastrointestinal isolation rooms was generally low, so that fewer observations could be collected and the likelihood of staff altering their behaviour as a direct result of being observed was increased.<sup>10</sup> Manual data capture was inadequate to record rapid multiple simultaneous activities and observation was often obscured by curtains or other objects. Continuous automatic contact monitoring is required and a system that can detect direct contact between healthcare worker and environmental surface and any subsequent hand hygiene has been evaluated.<sup>29</sup>

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## Conflict of interest statement

None declared.

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