



Design of a new non-sterile glove-dispensing unit to reduce touch-based contamination

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BRIEF REPORT

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ABSTRACT

Background

Despite best efforts by healthcare providers to sterilise their hands through hand washing prior to touching medical equipment and patients, bacteria are still present and can be spread through physical contact. We aimed to reduce the spread of touch-induced and airborne bacteria and virus spreading by using a touch-free glove-dispensing system that minimally exposes gloves in the box to air.

Method

The team met multiple times to undertake early prototyping and present ideas for the design. We experimented with folding gloves in varying patterns, similar to facial tissue-dispensing boxes, and tried several methods of opening/closing the glove box to determine the most effective way to access gloves with the least amount of physical contact. We considered the user experience and obtained user feedback after each design iteration.

Results

Ultimately, we decided on a vertically oriented box with optional holes for dispensing a glove on the side of the box or on the bottom by means of the pull-down drawer mechanism.

This system will dispense a single glove at a time to the user with the option of using a pull-down drawer trigger to decrease the likelihood of physical contact with unused gloves. Both methods dispense a single glove.

Conclusion

By reducing physical contact between the healthcare practitioner and the gloves, we are potentially reducing the spread of bacteria. This glove box design ensures that gloves are not exposed to the air in the clinic or hospital setting, thereby further reducing spread of airborne germs. This could assist in decreasing the risk of nosocomial infections in healthcare settings.

Key Words

Disposable gloves, contamination, pathogens, clinic

What this report adds:

1. What is known about this subject?

Despite best efforts by healthcare providers to sterilise their hands through hand washing prior to touching medical equipment and patients, bacteria can still be present.

2. What new information is offered in this study?

A design is presented to reduce the contamination of examination gloves used in medical care. The design is unique compared to other designs on the market.

3. What are the implications for research, policy, or practice?

By reducing the healthcare worker's physical contact with the gloves, we are potentially reducing the risk of nosocomial infections in the healthcare setting.

Background

Despite efforts by healthcare providers to implement effective hand-washing standards, compliance is generally poor.¹ Any contact by unclean hands in a hospital or

clinical setting therefore increases the potential for pathogen transmission and the subsequent risk of nosocomial infection.² The risk of pathogen transmission via unused, non-sterile gloves in a hospital setting has recently been demonstrated by Hughes et al.,² who showed that unused gloves on a hospital orthopaedic ward were contaminated prior to use – likely by contact with unclean healthcare worker hands. Our aim was therefore to minimise the potential for pathogen transmission by creating a touch-free glove-dispensing system that minimises exposure of the gloves in the box to air and to user handling.

Method

Various patterns of folding gloves, similar to facial tissue-dispensing boxes, and several methods of closures were explored as part of the design process for the glove box to determine the most effective way to access gloves with the least amount of physical contact. User experience was considered and early feedback was obtained after each design iteration. Users were provided with the prototype and asked to use it for one day in their healthcare setting. Mounting hardware was provided to attach the box to a wall. No instructions were given as to how to use the box. Five direct users from research laboratories, ambulatory care, and health clinics were recruited, but several other users at each location used the glove box during the day for a total of 15 users. Users included hospital staff (nurses and physician assistants), researchers, and emergency medical technicians. User feedback was collected by interview after the day of use. Feedback was received from 8 of the 15 users. Questions asked related to aesthetics, ease of use, and perceived effectiveness.

Results

The dispensing unit presented in this paper comprises a box with drawer-pull access for dispensing the gloves. The gloves will be packaged in the box using a puck-like scaffold design.

In standard glove manufacturing, gloves are formed on a mould and then blown or pushed off for packaging. Instead of letting the free gloves land on the production line for packaging in bulk, the gloves will be pushed into a puck scaffold to hold their shape (Figure 1). This requires very little effort and should only add one step to the manufacturing process. The puck designed in this study is made of recycled cardboard and can be further recycled after use as a scaffold for the glove. The scaffolded pucks will be loaded into a manner similar to how cookies and crackers are sold. To load the unit, the user will purchase a sleeve of gloves and the healthcare worker will open one end of the sleeve and insert the pucks into the dispensing unit. This loading process will

not increase the time beyond opening a new glove box to load into the current glove holder systems.

Figure 1: Glove shown on puck scaffold



Once the dispensing unit is mounted on the wall, the perforation on the bottom of the box is torn so that the gloves can be dispensed. At the bottom of the wall mount, there is a spring-loaded pull-down drawer mechanism that allows the user to open the container just wide enough to obtain one glove puck by pulling the handle down (Figure 2). The pull-down drawer automatically closes due to the spring-loaded apparatus before any more gloves are exposed to air or touch. This gives the user easy access to the dispensed gloves. The puck-like scaffold that holds the gloves allows the user to slip his/her hands through the scaffold into the gloves with ease (Figure 3). The scaffold is simply disposed of or recycled afterward, depending on the setting.

Figure 2: Loading gloves into the unit and dispensing gloves for use

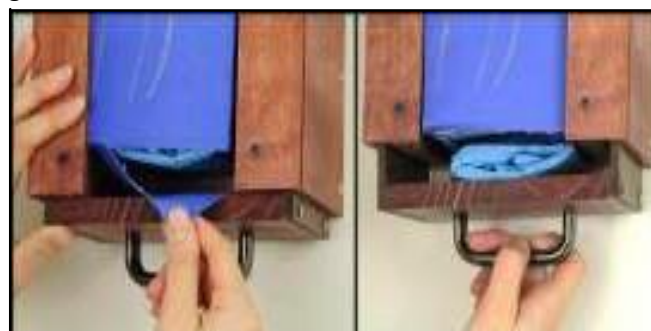


Figure 3: The puck is easily removed and the glove is slipped on



Discussion

The system described in this paper dispenses a single glove at a time to the user with the option of using a pull-down drawer trigger for more sterility. The user will only touch a single glove or the drawer-pull and not the gloves in the box, thereby reducing the potential for the spread of germs by touch.³ By reducing the possibility of physical contact by the healthcare worker with unused gloves, we expect to reduce the spread of pathogens by physical contact.⁴ In addition, the drawer mechanism ensures that gloves are not exposed to the air in the clinic or hospital setting, thereby further reducing the spread of airborne germs. This should reduce overall pathogen levels that may be present on the gloves.⁵

The first drawer-pull design that was produced was a horizontal access drawer at the base of the box, with the same puck-scaffold design. This yielded one glove at each dispense, but often jammed due to gloves falling into the drawer before the drawer could be closed. This led to the re-orientation of the drawer to a limited-access vertical pull. Users who tried the multiple prototypes provided helpful feedback in ease of use, aesthetics, and perceived effectiveness. Feedback on this design is that the unit is intuitive and easy to use. The puck design has received positive feedback for: 1) its ability to produce one glove; 2) drastically reducing the time needed to obtain a single glove because it lands in the user's hand in the correct orientation, wristband sticking out; and 3) not collapsing upon itself as non-scaffolded gloves often do. The clinic users liked the drawer-pull and found that it was easy to access and insert hands into gloves. Users also liked that the box was more aesthetically pleasing than the standard glove box and that they could customise it with fun designs to suit décor or for use in paediatrics.

It was suggested that those persons involved in ambulatory care were less likely to use the device since the drawer-pull requires more precision to access gloves than an open box, which may be difficult when travelling in the ambulance, and

they are often on location and do not want to transport such a bulky item. Clinicians from this setting suggested the puck design could be modified without the box structure in order to make the design more "user friendly" for their needs. Based on this feedback, a perforated puck dispenser was created as an alternate design so that the drawer mechanism was not required and the unit didn't require the wooden wall mount. Another perforation was added on the front side of the box near the bottom that can be removed to create an opening from which the gloves can be obtained (Figure 4).

Figure 4: Modified glove box with front-side perforation



As glove pucks are removed, gravity slides the next one into place at the orifice. The cost of creating the alternate form of the dispensing unit is minimal, since the only purchase needed is the sleeve and box without the drawer-pull. This modified design could still assist in the prevention of contamination from handling; however, it would expose the gloves to any airborne contaminants.

Conclusion

Many systems exist on the market for reducing contamination via unused non-sterile gloves. For example, some companies may reduce contamination by adding a flap to cover the opening of a glove box. Other companies add an antibacterial outer coating to their gloves that reduces the amount of bacteria transferred from a contaminated surface to another surface, so that if gloves are exposed to the air, most bacteria that touches the gloves will be eliminated by the coating. The construction of the glove box for our system is more



complicated than most glove boxes, however, the design reduces the possibility of contamination by automatically closing and reducing the amount of human contact with other gloves. In addition, the packaging of the gloves using a puck with the wrist opening sticking out helps users put gloves on without contaminating the glove surface prior to use. However, changing the glove box design is not the only way to achieve this goal. Promoting good hand-hygiene compliance in the workplace and improving glove-withdrawal techniques should be encouraged to improve sanitation in the workplace.¹

This design is a first step toward improving pre-use contamination of non-sterile disposable gloves. Many settings could benefit from the reduction of germs with a change in the method that gloves are dispensed. In the future, the wall mount materials and assembly will be explored to reduce labour and material costs. More extensive testing for optimal mounting and dispensing efficiency will aim to improve design efficiency and address end-user compliance with this new system.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.