

Short report

Disinfection of artificially contaminated gloved hands reduces transmission of *S. epidermidis* to catheter valves.

Running title: Disinfected gloves decrease *S. epidermidis* transmission

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Summary

Disinfection of gloved hands is increasingly advocated in situations where visibly not soiled gloves are used during multiple clinical activities on the same patient. Since there is no data demonstrating that such practice attributes to lower bacterial transfer during clinical care, a standardised experimental study was conducted. Gloved hands touched chicken breasts contaminated with *Staphylococcus epidermidis* with or without disinfection before touching sterile catheter valves. Contaminated gloves transferred 5.18 log₁₀ CFU *S. epidermidis* to the catheter valves. Disinfection of contaminated gloves reduced significantly the numbers transferred to 0.78 log₁₀ CFU. Disinfection of gloved hands may reduce the risk of transmission.

Introduction

In their recent systematic narrative review,¹ Kampf and Lemmen have highlighted an important aspect within the concept of hand hygiene in health care. The authors have thoroughly analysed the literature for available evidence on the risk of glove contamination and cross-transmission for subsequent manipulation on the same patient, compliance with hand antisepsis during continued glove use, efficacy of hand disinfection on gloved hands, glove integrity after using hand rubs on gloved hands, and the impact of disinfecting gloved hands on nosocomial infections. Although high quality evidence was not identified, the authors concluded that there is sufficient evidence to advocate disinfection of gloved hands by healthcare workers, up to ten disinfections, when performed during multiple activities on the same patient.

Interestingly, while Kampf and Lemmen were able to identify one prospective clinical study which demonstrated that disinfecting gloved hands during care on the same neonatal patient resulted in a significant reduction in the incidence of late-onset infections and necrotizing enterocolitis in a neonatal intensive care unit,² their review did not include data demonstrating that disinfected gloved hands attribute to lower bacterial transfer than non-disinfected gloved hands during clinical care.

To support their statements¹ and to strengthen this latter point, we have conducted a quantitative study investigating the impact of disinfecting contaminated gloves on the magnitude of bacterial transmission.

Material and methods

Briefly, a non-pathogenic *Staphylococcus epidermidis* (ATCC 14990) was used for the experiments, as it represents of the most frequently found micro-organisms in vascular cathetes. Overnight cultures of the test strain grown on Columbia agar plates (Biomérieux, France) were adjusted to an average density of 1×10^6 cells/mL in a 0.9% NaCl-solution by comparison to a 0.5 McFarland standard. One 160 g fresh and unfrozen chicken breast with skin but without feathers was inoculated with 5.0 mL of this suspension. The contaminated chicken breast was then held for 30 min at room temperature to facilitate attachment of the test strain. The colonised chicken breast was the touched with all five fingers of a hand wearing powder-free sterile latex gloves (Sempermed Supreme, Semperit, Austria) during an average time of 40 seconds. Thereafter, a sterile un-touched central venous catheter valve (Safite® valve, B. Braun AG, Germany) was rubbed between all fingers of the gloved hand for another 40 seconds. This standardised manoeuvre transferred *S. epidermidis* from the contaminated gloved hand to the catheter valve and simulated a condition, which may be found in intensive care units or wards as well. The whole procedure was repeated 10 times, 5 times with right hand gloves, and 5 times with left hand gloves. Thereafter, the identical procedure was repeated, but this time the contaminated glove was disinfected using 2×3 mL application of isopropanol 60% (v/v) following the hand rub procedure as described in the European Standard EN BS 1500:2013.³

Finally, the number of *S. epidermidis* on the catheter valves was determined by vortexing each valve separately in 1 mL Mueller-Hinton broth (Sigma-Aldrich, Germany) at 5,000 rpm for 30 seconds. Serial dilutions at 10^1 , 10^{-2} , 10^{-3} were plated on to Tryptone soya agar plates (TSA plates; Oxoid Ltd., UK) and incubated for 48 hours at $37^\circ\text{C} \pm 1^\circ\text{C}$. After incubation, the number of colony forming units (CFU)/catheter valve (corresponding to 1 mL sampling

broth) was counted and recorded for each dilution step. A neutralizer was not used because dilution with pure broth neutralized any antimicrobial effect of isopropanol.⁴

Results and discussion

The results are summarized in table I. In the absence of disinfection contaminated gloves transferred a mean of 5.18 log₁₀ CFU *S. epidermidis* to the catheter valves. On the other hand, the disinfection of contaminated gloves reduced the numbers transferred by 4.4 log₁₀ CFU to a mean of 0.78 log₁₀ CFU, a reduction that was statistically significant (p < 0.01).

Our brief experimental study has a number of limitations. Firstly due to methodological reasons, all experiments were conducted with powder-free sterile surgical gloves made of latex. Our results therefore are not automatically transferable to non-sterile medical examination gloves made of different materials such as latex, nitrile, or other novel synthetic material. Second, in order to ensure a quantifiable reduction in contamination a high bacterial inoculum was employed on the chicken breast. Generally, there is no direct correlation between the level of bacterial contamination of a surface and visible soiling. Yet, it may be speculated that such high inocula may occur in clinical practice in situations with visible soiling.⁵ However, if gloved hands are visibly soiled, e.g. with blood, mucous or faeces, it is unlikely that a healthcare worker would continue in patient care without removing gloves.⁶ Finally, we could not determine the number of CFU on the surface of the chicken breast or on the contaminated gloves without interfering with the inoculum size transferred to catheter valves. Therefore, we were not able to calculate differences in numbers of CFU transferred as they moved from the chicken breast to the glove and from the glove to the sterile catheter. This study provides only data on the impact of the presence or absence of glove disinfection on the contamination of a sterile target.

However, our results do provide additional support for Kampf and Lemmen's¹ conclusion that "disinfection of gloved hands by healthcare workers may substantially reduce the risk of transmission when gloves are indicated for the entire episode of patient care and when performed during multiple activities on the same patient". In addition to this, we also agree with Kampf and Lemmen's recommendation that further research is required to resolve outstanding issues such as the influence of the glove type on specific alcohol formulations, as was demonstrated by Scheithauer et al. recently,⁷ the influence of such practice on the overall compliance to the principles of hand hygiene, or the practicability and acceptability of glove disinfection in clinical practice.

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Tables

Table I. **Transfer of *S. epidermidis* from contaminated chicken skin to catheter valve, stratified by disinfected or not disinfected gloved hands.**

	Range on valve (log ₁₀ CFU/valve)		Mean contamination (log ₁₀ CFU/valve)
	Min.	Max.	
Contaminated gloved hand without disinfection	2.46	6.18	5.18
Contaminated gloved hand with disinfection (2 x 3 mL isopropanol 60% v/v)	< 0.60*	1.28	0.78

* The detection limit of test strains on catheter valves was 0.60 log₁₀ CFU/valve in this study.; each experiment was repeated 10x.

Conflict of Interest:

The authors have no conflict of interest to report.

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None