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Short report

Reducing pathogen transmission in a hospital setting. Handshake verses fist bump: a pilot study

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SUMMARY

Handshaking is a known vector for bacterial transmission between individuals. Handwashing has become a major initiative throughout healthcare systems to reduce transmission rates, but as many as 80% of individuals retain some disease-causing bacteria after washing. The fist bump is an alternative to the handshake that has become popular. We have determined that implementing the fist bump in the healthcare setting may further reduce bacterial transmission between healthcare providers by reducing contact time and total surface area exposed when compared with the standard handshake.

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Introduction

The handshake is an important social gesture that has been depicted in ancient Greek funerary steles as far back as the 5th century BC. It is hypothesized that the initial purpose of the handshake was to propose peace by demonstrating that the hand holds no weapon. In modern times, the handshake is a common way of greeting, offering congratulations, or coming to an agreement. In the hospital environment, healthcare workers are often confronted with a handshake on a daily basis. Alternatives to the handshake during social interaction have been utilized throughout the years, but they have failed to overtake the handshake.

Nosocomial infections have been identified as a major preventable complication of inpatient care, and numerous policies and protocols have been initiated to reduce the rate of these infections. One of the most visible initiatives to reduce nosocomial infections has been the hand hygiene initiative. Hand-to-hand contact is a known vector for the transmission of infectious diseases; as many as 80% of individuals retain some disease-causing bacteria after washing.[1] Efforts have been made to reduce this risk by encouraging frequent handwashing, as well as eliminating contact with contaminated surfaces such as door and sink handles.[2–6] However, ensuring compliance with this initiative has been challenging.[7]

One possible solution to help control the spread of infectious diseases in the healthcare setting would be to eliminate voluntary hand-to-hand contact. Although this would accomplish the goal of reducing transmission, it would neglect the social importance of the hand-to-hand contact that the handshake signifies. Therefore, the authors propose the fist bump as a safe and effective alternative to the traditional handshake in this setting.

The fist bump has gained recent notoriety as an alternative to the handshake after being displayed in the mainstream media; the most notable example being President Obama's use of the gesture. The fist bump is a simple, intuitive method of social interaction. The authors hypothesize that the fist bump will reduce bacterial transmission between individuals by reducing contact surface area, reducing total contact time

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between individuals, and protecting fingertips from pathogen exposure.

Methods

Surface area measurement

Five male and five female subjects were randomly selected from the West Virginia University Department of Engineering. Surface area of each subject's right hand and fist was determined using the following method. A semi-automated computer vision tool that determines surface area was developed using both a visible and thermal camera. Each individual placed both their right hand palm-down and fist on to the vision tool and these were photographed. A penny was placed next to each and was used as a reference since its true geometric area was known. Blob detection was utilized to localize the regions of interest (ROI), and then the ROIs were segmented using image thresholding. The reference object (penny) was localized by computing the roundness metric (RM):

$$RM = (4*pi*area)/perimeter^2$$

i.e. when RM is greater than a predetermined threshold the object is considered a circle. For each image we computed the penny's diameter, as well as the hand or fist width or height in pixels. Finally, by using the formula below, the surface area x of each photograph (inches) was determined.

$$x = \frac{\text{penny (inches)*hand or fist (pixels)}}{\text{penny (pixels)}}$$

Contact time measurement

Video footage of 18 different subjects (nine different subject pairs) was collected in order to measure the contact time of two main gestures between each pair, i.e. (i) handshake, and (ii) fist bump. The video frame rate was set to 30 frames/s. Each gesture was manually annotated frame by frame in order to determine the interval for which there was a skin contact between each pair of subjects for either gesture. The total number of frames for which contact was present was counted, and the average contact time in seconds was computed.

Bacterial transmission measurement

Institutional Review Board approval was obtained prior to this investigation. Four 20 × 20 cm plates were prepared using Mueller–Hinton Agar. Two healthcare workers, one male and one female, were assembled at a regional hospital. They were instructed to wash their hands thoroughly with soap and warm water for 1 min. After drying, they proceeded to travel from the first floor lobby to the fifth-floor surgical wards. Each subject performed the same tasks, such as pushing the elevator button and using door handles. Once present on the surgical wards, the subjects shook hands with 20 healthcare workers who were blinded to the purpose of the study. Immediately following the contact, healthcare workers were informed that they had participated in a blinded study on infection transmission and were instructed to wash their hands. The subjects then returned to the hospital lobby, and their right hand was plated palm-down and held for 5 s. To assess fist bump transmission, the subjects washed their hands as before and returned to the surgical ward along the same route. The subjects performed fist bumps with 20 new healthcare workers. Workers were informed to wash their hands following the contact. After returning to the lobby, the right clenched fist of each subject was plated with the exception that each subject plated their right fist instead of palm. The plates were incubated at 37 °C for 72 h, and colony-forming units (cfu) were manually counted.

Statistical analysis

Student's t-test was utilized for statistical analysis of differences in surface area. Colony counts and contact time are reported as the mean.

Results

The surface area of the palmar surface of the hand was significantly greater than that of the fist (30.206 vs 7.867 in^2, $P < 0.00001$). The total contact time of the handshake was 2.7 times longer than that of the fist bump (0.75 vs 0.28 s).

Total colonization of the palmar surface of the hand was four times greater than that of the fist after incubation for 72 h (187.5 vs 42.5 cfu) (Figures 1 and 2).

Discussion

Hand-to-hand transmission of bacteria is an important variable in efforts to reduce the spread of nosocomial infections.[2,5,6] Meticillin-resistant *Staphylococcus aureus* (MRSA) is most usually spread through direct contact between patient and providers.[8] It has also been demonstrated that door handles carry up to fivefold more bacteria than push-plate door openers; up to 20.9% of door handles contain meticillin-susceptible *Staphylococcus aureus*, whereas up to 8.7% harbour MRSA.[4,9]

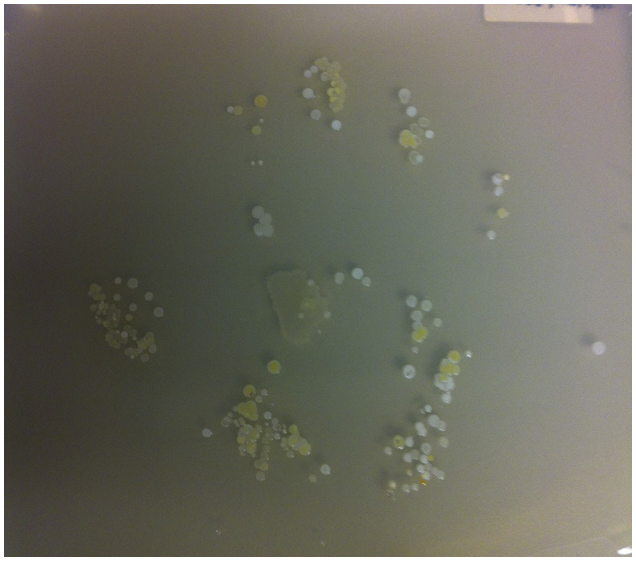

Figure 1. Representative plate illustrating bacterial growth of the palmar surface of the hand after undergoing 20 handshakes.

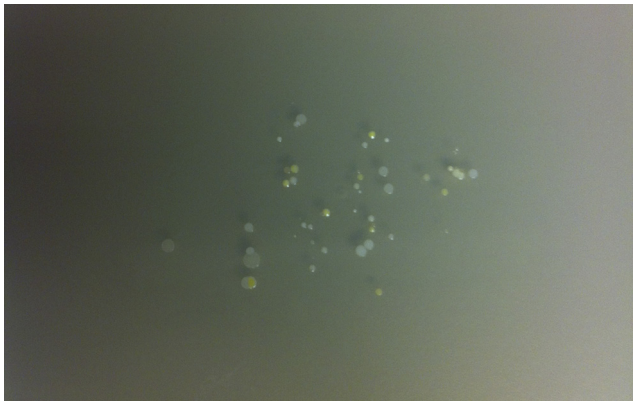

Figure 2. Representative plate illustrating growth cultured from the fist after 20 fist bumps.

Methods to reduce this avenue of transmission have included strict handwashing protocols, alcohol-based hand sanitizer, as well as reducing contact with contaminated surfaces. Although handwashing should be considered as an important tool to reduce bacterial transmission, it is far from a one-shot solution due to lack of compliance and variability. Alcohol-based hand sanitizers have been introduced in an attempt to supplement or replace handwashing, but they are not the panacea that many had hoped for. Of note is the rise of spore-forming nosocomial infections such as *Clostridium difficile*, which are resistant to alcohol-based hand sanitizers.[3]

The handshake remains an important social gesture in the healthcare setting. Whereas efforts have been made to reduce hand contact with potentially contaminated surfaces in these settings, the handshake has been mostly preserved. This is most likely due to habit, social norms, and the lack of a well-accepted alternative. Nevertheless, several popular media outlets have reported on the fact that handshakes are being banned within certain groups, such as Olympic teams and school athletic teams, due to the risk of pathogen transmission.

Variables that lead to hand-to-hand transmission of pathogens include the object of contact, the location on the hand at which the contact occurs, and the length of time in contact with the contaminated surface. This study has demonstrated that the fist bump significantly reduces both contact time and total surface area contacted when compared with the handshake. Additionally the fist bump exposes the less-used dorsal surface of the hand to a potential pathogen while protecting the fingertips and palm from exposure. The combination of these factors may explain the greater than fourfold reduction in colonization when utilizing the fist bump that was observed in this study. This suggests that the fist bump is an effective alternative to the handshake in the hospital setting that may reduce transmission of bacteria and improve the health and safety of patients and healthcare workers alike.

This study was designed as a pilot to explore the potential harmful effects of the handshake within the healthcare system, and as such it has several limiting factors. The study is limited by our small sample size and it could not assess statistical significance. Limited funding curtailed our ability to identify specific strains of bacteria. A larger study is planned to assess the level of significance between the handshake and fist bump as well as to assess virulence of the cultured strains. Furthermore, viral transmission is thought to be commonly transferred by skin contact, but was not assessed in this study.

In conclusion, reducing nosocomial infections is a highly targeted goal in today's healthcare system. Infectious agents are often transmitted on the hands of healthcare workers. With this pilot study it is proposed that replacing the handshake with the fist bump in the healthcare setting may reduce the rates of nosocomial infections by limiting their spread. Future studies should include real-world testing to determine whether this novel intervention affects infection rates.

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Conflict of interest statement
None declared.

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