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Meticillin-resistant *Staphylococcus aureus* contamination of healthcare workers' uniforms in long-term care facilities

P. Gaspard [a,*], E. Eschbach [a], D. Gunther [a], S. Gayet [b], X. Bertrand [c], D. Talon [c]

[a] *Equipe Inter-établissements d'Hygiène Hospitalière et de Gestion des Risques, Centre Hospitalier de Rouffach, Rouffach, France*
[b] *Centre Hospitalier Universitaire, Strasbourg, France*
[c] *Centre Hospitalier Universitaire, Besançon, France*

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Summary Meticillin-resistant *Staphylococcus aureus* (MRSA) and other multiply resistant bacteria are frequently isolated in long-term care facilities (LTCFs). This study evaluated the contamination of staff clothing in three LTCFs. Over 500 samples were taken from uniforms and their pockets and these samples showed a high level of MRSA contamination. Wearing plastic aprons and managing pocket contents improved the contamination rate. Our results highlight the continued importance of hand hygiene, since staff have frequent contact with their uniforms and could potentially contaminate their hands before care.

Introduction

Combating multi-drug resistant bacteria (MDRB), for example, meticillin-resistant *Staphylococcus aureus* (MRSA) and extended spectrum β-lactamase-producing organisms (ESBLs), remains a priority for healthcare services including long-term care facilities (LTCFs).[1–4] Once present, spread of these bacteria by cross-transmission should be prevented.[5] Currently, colonisation of patients in geriatric facilities is rarely monitored systematically and, in the case of asymptomatic carriers, the use of standard precautions is often the only possible means of control.[6–9]

* Corresponding author. Address: Equipe Inter-établissements d'Hygiène Hospitalière et de Gestion des Risques, Centre Hospitalier de Rouffach, 68250 Rouffach, France. Tel.: +33 89 78 74 47; fax: +33 89 78 70 00.
E-mail address: ph.gaspard@ch-rouffach.fr

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In this context, contamination of staff clothing is an important factor in geriatric LTCFs since close patient contact care is frequent and clothing can be a vector for transmitting organisms.[10] It is likely that the impact is even more significant because clothing could be a source of hand contamination with onward transmission.[11]

The aim of this study was to evaluate MRSA contamination of healthcare workers' (HCWs) uniforms in geriatric LTCFs and the influence of protective equipment and 'pocket control' education.

Methods

Study design

This was a descriptive study, evaluating MRSA contamination of HCWs' uniforms in three geriatric LTCFs and analysing the influence of protective equipment and 'pocket control' education. The LTCFs had similar demographics and procedures and were enrolled voluntarily. They were in three separate hospitals belonging to the same healthcare network (Acute Care Facility) in a geographical area of 15 square kilometres.

HCW uniforms were cleaned by specialist hospital laundries at a temperature $>70\,^{\circ}C$, using alkaline cleaning agents. Finishing tunnels at $140\,^{\circ}C$ for 3 min were used to dry uniforms. HCWs were required to change uniforms every work-shift.

The MRSA colonisation rate (anterior nares, perineal area and skin lesions) for patients in these three units was not significantly different: unit 1 [15.2% (5/33)], unit 2 [16.0% (8/50)], and unit 3 [17.9% (7/39)]. The average ages in each unit were 83.8, 86.2 and 85.1, respectively. During the study, standard precautions were routinely observed for all residents including hand hygiene and wearing gloves for contact with blood, body fluids (secretions, excretions, contaminated items, mucous membranes and non-intact skin) and environmental and device decontamination.

Instructions about the need to change work uniforms before every work-shift and clarity over use of plastic aprons were given at the beginning of each work-shift along with advice over pocket control. During each work-shift of the study, the hygiene team met each worker to check availability and use of plastic aprons. The hygiene team completed a questionnaire at the end of the work-shift to evaluate plastic apron use in relation to defined indications. HCWs were not included in the study if: their uniform was used for more than two work-shifts; there was no use of a plastic apron for a defined indication; the plastic apron was forgotten for more than five defined care activities; or worn continually for the whole work-shift. If HCWs noted that a plastic apron was not worn for one-to-five care, samples were performed and classified as 'partial compliance'. When plastic aprons were worn for all defined indications and all care, the practice was considered as 'total compliance'. Information about the project was given personally to every HCW by the hygiene team. This included use of plastic aprons and 'pocket control'.

The percentage of conformity was calculated: (number of situations with 'total compliance'/number of clothing samples included) $\times$ 100. For the uniforms, the percentage of use for one work-shift was calculated: (number of uniforms changed for the work-shift/number of uniforms included) $\times$ 100. The decontamination of pocket contents was evaluated: (number of pockets with content decontamination at the end of the work-shift/number of uniforms included) $\times$ 100. The pocket content recorded at the end of the work-shift allowed us to calculate the percentage compliance with instructions: (number of pockets managed in accordance with instructions/number of uniforms included) $\times$ 100.

Sampling strategy and microbiological procedure

Sampling of uniforms was performed in each unit between 12:00 and 13:00, to obtain contamination levels for the team at the end of the morning shift. Sampling occurred in units for an uninterrupted period (between Monday and Friday) ranging from 5 to 10 days. All nurses and care assistants (CAs) working during all periods in the units were included. Activity of nurses and CAs in relation to patient contact was defined and recorded.

'Zones' of uniforms reflecting points of contact with patients and the environment were identified as the upper part of the two pockets (2 cm high by 12.5 cm width, named 'pocket zone') and between the two pockets at the waist level (5 cm high by 10 cm width, named 'waist zone'). In addition to being points of contact with patients and the environment, these zones were also associated with hand contact by HCWs. One swab was used for the pockets and one for the area between the two pockets. Microbiological samples were taken using swabs with Stuart liquid (BD Diagnostics, Franklin Lakes, NJ, USA). Swabbing was standardised by rolling the swab over the sampling area for 20 s per site. Swab samples were enriched by incubation for 24 h at $37\,^{\circ}C$ in brain heart infusion

broth. Samples were plated on BBL CHROMagar® MRSA medium (BD Diagnostics). The presence of *S. aureus* was confirmed in every case by a BD Staphyloslide agglutination test (BD Diagnostics). The percentage of positive MRSA isolates in each 'pocket zone' or 'waist zone' was calculated.

Data analysis

Data analysis was performed by using the χ^2 and Fisher's exact test for categorical variables. $P \leq 0.05$ was considered to be significant. The statistical analysis was performed with the XLSTAT (version 2006) and the Open Source application R (version 2007) softwares.

Results

MRSA 'waist zone' contamination

In all, 256 samples were taken, 90 from nurses and 166 from CAs.

Table I indicates MRSA contamination at the 'waist zone' with and without plastic apron protection. When care was provided without protection, MRSA contamination ranged from 27.3% to 80.0%. Wearing plastic aprons during care recognised as being 'wet/dirty', e.g. washing, changing and/or dressing, is not sufficient to significantly reduce MRSA 'waist zone' contamination. Low contamination rates were seen for carers wearing aprons engaged in meal assistance (8.7% versus 34.9% and 31.2%, $P = 0.001$) and biological sampling (nevertheless with $P > 0.05-10.0$ versus 31.8% and 43.7%, $P = 0.07$).

MRSA 'pocket zone' contamination

In all, 256 samples were taken, 90 from nurses and 166 from CAs (Table II).

The level of MRSA contamination of pockets was high, with rates ranging from 18.1% to 60.0% when pocket use was not controlled. Only one of our units (unit 1) managed to stop CAs using their pockets at all. The pocket control evaluation

Table I 'Waist zone' contaminations in relation to the plastic apron uses and the healthcare worker activities

Staff qualification (activities in relation to patients during the work-shift)	Indication for wearing aprons	Unit or total	No. of uniforms changed for the work-shift/*N*[a] (%)	No. of samples with 'total compliance'/*N* (%)	No. of MRSA-positive clothing/*N* (%)	*P*[b]
Care assistant (washing, changing, meal assistance)	No protection	2	15/16 (93.8)	—	5/16 (31.2)	0.001
		Total	15/16 (93.8)	—	5/16 (31.2)	
		Control unit	13/13 (100.0)	—	0/13 (0.0)	
	Washing and changing	2	23/23 (100.0)	15/23 (65.2)	7/23 (30.4)	
		3	19/20 (95.0)	20/20 (100.0)	8/20 (40.0)	
		Total	42/43 (97.7)	35/43 (81.4)	15/43 (34.9)	
	Washing and changing and meal assistance	1	22/28 (78.6)	28/28 (100.0)	4/28 (14.3)	
		2	27/29 (93.1)	25/29 (86.2)	2/29 (6.9)	
		3	23/23 (100.0)	23/23 (100.0)	1/23 (4.3)	
		Total	72/80 (90.0)	76/80 (95.0)	7/80 (8.7)	
		Control unit	14/14 (100.0)	14/14 (100.0)	0/14 (0.0)	
Nurse (dressing, biological sampling, administering medicine)	No protection	2	9/11 (81.8)	—	3/11 (27.3)	0.07
		3	5/5 (100.0)	—	4/5 (80.0)	
		Total	14/16 (87.5)	—	7/16 (43.7)	
		Control unit	14/15 (93.3)	—	0/15 (0.0)	
	Dressing	2	9/9 (100.0)	5/9 (55.5)	3/9 (33.3)	
		3	9/13 (69.2)	8/13 (61.5)	4/13 (30.8)	
		Total	18/22 (81.8)	13/22 (59.1)	7/22 (31.8)	
	Dressing and biological sampling	1	6/7 (85.7)	3/7 (42.8)	0/7 (0.0)	
		2	8/8 (100.0)	5/8 (62.5)	1/8 (12.5)	
		3	5/5 (100.0)	2/5 (40.0)	1/5 (20.0)	
		Total	19/20 (95.0)	10/20 (50.0)	2/20 (10.0)	
		Control unit	16/17 (94.1)	17/17 (100.0)	0/17 (0.0)	

[a] N = number of uniforms included.
[b] P values for the comparison of total percentages (MRSA contamination) in relation to the indications for wearing aprons corresponding to the care assistant or nurse activities.

Table II 'Pocket zone' contaminations in relation to the pocket contents and the healthcare worker activities

Staff qualification (activities in relation to patients during the work-shift)	Pocket contents	Unit or total	Indication for wearing plastic aprons[a]	No. of pocket contents with decontamination/ N[b] (%)	No. of MRSA-positive clothing/N (%)	P[c]
CA (washing, changing, meal assistance)	No control (key, telephone, pen, scissor, gloves, notebook, personal objects, etc.) and no decontamination	2	NP	—	8/16 (50.0)	0.0003
		Total	—	—	8/16 (50.0)	
		Control unit	NP	—	0/13 (0.0)	
	Content control (key, telephone, pen, scissor) and decontamination after the work-shift	2	WC	20/23 (87.0)	6/23 (26.1)	
		2	WCM	15/29 (51.7)	8/29 (27.6)	
		Total		35/52 (67.3)	14/52 (26.9)	
	Content control (scissor, pen, key) and decontamination after the work-shift	3	WC	23/23 (100.0)	2/23 (8.7)	
		3	WCM	20/20 (100.0)	2/20 (10.0)	
		Total	—	43/43 (100.0)	4/43 (9.3)	
		Control unit	WCM	14/14 (100.0)	0/14 (0.0)	
	Nothing in the pockets	1	WCM	—	1/28 (3.6)	
		Total	—	—	1/28 (3.6)	
Nurse (dressing, biological sampling, administering medicine)	No control (key, telephone, pen, scissor, gloves, notebook, personal objects, etc.) and no decontamination	2	NP	—	2/11 (18.1)	0.24
		3	NP	—	3/5 (60.0)	
		Total	—	—	5/16 (31.2)	
		Control unit	NP	—	0/15 (0.0)	
	Content control (key, telephone, pen, scissor) and decontamination after the work-shift	2	D	7/9 (77.8)	3/9 (33.3)	
		2	DB	7/8 (87.5)	1/8 (12.5)	
		3	D	13/13 (100.0)	5/13 (38.5)	
		3	DB	5/5 (100.0)	1/5 (20.0)	
		Total	—	32/35 (91.4)	10/35 (28.6)	
		Control unit	DB	17/17 (100.0)	0/17 (0.0)	
	Content control (scissor, pen, key) and decontamination after the work-shift	1	DB	7/7 (100.0)	0/7 (0.0)	
		Total	—	7/7 (100.0)	0/7 (0.0)	

[a] NP, no protection; W, washing; C, changing; M, meal assistance; D, dressing; B, biological sampling.
[b] N = number of uniforms included.
[c] P values for the comparison of total percentages (MRSA contamination) in relation to the pocket contents corresponding to the care assistant or nurse activities.

shows good compliance with a high percentage of conformity: 99.2% for the CAs (122/123 in units 1, 2 and 3) and 90.5% for the nurses (38/42 in units 1, 2 and 3). The percentage of content decontamination was >90.0% except for unit 2 (67.3%).

Discussion

The environment of patients colonised and/or infected by MDRB, such as MRSA, frequently becomes contaminated. Some studies have specifically looked at staff clothing.[12–20]

Care in LTCFs involves many instances of very close contact between staff, patients and their environment, explaining the high rates of clothing contamination in our study. This contamination can function as a reservoir, since pockets and their contents can contaminate carers' hands. Similarly, clothing can act as a vector through contact between the patient and the 'waist zone' during care where aprons are not worn.

Low contamination rates were observed when the wearing of a plastic apron and pocket use control were implemented. However, low results were obtained only when aprons were worn by all the nurses and CAs during activities with frequent contact with patients and their environment, e.g. CAs (washing, changing and meal assistance) and nurses (dressing and biological sampling). Contamination control was limited for nurses because their activities are more diversified, e.g. medicine administration does not require apron wearing. Even in the absence of visible soiling, it was noted that uniforms become frequently contaminated.[21,22] Plastic aprons can indirectly improve the contamination of pockets by reducing their exposure during care, although the reduction in MRSA contamination of the waist zone was not correlated with a low pocket contamination rate. Consequently, managing pocket contents and their use is essential. Reorganising our departments enabled the elimination of pockets for carrying equipment such as gloves and notebooks by CAs, allowing contamination levels of $\leq$10%. The effect, however, was very limited. Other factors such as MRSA carriage by HCWs, poor hand hygiene and frequent use of the telephone during care may also be important.

Some of our results indicate that the use of protective aprons in combination with managing pocket content and use can lead to lower uniform contamination rates and consequently help to reduce the risk of dissemination. Boyce *et al.* reported on an outbreak of vancomycin-resistant enterococci that was controlled in this way, after the use of gloves and hand washing on their own had been ineffective.[23] Other papers have also implicated clothing contamination in outbreaks including *Clostridium difficile*.[3,4,24]

MRSA pocket contamination made us aware of the importance of providing information on clothing contamination to HCWs, in order to allow a better understanding of the risk and improve practice.[25]

In conclusion, this study evaluated the way in which uniforms can be protected with plastic aprons and 'pocket control' during HCW activities in a geriatric LTCF. High MRSA clothing contamination rates were observed in the three LTCFs even when MRSA-colonised patients were not identified. Clothing protection and 'pocket content control' are important, simple and affordable measures that can help to reduce the risk of MDRB spread. These results also confirm the importance of effective hand hygiene since HCWs have frequent contact with their uniform, potentially contaminating their hands before caring for patients.

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Conflict of interest statement
None declared.

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