Infection Prevention in Practice 2 (2020) 100091

Available online at www.sciencedirect.com

Infection Prevention in Practice

journal homepage: www.elsevier.com/locate/ipip

Continued wearing of gloves: a risk behaviour in patient care

M. Lindberg [a,b,c], B. Skytt [a,b], M. Lindberg [a,*]

[a] Faculty of Health and Occupational Studies, Department of Caring Sciences, University of Gävle, Sweden
[b] Department of Public Health and Caring Sciences, Uppsala University, Uppsala, Sweden
[c] Centre for Research and Development, Uppsala University, Region Gävleborg, Gävle, Sweden

ARTICLE INFO

Article history:
Received 25 June 2020
Accepted 10 September 2020
Available online 17 September 2020

Key words:
Gloves
Infection prevention
Nurse assistants
Organism transmission
Registered nurses

SUMMARY

Background: The wearing of gloves is included in the standard principles for preventing healthcare associated infections. A continued wearing of gloves may, however, result in the transmission of organisms instead of preventing infections. Few studies have explored how common it is for surfaces to be touched by potentially contaminated gloves.

Methods: Secondary analysis of field notes from 48 hours of unstructured observations of healthcare personnel's actions during patient care. The new focus was on to what extent healthcare personnel wore gloves that should have been removed or changed, what surfaces were touched by contaminated gloves and what patient-related activities were involved.

Results: A continued wearing of gloves occurred in about half of the observed episodes of patient care. On average, 3.3 surfaces were touched by contaminated gloves. The surfaces most frequently touched were 'unused single-use items', 'equipment controls/switches/regulators/flush buttons' and 'bed linen'. This occurred mostly while helping patients with 'personal hygiene', when performing 'test taking' or during procedures involving the operation of medical or other 'equipment'.

Conclusion: The continued wearing of gloves during patient-related activities carries the risk of organism transmission, as the gloves touch many surfaces. The most critical moments seem to be when the use of gloves is considered essential. A better understanding of the motivators of improper glove-use behaviour is needed to develop interventions that rectify the improper use of gloves.

Introduction

A healthcare-associated infection (HAI) is an infection that occurs in a patient receiving health care that was not present or incubating at the time of admission [1]. A HAI can lead to a prolonged hospital stay, an increased risk of long-term disability and death. The prevention of HAIs is therefore of great importance. Approximately one third (and as much as 70%) of all HAIs are considered to be preventable [1,2]. The single most important measure is for healthcare personnel (HCP) to be compliant with hand hygiene measures [3]. The value of hand hygiene is undisputable, but compliance is suboptimal [4,5], especially when gloves are used [6]. The use and misuse of

* Corresponding author. Address: Faculty of Health and Occupational Studies, Department of Caring Sciences, University of Gävle, SE 801 76, Gävle, Sweden. Phone: +46 26 64 84 48.
E-mail address: magnus.lindberg@hig.se (M. Lindberg).

https://doi.org/10.1016/j.infpip.2020.100091

gloves in health care negatively affects the HCP's compliance with the five moments of hand hygiene [7–9] and subsequently increases the risk of organism transmission [10].

The wearing of personal protective equipment such as non-sterile gloves during some clinical activities is in accordance with standard hygiene precautions. Gloves reduce the risk for hand contamination and limit the risk of organism transmission when used properly in combination with hand disinfection [11]. However, the actual manner in which HCP use gloves is not in accordance with the guidelines. For example, Baloh et al. [6] observed a substantial gap between self-reported compliance with hand hygiene before gloving and an actual observed compliance. The misuse of gloves has been described as an overuse of gloves and a failure to remove the gloves at the appropriate time e.g. directly after a care activity, between procedures and patients or between different measures performed on the same patient [8,10,12–14].

Raybould [15] concluded 20 years ago that gloves were often misused or not used by HCP at the appropriate time, and by so doing could expose HCP and their patients to HAIs. Recent studies [6,9] have concluded that HCP have an over-reliance on gloves, in that the gloves are often used as a method to protect themselves rather than a method to prevent the transmission of organisms. An international observational study found that HCP used the same gloves continuously at a high rate, and that there were significant differences between the observed countries. The Nordic countries showed that the HCP used the same gloves continuously at a lower rate before patient contact. Of note, was the remarkably high rate of the use of gloves that should have been changed before aseptic or clean procedures in all of the countries [9]. Even in care activities that required strict aseptic precautions, it was observed that one out of five patients were put at risk for organism transmission because the HCP did not change their gloves before the care activity [14]. It has also been found that gloves were used inappropriately in over 50% of the observed episodes of glove use during patient-related activities [8,16]. Not changing possibly contaminated gloves between procedures performed on the same patient is the most common source of possible contamination, and failure to change gloves between patients is also prevalent [13].

Loveday et al. [8] have shown that HCP commonly touch about three objects with their gloved hands before performing patient-related care activities. The items most often touched are clinical equipment around the patient, patient notes, urine bottles/bedpans and objects on the bedside table. Any hand-touched surface is a potential fomite that can be a route for organism transmission if the surface has been contaminated. [3]. HCP frequently touch clinical equipment such as intravenous drip tubing/machines and blood pressure monitors with their hands [17,18]. Other sites regularly touched include bed rails, call buttons, furniture, light switches and telephones [17].

A limited number of studies have focused on the use of gloves by HCP in relation to the surfaces touched by their potentially contaminated gloved hands. Therefore, this phenomenon needs to be further explored to better understand the glove-use behaviour of HCP and facilitate the prevention of HAIs.

Aims

The aim of the study was to explore the extent that HCP wore gloves that should have been removed or changed, what surfaces were touched by contaminated gloves and what patient-related activities were involved.

Methods

Design

Secondary analysis of longitudinal data.

Sample/participants

The hospital ward conveniently selected for the case study [19] was an internal medicine ward with 26 beds. Patients cared for in the ward had either standard precautions, contact precautions or protective isolation. There were nine two-bed and five one-bed patient rooms that shared toilets/showers and anterooms. There were also three one-bed en-suite isolation rooms with anterooms. Participating in the study were registered nurses, nurse assistants, and physicians (n=20) that worked in the ward.

Data collection

The data were originally collected for another study [19]. A single observer (MaL), who is a registered nurse with long experience in a variety of infection prevention and control positions, performed 48 hours of unstructured observations in a hospital ward. The observations were performed over a period of 18 months on business days, mainly from 7.30 am to 12 noon, on twelve randomly selected occasions. HCP were shadowed during patient-related activities and field notes of their patient related actions were made. The focus of the observer was to document what was happening. An example of the unstructured observations is published online https://ars.els-cdn.com/content/image/1-s2.0-S0195670118304067-mmc1.docx.

Ethical considerations

The Regional Ethical Review Board in Uppsala favourably reviewed the research plan (Dnr 2012/373). Hospital management also approved the plan. Written informed consent was obtained from the observed HCP. Confidentiality was assured and observations were conducted only after the involved patients and the HCP agreed to the observer's presence. None of the researchers worked in or with the daily operations of the ward.

Data analysis

The transcribed field notes [19] were reanalysed for this study by the first and last author. The analysis incorporated the 125 observation units that involved the use of gloves by HCP during patient-related activities, i.e. episodes of patient care. The analysis focused on identifying when risks of organism transmission occurred due to the continued wearing of gloves that should have been removed or changed. In addition, we wanted to quantify the extent objects were being touched by those gloves. We used the Standard principles (SP) for preventing healthcare associated infections described by Loveday et al. [11] to determine how gloves should be properly used:

SP21, gloves must be worn for: invasive procedures; contact with sterile sites and non-intact skin or mucous membranes; all activities

that have been assessed as carrying a risk of exposure to blood or body fluids; and when handling sharps or contaminated devices. SP22, gloves must be: worn as single-use items; put on immediately before an episode of patient contact or treatment; removed as soon as the episode is completed; changed between caring for different patients; and disposed of into the appropriate waste stream in accordance with local policies for waste management. SP23, hands must be decontaminated immediately after gloves have been removed. [11 p. 5]

Risks for organism transmission while wearing gloves were defined based on "My five moments for hand hygiene" by Sax et al. [3] and described by Loveday et al. [8]:

Hand hygiene moment (HHM) HHM-1: A patient was touched by a contaminated glove. Definition: Gloved hand was considered to be contaminated if it had contact with any part of the environment outside the patient's zone before direct contact with the patient's intact skin.
HHM-2: A contaminated gloved hand touched a susceptible site such as a wound, intravenous access site, phlebotomy, etc. Definition: Gloved hand was considered to be contaminated if it had touched any other non-sterile objects or patient sites before the aseptic task, e.g. patient skin, bed linen, furniture.
HHM-3: A gloved hand touched a surface or patient after contact with blood/body fluids. Definition: Gloves used for handling urine or assisting a patient with toileting then touched other surfaces or patients.
HHM-4: Gloves used for contact with the patient are not removed or hand hygiene not performed before contact with an object outside the patient zone. Definition: Touching another patient or objects outside the patient bed area while still wearing the same pair of gloves; failure to carry out hand hygiene after glove removal, removal of one glove or an outer glove where double gloves used part way through a procedure.
HHM-5: Failure to remove gloves and perform hand hygiene after contact with patient surroundings. Definition: Moving out of the healthcare zone and not then removing gloves and performing adequate hand hygiene. [8 p. 112]

Procedures performed by the HCP when there was an identified risk of organism transmission have been deductively classified into the following categories of tasks, in accordance with Lindberg et al. [20]:

Food: Ordering/handling kitchen items, Preparation/subsequent work (related to the food trolley) including sorting of menus, filling in of food and fluid intake lists, distribution of food trays/providing drink. Feeding patients including cutting up food, Handling of dishes including tray removal.
Personal hygiene: Upper and lower body including dressing and if needed showering, Upper body washing including dressing the patient if needed or only dressing the patient, Lower body washing including dressing if needed.
Elimination: In bed including diaper, bedpan, urinal, indwelling urinary catheter and use of the top-loaded flusher disinfector, On the commode (portable toilet) with use of bedpan and the use of the top-loaded flusher disinfector, On the toilet (even the use of an elevated toilet seat).
Transferring/transport: Patient transport within/outside the ward (e.g. to x-ray, another room), Patient transferring (e.g. from bed to chair, walking/following along, positioning in bed, Transport of items (e.g. test tubes, boxes, empty beds).
Test taking/examining: Testing/blood sugar/venflon venepuncture including documentation, Arrange for ordered tests, Inspection/examination/control of vital parameters including emptying of drains, weight and documentation of such, Conversation/communication with patients e.g. rounds, giving of information.
Dressing/wound Care: Wound care (remove-clean-replace bandage), Dressing of peripheral line insertion site including change of dressing, removal of venflon cannula or adhesive bandage.
Laundry: Handling of clean bed linens or patient clothing, Handling of used bed linens or patient clothing, Handling of laundry bags.
Bed making: Making the bed including fixing the draw sheet, sheet, mattress, changing all the sheets.
Waste management and surfaces: Waste bags, Refuse sacks, Tidy up/clean (e.g. bed table), Wipe off surfaces including bed table, tray trolley, counter tops, Adapt the care environment including the lights, bed rails, backrest, blinds, blankets, phones, alarm cords, removal of over bed lifting pole/trapeze bar.
Equipment: Operation of medical equipment and other equipment (e.g. oxygen, electrocardiograph), Cleaning of the equipment including syringe tray, scissor, rolling walker, bottles, Retrieve/add materials/equipment.
Medication administration: Administration i.v., i.m., p.o., s.c., including documentation and removal of i.v., Preparation of medication.
Communication: Verbal and written (e.g. telephone, inquiries, calling, reporting). [20, p.41]

All of the objects that the HCP were observed to have touched with a gloved hand after the glove was considered to be contaminated were inductively classified into 13 types of surfaces. These were: work clothes, doors, unused single-use items, handles, work aids, clean hygiene equipment, clean patient clothing, equipment control/regulators/flush buttons, measuring instruments/equipment, the patient, patient belongings, the bed/side table and bed linen. A cross tabulation procedure was performed using the IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp to describe relationships between the performed task and surfaces touched by contaminated gloves. This also allowed us to produce an illustration showing the surfaces touched in the different ward zones. In the original study, an analysis of each observation unit was deductively labelled according to the character of the activity, i.e. a single, combined, or interrupted activity [20]. A One-Way ANOVA was used to determine whether there were any differences in the mean number of surfaces touched by contaminated gloves in the single, combined and interrupted activities.

Rigour

Since the confidence in a study's results is partly a function of the amount of error introduced by any inconsistent interpretation of the data, an analysis of interrater agreement was

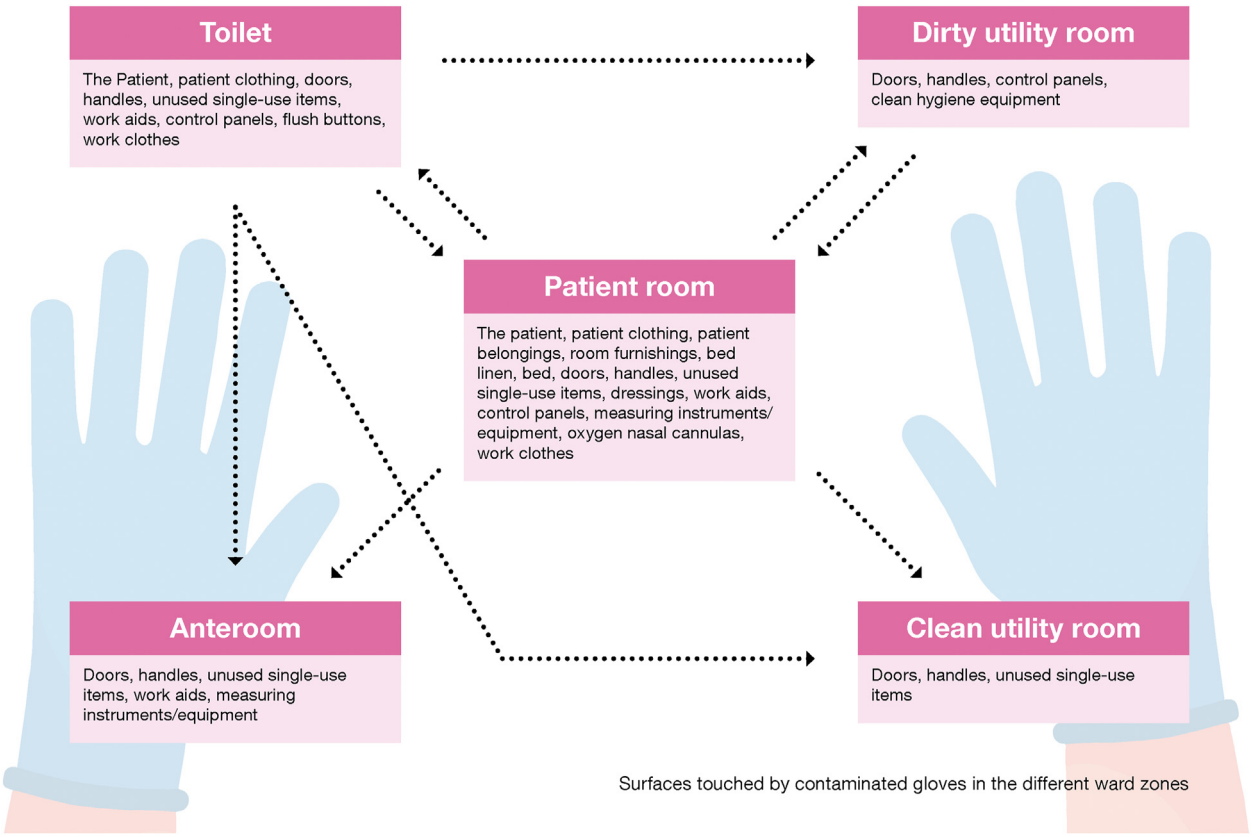

Figure 1. Surfaces touched by contaminated gloves in the different ward zones.

included in the design of this study. The extent of consistency among two independent data raters has been analysed using Cohen's kappa, a frequently used statistic to test interrater reliability between two raters of nominal data, i.e. no risk of organism transmission or risk of organism transmission. The resulting kappa coefficient (0.600) was interpreted to be an indication of adequate agreement between the raters of the data in the present context [21]. The two data raters thereafter reviewed any differences and a consensus was reached before further analysis. An important issue related to the trustworthiness of a secondary analysis of a set of qualitative observational data is the researchers' sensitivity to the context of the data that was collected [22]. The researchers were very familiar with the context since the first author conducted the data collection and made reflective notes in the original study.

Results

A risk of organism transmission by gloves worn after they should have been removed or changed occurred 216 times in 66 of the 125 observed episodes of patient care that involved the wearing of gloves. The average number of surfaces touched by gloves that should have been removed or changed was 3.3 (SD 2.8, min 1 max 13). In 19.7% of the observed episodes, five or more surfaces were touched and 4.5% involved more than ten surfaces. A risk of organism transmission was observed not only within, but also between different ward zones. For example, we observed HCP assisting patients in the bathroom to change their incontinence underwear. The same gloves were worn continuously by the HCP when they left the bathroom to get supplies or materials from the clean utility room or anteroom. The surfaces touched in the different ward zones and the possible spread of the organisms between ward zones is illustrated in Figure 1.

The surfaces most frequently touched by contaminated gloves were 'unused single-use items', which accounted for 24.5% of all of the observed risks for organism transmission. Thereafter, 'equipment controls/switches/regulators/flush buttons' accounted for 14.8% and 'bed linen' for 8.8% (Table I).

The task most commonly performed when the HCP touched surfaces with contaminated gloves was the assisting of patients with 'personal hygiene', which accounted for 18.5% of the patient care episodes and involved 10 of the 13 classified surfaces. Thereafter, 'test taking' that involved 11 classified surfaces accounted for 13%. Procedures involving the operation of medical or other 'equipment' also accounted for 13% and involved eight surfaces (Table I).

There were no significant differences ($F[2,63]=1.673$, $p=.196$) in the number of surfaces touched by contaminated gloves during single activities ($n=12$), mean 2.4 (SD 1.8); surfaces touched during combined activities ($n=19$), mean 2.8 (SD 1.8); or interrupted activities ($n=35$), mean 3.9 (SD 3.4).

Discussion

Our findings confirm that protective gloves are often used incorrectly by HCP. We observed a potential risk of organism transmission in every second episode of patient care that

Table I
Relationships between the performed task and surfaces touched by contaminated gloves, i.e. used gloves that should have been removed before continuing with patient-related activities

Tasks	13 types of surfaces touched by contaminated gloves													
	Work clothes	Doors	Unused single-use items	Handles	Work aids	Clean hygiene equipment	Clean patient clothing	Equipment controls /regulators/flush buttons	Measuring instruments /equipment	The patient	Patient belongings	The bed/side table	Bed linen	Total
Bedmaking	-	3	2	-	-	-	-	2	-	-	-	1	11	19 (8.8%)
Communication	3	-	-	-	-	-	-	-	-	-	-	-	-	3 (1.4%)
Dressing	2	-	8	1	-	-	-	1	-	-	-	1	1	14 (6.5%)
Elimination	-	4	3	1	2	-	1	8	-	1	-	2	2	24 (11.1%)
Equipment	-	2	3	1	2	4	-	13	-	-	2	1	-	28 (13.0%)
Food	-	-	-	1	-	-	-	-	-	2	-	1	-	4 (1.8%)
Laundry	-	1	1	1	-	1	3	-	-	-	-	-	1	8 (3.7%)
Medication	2	-	6	-	-	-	-	-	-	4	-	-	-	12 (5.5%)
Personal hygiene	-	3	10	1	1	-	8	1	-	8	2	4	2	40 (18.5%)
Test taking	1	-	5	5	1	1	-	1	7	1	1	3	2	28 (13.0%)
Transferring	-	2	1	1	3	-	1	5	-	1	-	-	-	14 (6.5%)
Waste management	-	2	14	5	-	-	-	1	-	-	-	-	-	22 (10.2%)
Total	8	17	53	17	9	6	13	32	7	17	5	13	19	216
	3.7%	7.9%	24.5%	7.9%	4.2%	2.8%	6.0%	14.8%	3.2%	7.9%	2.3%	6.0%	8.8%	100%

- = no observation.

involved the wearing of gloves, which is consistent with the results of Wilson et al. [16]. The application of gloves and the removal of contaminated gloves, at the appropriate time, plays a significant role in health care since the improper use of gloves increases the risk of organism transmission [10,14,16]. In order to counteract the misuse and overuse of gloves, Loveday et al. [8] have concluded that a better understanding of the mediating and moderating factors of glove use behaviour among HCP is needed. Wilson et al. [16] have found that for HCP, the key elements in the decision-making process regarding the use of gloves are emotions such as fear and disgust and socialisation within the profession as well as the organization. In the quest to protect patients from HAIs, future interventions should go beyond the traditional educational instructions on when to wear gloves. To optimize glove-use behaviour among HCP, interventions should also incorporate a strategy that promotes an understanding of the interactions between humans and contact with other elements in the healthcare system. It is particularly important to gain more knowledge regarding the continuous use of contaminated gloves, as the number of surfaces touched by gloves that should have been removed or changed was remarkably high in the present study. A shared understanding [23] regarding glove-use behaviour among HCP is essential in order to alter the non-adherence to standard hygiene precautions. Therefore, measures to achieve a shared understanding need to be incorporated as active ingredients in interventions aimed at altering glove-use behaviour [24].

Contaminated gloves that should have been removed or changed touched up to 13 surfaces. Unexpectedly, almost one quarter of the observed risks for organism transmission occurred when contaminated gloves touched unused single-use items such as sterile dressings, syringes and equipment for venepuncture. This phenomenon is considered remarkable because training on when to use an aseptic technique is included in the basic education of both registered nurses and nurse assistants. Furthermore, guidelines for the prevention of HAIs such as those presented by Loveday et al. [8] also include information on when aseptic techniques should be used in patient-related activities. Based on our finding, it seems HCP omit the application of the aseptic principles when they wear gloves. One plausible explanation could be the complexity of trying to get everything in the workflow right. This is difficult while trying to balance evidence-based guidelines with the circumstances in the organisation (such as the availability of resources and materials, peer pressure, and the attitudes among colleagues, patients and stakeholders). Interestingly, Cusini et al. [25] have demonstrated a significant improvement in hand hygiene compliance and the appropriate use of gloves when the mandatory use of gloves during the care of patients placed on contact precautions in a hospital setting was rescinded. Without complex instructions and conflicting guidelines, it might be easier for HCP to adopt appropriate behaviours. When guidelines are not being applied, it is necessary to understand that there is a difference between an intentional violation of the rule and an imposed violation because the guideline itself is too challenging. Another explanation for the observed continuous use of contaminated gloves while handling clean materials could be the fear of coming in contact with something perceived to be unclean. The emotion of fear induces HCP to wear gloves for personal protection and that kind of behaviour might be increased with easy access to gloves [16,26].

It is obvious that HCP have to touch a considerable number of surfaces while performing patient care activities [8,17,18]. However, we found that contaminated gloves touched a remarkably large proportion of various surfaces while the HCP helped with 'personal hygiene' or performed 'test taking'. These tasks prompt the use of gloves because they involve possible contact with blood and other body fluids, but the gloves need to be changed or removed at the appropriate time to prevent organism transmission [10,16]. The zone nearest the patient is known to have the highest risk for contamination [3] and nosocomial pathogens have been identified in both close and distant patient areas [27]. Since HCP touch numerous surfaces with their contaminated gloves in the patients' rooms (Figure 1), it is important to alter the glove-use behaviour of the HCP in order to reduce HAIs. It is not surprising that when HCP handle medical equipment, the most common surfaces touched by contaminated gloves were 'switches/regulators/flush buttons or control panels for electronic equipment'. For example, with the risk of coming in contact with blood while connecting an intravenous drip there is also the risk of organism transmission when handling the infusion pump controls. Touching the pump controls with a blood-stained glove is per se, not a problem if the surface is appropriately cleaned afterwards. However, the circumstances and routines may not always be conducive to cleaning.

Limitations

The use of existing data from the original study performed by the authors [19] somewhat limits this study. The sample size, time of data collection and selection of hospital ward were not taken into consideration for the present study's aim. Therefore, the findings cannot be considered to be representative of current nursing practices. However, the phenomenon in the present study is closely related to the aim of the original study and therefore we considered the data to be valid for the generation of the new findings, i.e. the data was of pertinent detail and appropriate depth [22]. There were care activities where gloves were not worn when they generally should have been. These episodes were not included in the analysis since the aim of the study was to explore the extent contaminated gloves were being worn and what surfaces were being touched.

Conclusion

The glove-use behaviour of HCP during patient-related activities is associated with risks for organism transmission because HCP touch many surfaces with possibly contaminated gloves that should have been removed or changed. The most critical moments in patient care seem to occur during procedures where there is an expected risk of contact with blood and body fluids and the use of gloves is considered essential. Workflow that is poorly prepared from a hygiene perspective or un-reflected actions may contribute to the transmission of organisms from the gloves to various surfaces. Efforts to ensure patient safety should include a better understanding of the motivators of improper glove-use behaviour in order to enhance the development of effective interventions aimed at rectifying the improper use of gloves among HCP.

Credit authorship contribution statement

Maria Lindberg: Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation Writing- Review & Editing, Project Administration, Funding acquisition. Bernice Skytt: Conceptualization, Methodology, Validation, Writing- Review & Editing, Supervision. Magnus Lindberg: Conceptualization, Methodology, Software, Formal Analysis, Data Curation, Writing- Original Draft, Visualization, Project administration, Funding acquisition.

Acknowledgement

None.

Conflict of Interest statement

None to declare.

Funding

This work was supported by the Centre for Research and Development, Uppsala University/ Region Gävleborg and the Faculty of Health and Occupational Studies, University of Gävle. The funding sources were not involved in the study design; the collection, analysis, and interpretation of data; the writing of the report; or the decision to submit the manuscript for publication.

References

[1] WHO. The burden of health care-associated infection worldwide. 2019. https://www.who.int/gpsc/country_work/burden_hcai/en/. [Accessed 17 January 2020].
[2] Bearman G, Doll M, Cooper K, Stevens MP. Hospital Infection Prevention: How Much Can We Prevent and How Hard Should We Try? Curr Infect Dis Rep 2019;21. https://doi.org/10.1007/s11908-019-0660-2.
[3] Sax H, Allegranzi B, Uçkay I, Larson E, Boyce J, Pittet D. "My five moments for hand hygiene": a user-centred design approach to understand, train, monitor and report hand hygiene. J Hosp Infect 2007;67:9—21. https://doi.org/10.1016/j.jhin.2007.06.004.
[4] Erasmus V, Daha TJ, Brug H, Richardus JH, Behrendt MD, Vos MC, et al. Systematic Review of Studies on Compliance with Hand Hygiene Guidelines in Hospital Care. Infect Control Hosp Epidemiol 2010;31:283—94. https://doi.org/10.1086/650451.
[5] Kingston L, O'Connell NH, Dunne CP. Hand hygiene-related clinical trials reported since 2010: a systematic review. J Hosp Infect 2016;92:309—20. https://doi.org/10.1016/j.jhin.2015.11.012.
[6] Baloh J, Thom KA, Perencevich E, Rock C, Robinson G, Ward M, et al. Hand hygiene before donning nonsterile gloves: Healthcare workers' beliefs and practices. Am J Infect Control 2019;47:492—7. https://doi.org/10.1016/j.ajic.2018.11.015.
[7] Fuller C, Savage J, Besser S, Hayward A, Cookson B, Cooper B, et al. "The Dirty Hand in the Latex Glove": A Study of Hand Hygiene Compliance When Gloves Are Worn. Infect Control Hosp Epidemiol 2011;32:1194—9. https://doi.org/10.1086/662619.
[8] Loveday HP, Lynam S, Singleton J, Wilson J. Clinical glove use: Healthcare workers' actions and perceptions. J Hosp Infect 2014;86:110—6. https://doi.org/10.1016/j.jhin.2013.11.003.
[9] Vikke HS, Vittinghus S, Giebner M, Kolmos HJ, Smith K, Castrén M, et al. Compliance with hand hygiene in emergency medical services: An international observational study. Emerg Med J 2019;36:171—5. https://doi.org/10.1136/emermed-2018-207872.
[10] Picheansanthian W, Chotibang J. Glove utilization in the prevention of cross transmission: a systematic review. JBI Database Syst Rev Implement Reports 2015;13:188. https://doi.org/10.11124/jbisrir-2015-1817.
[11] Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. Epic3: National evidence-based guidelines for preventing healthcare-associated infections in nhs hospitals in england. J Hosp Infect 2014;86. https://doi.org/10.1016/S0195-6701(13)60012-2.
[12] Chau JPC, Thompson DR, Twinn S, Lee DTF, Pang SWM. An evaluation of hospital hand hygiene practice and glove use in Hong Kong. J Clin Nurs 2011;20:1319—28. https://doi.org/10.1111/j.1365-2702.2010.03586.x.
[13] Cheng VCC, Chau PH, Lee WM, Ho SKY, Lee DWY, So SYC, et al. Hand-touch contact assessment of high-touch and mutual-touch surfaces among healthcare workers, patients, and visitors. J Hosp Infect 2015;90. https://doi.org/10.1016/j.jhin.2014.12.024.
[14] Girou E, Chai SHT, Oppein F, Legrand P, Ducellier D, Cizeau F, et al. Misuse of gloves: The foundation for poor compliance with hand hygiene and potential for microbial transmission. J Hosp Infect 2004;57:162—9. https://doi.org/10.1016/j.jhin.2004.03.010.
[15] Raybould LM. Disposable non-sterile gloves: a policy for appropriate usage. Br J Nurs 2001;10:1135—41. https://doi.org/10.12968/bjon.2001.10.17.9953.
[16] Wilson J, Bak A, Loveday HP. Applying human factors and ergonomics to the misuse of nonsterile clinical gloves in acute care. Am J Infect Control 2017;45:779—86. https://doi.org/10.1016/j.ajic.2017.02.019.
[17] Huslage K, Rutala WA, Sickbert-Bennett E, Weber DJ. A Quantitative Approach to Defining "High-Touch" Surfaces in Hospitals. Infect Control Hosp Epidemiol 2010;31:850—3. https://doi.org/10.1086/655016.
[18] Smith SJ, Young V, Robertson C, Dancer SJ. Where do hands go? An audit of sequential hand-touch events on a hospital ward. J Hosp Infect 2012;80:206—11. https://doi.org/10.1016/j.jhin.2011.12.007.
[19] Lindberg M, Skytt B, Wågström BM, Arvidsson L, Lindberg M. Risk behaviours for organism transmission in daily care activities: a longitudinal observational case study. J Hosp Infect 2018;100:e146—50. https://doi.org/10.1016/j.jhin.2018.07.041.
[20] Lindberg M, Lindberg M, Skytt B. Risk behaviours for organism transmission in health care delivery A two month unstructured observational study. Int J Nurs Stud 2017;70:38—45. https://doi.org/10.1016/j.ijnurstu.2017.02.016.
[21] McHugh ML. Interrater reliability: The kappa statistic. Biochem Medica 2012;22:276—82. https://doi.org/10.11613/bm.2012.031.
[22] Hinds PS, Vogel RJ, Clarke-Steffen L. The possibilities and pitfalls of doing a secondary analysis of a qualitative data set. Qual Health Res 1997;7:408—24.
[23] Sandberg J. Understanding human competence at work: an interpretative approach. Acad Manag J 2000;43:9—25.
[24] Sandberg J, Targama A. Managing understanding in organizations. London: Sage Publications Ltd; 2007.
[25] Cusini A, Nydegger D, Kaspar T, Schweiger A, Kuhn R, Marschall J. Improved hand hygiene compliance after eliminating mandatory glove use from contact precautions-Is less more? Am J Infect Control 2015;43:922—7. https://doi.org/10.1016/j.ajic.2015.05.019.
[26] Acquarulo BA, Sullivan L, Gentile AL, Boyce JM, Martinello RA. Mixed-methods analysis of glove use as a barrier to hand hygiene. Infect Control Hosp Epidemiol 2019;40:103—5. https://doi.org/10.1017/ice.2018.293.
[27] Wille I, Mayr A, Kreidl P, Brühwasser C, Hinterberger G, Fritz A, et al. Cross-sectional point prevalence survey to study the environmental contamination of nosocomial pathogens in intensive care units under real-life conditions. J Hosp Infect 2018;98:90—5. https://doi.org/10.1016/j.jhin.2017.09.019.