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Major Article

Safe removal of gloves from contact precautions: The role of hand hygiene

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Background: Routine hand hygiene effectively removes methicillin-resistant *Staphylococcus aureus* (MRSA) and/or vancomycin resistant *Enterococcus* (VRE) from the ungloved hands of healthcare workers (HCWs) who are caring for patients under contact precautions, when exposure to bodily fluids is not expected. **Methods:** HCWs' ungloved hands were cultured after hand hygiene with alcohol-based hand rub (ABHR) or soap-and-water wash after routine clinical care of patients known to be colonized or infected with MRSA or VRE.

Results: Two hundred forty samples from 40 HCWs were tested and found to be culture negative for either MRSA or VRE after contact with patients when 3 pumps of ABHR (0/80) or plain soap-and-water wash (0/80) were used. No VRE was observed in any of the 120 samples collected. Two plates (2/40) grew 1 colony-forming unit of MRSA after 2 pumps of ABHR. Two HCWs with positive plates were cultured negative on retesting.

Conclusion: We showed that appropriate hand hygiene was effective in removing MRSA and VRE even when gloves were not used for routine clinical care, despite contact with patients known to be colonized with MRSA or VRE. A modified approach to glove use for dry contact with patients on contact precautions might improve patient safety within healthcare settings.

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Contact precautions are a set of practices used by healthcare workers (HCWs) with patients known or suspected to be infected or colonized with epidemiologically important transmissible microorganisms that are not thought to be contained by standard precautions alone.¹⁻³ During contact precautions, HCWs are required to don personal protective equipment (PPE), usually nonsterile gloves and an apron or gown, for all contact with the patient and the patient zone.^{1,3}

HCWs' hands are important in the transmission of microorganisms from one site to another in the same patient and between patient zones.^{4,5} PPE is intended to reduce the risk of contamination of HCWs' hands or clothing during patient care and to eliminate the transmission of microorganisms from patient to patient.⁶

However, evidence suggests that glove use and the removal of gloves increase the risk of contamination of both HCWs and patients.⁷⁻¹⁶ During standard care, it has been shown that HCWs failed to change gloves for 66% of indications, and 82% of HCWs touched patients or patient zones more than once with contaminated gloved hands.⁷ The removal of PPE was associated with 53% of HCWs contaminating their skin and clothing.⁸ Another study found that even after appropriate PPE use, between 1.7% and 4.2% of hands were contaminated.⁹ Alarming, before an aseptic procedure, 14.6% of ungloved hands and 19.6% gloved hands were contaminated.¹⁰ Although hand hygiene is an effective prevention method for many healthcare-associated infections,¹¹ it is not unusual for HCWs to fail to practice it before and after glove use^{5,12,13} and fail to practice correct hand hygiene techniques.^{14,15} Contaminated ungloved hands effectively transfer microorganisms to the patient and the patient zone.^{16,17} However, we are now learning that the glove surface has an increased mechanical efficacy over ungloved hands to successfully transfer microorganisms to the patient and patient zone.¹⁸⁻²⁰

Gloved hands must be viewed as contaminated once there is any surface contact. The World Health Organisations (WHO) guidance

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on hand hygiene²¹ emphasizes the importance of removing gloves after contact with a patient, after a procedure, and after contact with the patient zone.²¹ Although glove use for contact precautions is a highly complied recommendation, there is no explicit integration of hand hygiene with glove use within the framework of *My Five Moments for Hand Hygiene*.²¹⁻²⁴

Incorporating contact precautions into *My Five Moments for Hand Hygiene* is challenging for HCWs. HCWs receive conflicting messages that hand hygiene cannot be relied on for the removal of microorganisms and multidrug-resistant organisms, when in fact glove use for all contacts during contact precautions is required, even when exposure to bodily fluids is not expected.⁴ The reliance on gloves as part of contact precautions also potentially implies that standard precautions may be ineffective in removing or reducing the risk of microorganism transmission.^{24,25}

In our hospital, we are testing an awareness campaign called “no gloves for dry contact with patients under contact precautions,” to remove gloves from contact precautions where contact with bodily fluids is not expected. We call these contacts “dry contacts.” Our aim was to demonstrate to HCWs that hand hygiene effectively removes methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus* (VRE) from their ungloved hands after routine contact with patients who are known to be colonized with either MRSA or VRE.

METHODS

Participants

All participants were HCWs from a 440-bed referral public university teaching hospital located in Sydney, Australia, during a 2-week period in December 2016. Ethics approval was obtained from the Local Health District Human Research Ethics Committee. Forty participants were recruited through their nurse unit managers, who provided information about the participants to the Infection Prevention and Control Consultant (IPCC) (S.J.). Thirteen HCWs were from the respiratory medicine and infectious diseases ward; 15 were from the surgical ward; and 12 were from the spinal and rehabilitation wards. Signed informed consent was obtained from all participants.

HCWs performed routine care where exposure to bodily fluids was not expected for patients known to be colonized or infected with MRSA or VRE. Routine care included recording vital signs, administering medication, and assisting the patient. The IPCC observed each HCW until their ungloved hands contacted both the patient and the patient surroundings during care, such as the patient's hand and high-touch areas including the bed railing, linens, and side table. Before the samples were collected, 3 different hand hygiene methods were used along with the 7 poses for hand hygiene for alcohol-based hand rub (ABHR), or the 10-poses of handwashing steps, until their hands were dry. Once hands were dry, microbiological samples from all 5 fingertips of both hands were collected by pressing the fingertips onto agar plates for 15 seconds. If the HCW provided care to a patient known to be MRSA positive, all 5 fingertips of the dominant hand were pressed onto a Brilliance™ MRSA Agar chromogenic screening plate, and the non-dominant hand was pressed onto a Brilliance™ VRE Agar chromogenic screening plate. If the patient was known to be VRE positive, the dominant hand was pressed onto a VRE plate, and the non-dominant hand was pressed onto a MRSA plate.

The 3 sample collection steps included

Step 1. Hand hygiene using 2 pumps of ABHR

Immediately before patient contact, HCWs were instructed to deliver 2 pumps of ABHR foam and perform the 7-step hand hygiene

skin coverage technique.²⁶ Once their hands were dry, HCWs entered a contact precautions room with ungloved hands and performed routine care. On completion of care, the HCWs performed hand hygiene using the 7-poses for hand hygiene until their hands were dry.

Step 2. Hand hygiene using 3 pumps of ABHR

Participating HCWs with ungloved hands repeated the routine care with the same patient. Then, a second imprint was obtained 20-30 minutes later after hand hygiene was performed using 3 pumps of ABHR before and after patient contact.

Step 3. Hand hygiene with soap and water wash

Participating HCWs with ungloved hands repeated the routine care with the same patient. Then, a third imprint was obtained 20-30 minutes later after a soap-and-water handwash using 1 ml of plain soap before and after patient contact.²⁶

Processing and analysis

The 6 plates collected from each HCW were given a code selected by the HCW to identify their own plates after culture. Plates were transferred to an accredited pathology service for processing and incubated aerobically at 37°C and read at 24 hours and 48 hours. Per the manufacturer's instructions, colonies with an appearance consistent with MRSA or VRE were counted.²⁷ Any HCW with a positive result was observed again performing routine care with ungloved hands and supervised in the correct hand hygiene technique before their hands were retested. This test was repeated until all cultures from the participants were negative. Culture results were provided to HCWs by the IPCC.

RESULTS

A total of 240 specimens were collected for processing, including 120 MRSA and 120 VRE samples: 40 MRSA plates and 40 VRE plates after 2 pumps of ABHR; 40 MRSA plates and 40 VRE plates after 3 pumps of ABHR; and 40 MRSA plates and 40 VRE plates after soap-and-water wash. Hand sampling included contact with patients known to have MRSA (N = 17), MRSA and VRE (N = 11), and VRE (N = 15). Two plates (2/40) grew 1 colony-forming unit of MRSA after 2 pumps of ABHR from 2 HCWs (Fig 1). The HCW with positive plates tested negative on retesting, using 2 pumps of ABHR. No MRSA or VRE growth was found for hand hygiene with 3 pumps of ABHR or plain soap-and-water wash.

DISCUSSION

Many studies have confirmed that adequate hand hygiene is an effective measure for the removal of microorganisms.²⁸⁻³⁰ Yet despite the evidence, international recommendations, and national guidelines, improving hand hygiene compliance remains a challenge,³¹⁻³³ and glove use continues to be associated with non-compliance.^{23,32,34} The generally accepted recommendation is that gloves should be used for activities that may involve exposure to bodily fluids and with patients being cared for under contact precautions.²¹ The recommendations for mandatory gloving in contact precautions were based on general consensus and expert opinion rather than high-level evidence.^{2,22} Glove use has since been extended to a wide range of activities that do not involve contact with bodily fluids.^{6,13,35} However, glove use raises concerns about cross-contamination when gloves are donned too early, removed too late, or are not changed between tasks.^{7,23,36,37} In addition, the material of contaminated gloves

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