The misuse and overuse of clinical gloves: a validated audit tool to define the problem

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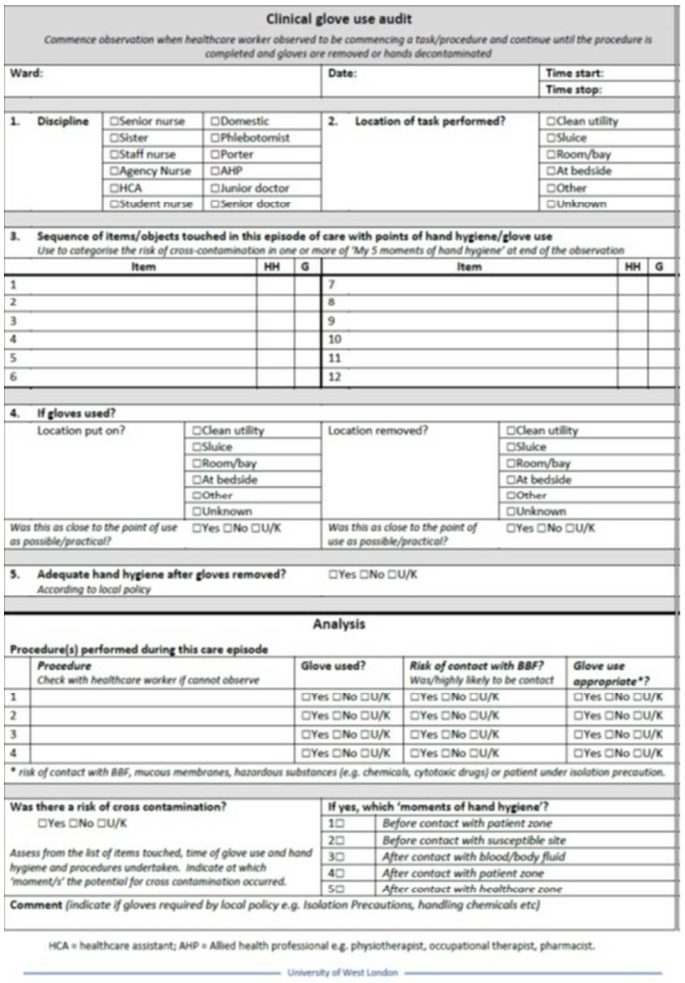

Clinical glove use audit

Commence observation when healthcare worker observed to be commencing a task/procedure and continue until the procedure is completed and gloves are removed or hands decontaminated

Ward:	Date:	Time start:
		Time stop:

1. Discipline			2. Location of task performed?	
	☐Senior nurse	☐Domestic		☐Clean utility
	☐Sister	☐Phlebotomist		☐Sluice
	☐Staff nurse	☐Porter		☐Room/bay
	☐Agency Nurse	☐AHP		☐At bedside
	☐HCA	☐Junior doctor		☐Other
	☐Student nurse	☐Senior doctor		☐Unknown

3. Sequence of items/objects touched in this episode of care with points of hand hygiene/glove use

Use to categorise the risk of cross-contamination in one or more of 'My 5 moments of hand hygiene' at end of the observation

Item	HH	G	Item	HH	G
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

4. If gloves used?

Location put on?		Location removed?	
	☐Clean utility		☐Clean utility
	☐Sluice		☐Sluice
	☐Room/bay		☐Room/bay
	☐At bedside		☐At bedside
	☐Other		☐Other
	☐Unknown		☐Unknown
Was this as close to the point of use as possible/practical?	☐Yes ☐No ☐U/K	*Was this as close to the point of use as possible/practical?*	☐Yes ☐No ☐U/K

5. Adequate hand hygiene after gloves removed? ☐Yes ☐No ☐U/K

According to local policy

Analysis

Procedure(s) performed during this care episode

	Procedure *Check with healthcare worker if cannot observe*	Glove used?	*Risk of contact with BBF?* *Was/highly likely to be contact*	*Glove use appropriate*?*
1		☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K
2		☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K
3		☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K
4		☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K	☐Yes ☐No ☐U/K

** risk of contact with BBF, mucous membranes, hazardous substances (e.g. chemicals, cytotoxic drugs) or patient under isolation precaution.*

Was there a risk of cross contamination? ☐Yes ☐No ☐U/K	If yes, which 'moments of hand hygiene'?	
Assess from the list of items touched, time of glove use and hand hygiene and procedures undertaken. Indicate at which 'moment/s' the potential for cross contamination occurred.	1☐	*Before contact with patient zone*
	2☐	*Before contact with susceptible site*
	3☐	*After contact with blood/body fluid*
	4☐	*After contact with patient zone*
	5☐	*After contact with healthcare zone*

Comment *(indicate if gloves required by local policy e.g. Isolation Precautions, handling chemicals etc)*

HCA = healthcare assistant; AHP = Allied health professional e.g. physiotherapist, occupational therapist, pharmacist.

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Figure 1: The glove use audit tool
216x212mm (96 x 96 DPI)

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Abstract

Background: The use of clinical gloves has become routine in the delivery of healthcare, often for procedures for which they are not required, their use may increase the risk of cross-contamination, and is generally not integrated into hand hygiene audit. This paper describes a small-scale application and validation of an observational audit tool devised to identify inappropriate glove-use and potential for cross-contamination.

Methods: Two observers simultaneously observed the glove-use during episodes of care in an acute hospital setting. The inter-rater reliability (IRR) of the audit tool was measured corrected for chance agreement using kappa.

Results: A total of 22 of episodes of care using gloves were observed. In 68.6% (24/35) of procedures there was no contact with blood/body fluid; in 54.3% (19/35) glove-use was inappropriate. The IRR was 100% for eight of 12 components of the tool. For hand hygiene before and after glove removal it was 82% (Kappa = 0.72) and 95% (Kappa = 0.87) .

Conclusions: In this small-scale application of a glove-use audit tool we demonstrated over-use and misuse of gloves and the potential for cross transmission on gloved hands. The audit tool provides an effective mechanism for integrating glove-use into the audit of hand hygiene behaviour.

Background

The hands of staff are recognised to play a major role in the transmission of infection in healthcare settings (World Health Organisation, 2009). Hand hygiene is now accepted as an essential component of infection control programmes, and education on hand hygiene is commonly based on the promotion of the '5 moments of hand hygiene' (5MHH) (Sax *et al,* 2007; World Health Organisation, 2009).

The routine use of gloves in clinical care emerged in the late 1980s when the Centre for Disease Control (CDC) recommended 'universal precautions' in response to the emerging AIDS epidemic (CDC, 1987). These precautions required the use of protective clothing for direct contact with blood and some body fluids from any patient on the basis that it was not possible to discriminate those carrying blood borne viruses (CDC, 1988). Subsequently the recommendations were extended to all body fluids to address the increased risks of contamination associated with such contact and became known as standard precautions (Lynch *et al,* 1987; Wilson & Breedon, 1990; Pratt *et al*, 2001). Thus standard precautions indicate that personal protective equipment (PPE) should be used for any procedure where a risk of direct contact with blood and body fluids (BBF) is anticipated (Loveday et al 2014a; RCN 2012). The type of PPE selected should be dictated by the extent of potential exposure to BBF and as most contact involves hands, disposable gloves are the most commonly used form of PPE. However, adequate hand hygiene after glove use and the need to change gloves between procedures on the same patient and between patients is required to minimise the risk of infection transmission (World Health Organisation, 2009; Loveday *et al,* 2014a). If gloves are worn during the delivery of care, but not removed at the points in care where hand hygiene is indicated by the 5MHH, then their use will increase rather than decrease the risk of transmission of infection between patients. Although most studies focus on hand

hygiene rather than glove use behaviour, a few have indicated an emerging problem with an overuse of gloves, with staff wearing them in for procedures that do not involve exposure to BBF and not removing them in a timely way (Thompson *et al,* 1997; Prieto & Macleod Clark, 2005). Other studies have suggested that the use of clinical gloves may have an adverse effect on compliance with the 5MHH (Fuller *et al*,2011, Flores & Pevalin, 2006).

A mechanism of feeding back of data on the misuse of gloves is required in order to educate clinical staff about using gloves appropriately and recognising the importance of hand hygiene in the context of glove use. Most hospitals in the UK measure compliance with 5MHH using simple audit tools but these do not account for the use of gloves in the delivery of care and are not able to capture data on the specific risks of cross contamination associated with the use of gloves. In a previous study we designed and tested an observational audit tool to identify inappropriate glove-use and potential for cross contamination associated with the use of gloves (Loveday *et al*, 2014b). We found glove use was inappropriate in 42% (69 of 163) of episodes and a risk of cross contamination in 37% (60 of 163) because an indication for hand hygiene was missed. This study we describe components of the glove-use audit tool and report on the inter-rater reliability associated with its use.

Method

The audit tool has been designed to capture the detail of clinical procedures performed whilst wearing gloves, the items that were touched during their use and the point when gloves were removed and hand washed. This approach enables glove use behaviour to be analysed and the risk of cross contamination associated with glove use to be measured. Although the audit tool was initially designed to be used for recording events related to the use of a single pair of gloves (Loveday *et al*, 2014), we have subsequently adapted it in order to record points during an episode of care where gloves are put on or removed and

hands decontaminated (Figure 1). The advantage of this approach is that it enables the extent of misuse of gloves to be estimated by measuring the proportion of episodes of care in which gloves are used. The audit episode commences once the healthcare worker (HCW) is observed to be preparing to undertake an episode of care and ends once the HCW completes the episode. Each item touched with the hands during the procedure/s, the order that they are touched and the point at which hand hygiene occurs or gloves put on/taken off is recorded. On completion of the observation, the information is used to categorise the potential for cross-contamination during each procedure observed using the criteria shown in Table 1. These criteria have been adapted from the 5MHH for use in the context of the gloved hand with a 'moment of HH' translating to the requirement to remove or change gloves and/or decontaminate hands. Lack of hand hygiene before putting on gloves was not considered as a risk of cross contamination (Rock *et al,* 2013). Hand hygiene after glove removal was considered adequate if performed according to the hospital protocol.

Appropriateness of glove use was also assessed for each procedure. Glove use was considered appropriate if the procedure was in the high-risk category of the Fulkerson scale and therefore involved contact with, or a risk of contact with BBF (or hazardous substances, mucous membranes) or gloves were required because of local policy (e.g. patient under isolation precautions) (McLaws *et al*, 2009).

We tested the tool in three wards in a large, acute teaching hospital. In order to minimise the Hawthorne effect, the purpose of the observation would be made obscure. In general staff will assume the observation is related to hand hygiene rather than the use of gloves and they are therefore less likely to change their glove use behaviour during the observation. In addition, auditors would be present on the ward for at least 10 minutes prior to collecting data the staff become more familiar with their presence and are more likely to exhibit their normal behaviour. Positioning of the auditor is important to ensure that observations can be carried out un-obtrusively, however, often clinical tasks or

procedures require the patient to be given privacy and care may be delivered behind curtains. Where possible, observers would deduce procedures being undertaken by the equipment being used and confirm by questioning the healthcare worker or patient. Ethical approval was not required for this study as the observations constituted audit of practice and were a normal part of infection control activity.

To determine the validity of the audit tool paired observations were captured simultaneously by two observers. The inter-rater reliability (IRR) for each of 11 items documented in the tool was assessed using percentage agreement between observers and corrected for chance using Cohen's kappa coefficient in Excel. Kappa values of 0.41 to 0.6 are considered to demonstrate moderate agreement, 0.61 to 0.8 good and 0.81 or more very good agreement (Viera & Garrett ,2005).

Results

Twenty-two episodes of care were observed in a medical ward (9), high dependency unit (6) and neurosurgical ward (7), all of which involved the use of gloves. These were performed by staff nurses (9 episodes), healthcare assistants (9 episodes), student nurses (2 episodes) and allied health professionals/phlebotomists (2 episodes). There were 35 procedures performed during these episodes of which 34 were performed using gloves. The number of procedures where there was contact with blood or body fluid and where glove use was deemed appropriate is shown in Table 2.

Gloves were put on in the bay or outside the patient's room in 17 or the 22 episodes (77%). A total of 54 items were observed to be touched using gloves. On one of the 22 episodes (5%) a risk of cross contamination was observed after Moment 4. In a further six of the 22 episodes (27%) the curtains

surrounding the patient's bed were touched before contact with the patient and, since this is deemed to be outside the patient zone, it contravened moment 1.

The validation of the observational audit found high IRR in the paired observations for eight of 12 variables documented in the tool, including the appropriateness of glove use and risk of cross contamination (see Table 3). In the five discrepant observations related to hand hygiene before or after glove removal four related to hand hygiene being documented as 'unknown' rather than 'yes' or 'no'. In 2 of the 22 episodes there was a minor difference in documentation of the exact point where gloves were removed (IRR 91%; Kappa 0.48); although this Kappa coefficient is likely to be underestimated because disagreement with this variable was rare (Viera & Garrett 2005) (Table 3). In addition, there was one minor variation in the description of the procedure being performed (Hygiene needs vs. tidying bed/bedspace) and nine differences noted in specific items touched out of a total of 54 documented items touched (IRR 83%) (Table 4).

Discussion

Our validation study demonstrated a high level of agreement between observers in documenting the use of gloves using this audit tool, with an inter-observer agreement of 100% for the majority of variables, including appropriateness of use and risk of cross-contamination, and Kappa scores of more than 0.7. In this small set of observations we found that gloves were worn for more than 50% of procedures but not required for 67% of these as there was no risk of contact with BBF or indications for their use. In 27% of episodes of care we also found evidence that glove use was associated with a risk of cross contamination, between the environment and patients or between patients, because gloves were put on at a point distant to the patient and therefore contaminated outside the patient zone prior to

contact. The actual risk of cross-infection associated with observed glove-use practice has been demonstrated by Girou *et al* who sampled gloves after use and recovered pathogens from 86%, even after the application of alcohol hand rub (Girou *et al,* 2004). Snyder *et al* also found that gloves become readily contaminated with antibiotic-resistant pathogens as a result of contact with patients or their environment (Snyder *et al,* 2008). The widespread use of gloves was observed by Fuller *et al* (2011) who found that 26% of hand hygiene opportunities involved the use of gloves. Other studies have found poor compliance with timely removal of gloves where healthcare episodes which involve more than one procedure on the same patient, particularly in the context of patient isolation for infection (Patterson *et al,* 1991; Johnstone *et al,* 1990; Prieto & Macleod Clark, 2005).

An earlier version of the tool reported in this paper was used in a larger study in a different acute care hospital, where we found that the decision of healthcare workers to use gloves appeared to be influenced by feelings of disgust and misjudgement about the risk to self, and that glove-use behaviour was often influenced by co-workers (Loveday *et al,* 2014b). Whilst we cannot be sure about the origin of these sentiments, they may have emerged from the widespread publicity about risk of HCAI, strong promotion of hand hygiene as fundamental to preventing infection, and from the promotion of personal protective clothing as part of standard precautions.

Whilst promotion the 5MHH framework and the use of alcohol hand gel has become the standard approach to education and training on hand hygiene in healthcare settings (WHO, 2009), the use of gloves does not fit easily with these principles. Guidance on use of 5MHH suggests that indications for hand hygiene are independent of those that justify the use of gloves and glove use should not replace or alter the performance of hand hygiene. However, when 5MHH was conceived it was assumed that gloves would be used as '*a second skin to prevent exposure of hand to body fluids*' and that '*glove*

removal represents a strong cue to hand hygiene' (Sax *et al* 2007). Unfortunately, our observations suggest that the use of gloves has now been extended to a wide range of clinical activities that do not involve exposure to body fluids and their use compromises the principles of the 5MHH because they are frequently donned outside the patient zone and, in the absence of exposure to body fluid, the trigger to remove them and perform hand hygiene may be lost. For example, we observed that it was common practice to put on gloves in the bay where the glove dispenser was situated or outside patient's room rather than at the bedside. As a result curtains and other equipment outside the patient zone were touched by the gloved hand before contact with the patient. Similarly, donning gloves in the bay precluded the application of alcohol hand gel immediately prior to contact with the patient. Therefore, in using gloves to reduce the risk of infection, HCWs may actually increase the risk of transmission between the environment and patient and between patients through lack of their timely application and removal.

The audit tool also highlights other inconsistencies with 5MHH that are difficult to reconcile, for example a commode moves from outside to inside the patient zone and then returns outside after use, which makes it difficult to categorise the relevant moments of hand hygiene and/or glove removal. In addition, the surfaces within the patient zone are considered to be continuous with the patient as they are likely to become readily contaminated with their micro-organisms. However, the true microbiological risks associated with this approach are unknown.

There are few examples in the literature of studies evaluating inter-observer agreement of hand hygiene behaviour. McAteer *et al* used a simplified audit tool based on the assignment of hand hygiene opportunities to six groups (before and after low risk contact, before and after high risk contact and before and after unobserved contact). They found a *kappa* for hand hygiene opportunities and hand

hygiene actions of 0.68 and 0.77 respectively, but commented that use of the tool required clear standard operating procedures and between 4 and 6 hours of training. In most healthcare settings monitoring of compliance with hand hygiene is based on the WHO hand hygiene observation method, although the recommendations to train and validate observers to ensure consistency is probably not commonly performed (Sax *et al* 2009). Data on the IRR of this method is limited (Huis *et al* 2013, Steed *et al* 2011).

We suggest that the standard approach to hand hygiene audit needs to be developed to address inappropriate use of gloves and to more accurately reflect non-compliance with 5MHH in situations where gloves are being used. We have shown that our audit tool can be used to provide consistent data about the misuse of gloves and their potential impact on infection control, which infection prevention teams can use to challenge the over-use of gloves and increase the knowledge and understanding of healthcare workers about the hazards associated with their misuse. It does have limitations, in particular it requires some expertise to interpret the risk of cross contamination, and the findings may be subject to the Hawthorne effect (Holden 2001).

In conclusion, systematic audit of glove use behaviour indicates the lack of integration between glove-use and 5MHH and a significant potential for cross transmission on gloved hands. Further work is required to determine how widespread the observed glove-use practice is among clinical staff, understand the drivers of this behaviour and to develop effective interventions to improve appropriate use of clinical gloves.

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Figure legends

Figure 1: The glove use audit tool

Table 1: Classification of the risk of cross contamination to incorporate the use of gloves (adapted from 'My 5 moments for hand hygiene' Sax *et al,* 2007)

Moment for hand decontamination	Risk of cross contamination	Definition
1	A patient touched by a contaminated glove/hand	Gloves/hands contaminated if they had contact with any part of the environment outside the patient's zone before direct contact with the patient's intact skin. *If the HCW touches their own clothing, skin or hair this is not considered part of the 'patient zone'*
2	A contaminated glove/hand touched a susceptible site e.g. wound, IV access site, phlebotomy	Gloves/hands contaminated if they had touched any other non-sterile objects or patient sites before the aseptic task e.g. patient skin, bed linen.
3	A glove/hand touched a surface or patient after contact with BBF	Gloves/hands contaminated if used for handling urine or assisting a patient with toileting then touched other surfaces or patient.
4	Gloves used for contact within patient zone not removed or hand hygiene not performed before contact with an object outside patient zone	Gloves/hands contaminated if touched another patient/objects outside patient zone; hand hygiene not performed after glove removal; or one glove/outer glove (where double-gloves used) removed part way through procedure.
5	Failure to remove gloves and/or perform hand hygiene after contact with patient	Gloves not removed or adequate hand hygiene not performed on leaving the healthcare zone.

surroundings

Table 2: Appropriateness of glove use for 34 procedures undertaken during episodes of care

	No		Yes		Unknown		Total
	No.	*%*	*No.*	*%*	*No.*	*%*	
Contact with BBF	23	67.6%	7	20.1%	4	11.4%	34 (100%)
Glove use appropriate	18	52.9%	15	44.1%	1	2.9%	34 (100%)

Table 3: Inter-observer agreement for variables in glove-use audit tool

a) Variables related to 22 episodes of care

Item	Description	No. (%) agreement
1	Discipline of staff	22 (100%)
2	Location gloves put on	22 (100%)
3	Location task performed	22 (100%)
4	Gloving location appropriate	22 (100%)
5	Location gloves removed	22 (100%)

b) Variables related to glove removal and hand hygiene pre and post gloving during 22 episodes of care

Item	Description	No. in agreement			Total no. (%) agreement	Kappa
		Yes	No	UK		
6	Hand hygiene pre gloving	6	9	3	18 (82%)	0.72
7	Hand hygiene after removal	17	0	4	21 (95%)	0.87
8	Point of glove removal	20	2	-	20 (91%)	0.48

c) Variables related to 35 procedures observed during 22 episodes of care

Item	Description	No. (%) agreement
9	Procedure performed	35* (100%)
10	Risk of contact with BBF	35 (100%)
11	Glove use appropriate	35 (100%)
12	Risk of cross contamination	35 (100%)

*minor variation in description for one procedure

Table 4: Discrepancy in items observed to be touched during procedure

	Observer 1	Observer 2
1	Call button	*Not recorded*
2	*Not recorded*	Slide sheet
3	Shower chair	Commode
4	*Not recorded*	Toothbrush
5	Needle & syringe	*Not recorded*
6	*Not recorded*	Table
7	*Not recorded*	Sink
8	*Not recorded*	Patient property bag
9	Crockery	Zimmer frame