Impact of Replacing Powdered Gloves With Powder-free Gloves on Hand-hygiene Compliance Among Healthcare Workers of an Intensive Care Unit: a Quasi-experimental Study

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Research

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Abstract

Background/Objective. After wearing powdered gloves, healthcare workers (HCW) are supposed to wash their hands instead of using alcohol-based hand-rub (ABHR). Washing hands takes longer than using ABHR, and the use of powdered gloves may be an obstacle to hand-hygiene compliance. This study aimed to evaluate the impact of replacing powdered gloves with powder-free gloves on hand-hygiene compliance among HCW of an intensive care unit (ICU).

Methods. A quasi-experimental study was conducted in a general ICU of a tertiary care university hospital in Brazil. From June 1st to July 15th, 2017, all HCW were provided with powdered latex gloves only for all clinical procedures. From July 15th to August 31st, 2017, HCW were provided with nitrile powder-free gloves only. Hand-hygiene compliance was assessed through direct observation, and evaluated according to the World Health Organization (WHO) Hand Hygiene guidelines. We calculated that a sample size of 544 hand hygiene opportunities needed to be observed per period. Data analysis were performed using the STATA SE® version 14, and we compared the individual's percentage of compliance using the t test for paired data before and after the intervention.

Results. Overall, 40 HCW were assessed before and after the introduction of nitrile powder-free gloves, with 1114 and 1139 observations of hand hygiene opportunities, respectively. The proportion of compliance with hand hygiene was 55% (95% Confidence Interval [CI]: 51-59%) using powdered latex gloves and 60% (95% CI: 57-63%) using powder-free gloves. The difference in proportions between the two types of gloves was 5.1% (95% CI: 2.5-7.6%, $p<0.001$).

Conclusion. Our data indicate that replacing powdered gloves with powder-free gloves positively influenced hand-hygiene compliance by HCW in an ICU setting.

Background

Healthcare-associated infections (HAI) are a public health problem, and in developed countries, 5–19% of hospitalized patients are reported to contract a health care-associated infection [(1)].

In the United States (US), it was estimated that 4.5 to 5.7 million dollars are spent yearly for treatment of HAI, with an average of two million cases, resulting in 80 thousand deaths a year [(2)]. In 2015, in the US, 12,299 patients were surveyed in 199 hospitals. Of those, 394 patients presented at least one episode of HAI (3.2%; 95% Confidence Interval [95% CI]: 2.9 to 3.5%) [(3)].

Silva (2005) [(4)] stated that 30% of all HAI can be prevented and that there is convincing evidence that hand hygiene is the most effective measure in preventing these events [(5–8)]. Alcohol-based hand-rub (ABHR) has been listed since 2002 as a standard solution for hand hygiene for health care workers (HCW), while hand washing is recommended when there is for visible dirty in the hand or the HCW comes in contact with patients with *Clostridium difficile* [(9–10)].

ABHR is useful to improve compliance with hand hygiene since its use requires about one-third of the time to wash hands with soap and water. In addition, ABHR is more effective in eliminating microorganisms, and sometimes improves the cleanliness of the hands of HCW [10–15]. ABHR can be taken to the bedside, allowing workers to clean their hands while caring for patients. For the World Health Organization (WHO), hand-hygiene products must be easily accessible and placed as close as possible to the patient care area or where treatment is being delivered [10].

HCW have increasingly complied with hand hygiene practices when they are provided with ABHR and after capacity building training [16–18].

A study performed in an intensive care unit in the state of Virginia (United States), showed the benefit of ABHR for compliance with hand hygiene. After providing one ABHR for every four beds, hand hygiene rates went from 19 to 41% [19].

It is recommended that HCW wear gloves to prevent that microorganisms that are either colonizing or temporarily present in their hand skin be transmitted to patients or from one patient to another, while reducing the risk that HCW themselves acquire infections from the patients [20]. After removing the gloves, the HCW should perform hand hygiene. Since powdered gloves preclude the use of an ABHR after their removal, using powder-free gloves should be encouraged, because they do not interfere with hand-hygiene using ABHR [20].

The US Food and Drug Administration (FDA) prohibits the sales of powdered surgical gloves. In the past, these gloves were popular for being easier to put on and remove than powder-free gloves. However, recent studies have pointed out that the powders pose a substantial risk to develop allergies to them by the healthcare workers and patients [21].

Despite these data, in developing countries the use of powdered gloves is still a frequent practice, mainly due to the lower cost of these gloves. However, if the use of powdered gloves decreases compliance with hand hygiene, there might be an impact in HAI rates, possibly increasing them.

This study aimed to evaluate the impact of replacing powdered gloves with powder-free gloves on the hand-hygiene compliance among HCW of an intensive care unit (ICU) in Brazil.

Methods

Type of study

The study was quasi-experimental and quantitative, carried out in a nine-bed intensive care unit, in a tertiary teaching hospital. This study was approved by the research ethics committee of the institution under the number CAAE 69241417.8.0000.5440. All HCW signed an informed consent before participating in the study.

The units of analysis were the opportunities for hand hygiene of all professionals working in the participating ICU.

The sample size was estimated using the STATA SE® version 14. We considered that an overall increase in compliance of 10% from the pre-intervention phase (powdered gloves) to the intervention phase (powder-free gloves), would be worth to be detected. Sample size for comparison of two percentages are larger when the percentages approach 50%. We calculated the largest sample size needed to detect a 10% change in that situation (in our case, corresponding to 45% compliance in the pre-intervention and 55% in the post-intervention), with a significance level of 0.05 and power of 0.90. Under those assumptions, we would need 544 opportunities per period: pre-intervention (one month) and intervention (one month), totaling 1088 overall opportunities.

Data Collection Procedure

A checklist was used to assess hand hygiene practices of all observed employees. The main author, who was trained in Geneva, was responsible for observing the compliance with hand hygiene, without interfering in the HCW routine. Hand hygiene opportunities were divided into five moments [10]: before contact with patients, before the aseptic procedure, after body fluid exposure, after contact with patients, and after contact with patients' environments. For each opportunity, compliance (yes or no) was marked in the checklist. Phase I: At this stage, all HCW working in the ICU wore powdered gloves, and were observed for hand hygiene practices in all shifts.

Phase II: in this stage, all HCW in the ICU wore powder-free gloves. Again, hand hygiene practices of all HCW in the ICU were observed in all shifts.

Statistical Analysis

All data collected were entered into an Excel spreadsheet and later analyzed using the STATA SE® version 14. Descriptive statistics were calculated to describe the characteristics of the 40 HCW of the ICU.

The data was analyzed by individual health care professional and by hygiene opportunity. Overall, the percentage of compliance was the number of times in which hand hygiene was performed divided by the total number of hygiene opportunities within the period of time a certain type of glove was used, and multiplied by 100%. Similarly, in the individual level, compliance was calculated as number of times a HCW performed hand hygiene divided by the number of opportunities the individual had to do so, multiplied by 100%. We compared the overall compliance between the two periods using a test of proportion. We compared the individual’s percentage of compliance using the t test for paired data. We also calculated the 95% confidence interval (CI) for the proportion of compliance among the individuals. Results were considered statistically significant at 0.05 level.

Results

Forty HCW were observed during the study. Table 1 describes their demographic characteristics.

Among the 40 assessed HCW, a total of 1114 and 1139 hand hygiene events were observed for powdered and powder-free gloves, respectively. Specifically, for powdered and powder-free gloves, we conducted 352 and 359 observations, before patient contact; 177 and 198, before aseptic procedures; 153 and 162, after contact with body fluids; 255 and 234, after contact with patients; and 177 and 186, after contact with contaminated surfaces, respectively. Each HCW was observed for at least 17 opportunities (maximum of 41) for hand hygiene while wearing powdered gloves, and for at least 19 (maximum of 37) while wearing powder-free gloves.

Table 2 shows the hand-hygiene compliance percentage for each opportunity category and in each studied phase, considering the opportunity as the unit of analysis. We ordered the types of opportunity by decreasing percentage of total compliance. After contact with fluids, compliance percentages remained the same and ABHR use increased slightly; however, ABHR use was low at this hand hygiene type of opportunity, while compliance percentage were almost 100%. After contact with patients, general hand-hygiene compliance percentage as well as use of ABHR with powdered gloves was higher than with powder-free gloves. Before aseptic procedures, there was an increase in general hand-hygiene compliance percentage, and ABHR use was four times higher when using powder-free gloves. After contact with surfaces, there was an increase in compliance percentage and ABHR use when using powder-free gloves. Before contact with patients, the percentage of compliance with hand hygiene (hand wash or ABHR) was low with powdered gloves (18.5%) and increased with the use of powder-free gloves (31.2%), although this is still considered a low percentage in a hospital setting. ABHR use was 2.3 times higher for the powder-free gloves. Finally, overall, there was an increase in compliance using ABHR when wearing the powder-free gloves, while compliance by washing hands remained somewhat stable, except for before aseptic procedures, when there was more compliance with hand washing for powdered gloves.

Figure 1 displays the overall percentages of compliance with hand hygiene practices while wearing powdered and powder-free gloves, ordered by decreasing percentage of compliance according to opportunity and all opportunities together.

When treating the in individual as the unit of analysis, we looked only at the total compliance of the individual with powdered and powdered-free gloves, since each person had a small number of events in each opportunity category and those percentages would not be robust estimates of the true proportion of compliance.

Figure 2 shows the total percentage of hand-hygiene compliance for each HCW, wearing powdered and powder-free gloves. Most individuals had a higher rate of compliance with hand hygiene when they were provided with the powder-free gloves. The mean percentage of compliance with hand-hygiene was 55.0% (95% CI: 51.1-58.9%) with powdered gloves and 60.1% (95% CI: 56.9-63.3%) with powder-free gloves. The mean difference in percentages between hand-hygiene compliance for both types of gloves for the individuals was 5.1% (95% CI: 2.5-7.6%), and it was statistically different from 0 ($p<0.001$), with higher proportion of compliance when using the powder-free gloves.

Discussion

The literature has clearly shown the relevance of hand hygiene as the main measure for preventing HAI. Although it the practice of hand hygiene is well stablished and disseminated, ensuring its compliance in different healthcare situations is still a challenge. Therefore, strategies to increase such compliance are relevant to hospitals.

In this study, we observed an overall percentage of compliance of 55.9% using the powdered gloves and 60.4% using the powder-free gloves. Our observations are similar to other studies, although they did not reported whether gloves were powdered or not. In a study at the emergency department of a university hospital in Brazil, a hand-hygiene percentage of compliance of 54.2% was observed among 59 healthcare workers [(22)]. In another quasi-experimental study carried out in 55 departments of 43 hospitals in Costa Rica, Italy, Mali, Pakistan, and Saudi Arabia, a total of 21,884 hand-hygiene opportunities were identified, with compliance of 51% of the time [(23)].

A study performed in five ICU of four hospitals in Texas evaluated a total of 3,620 opportunities for hand hygiene, which were recorded during 18 days of observation (144 hours), and a proportion of compliance of 64% was observed [(24)].

After implementing the use of powder-free gloves in the ICU, we observed an increased hand-hygiene percentage of compliance of 60%, which was statistically significant, but still modest. The possibility of using ABHR after removing the powder-free gloves may have contributed to such an increase in the percentage. During health care, it is often unfeasible for clinicians to sanitize hands with soap and water. For instance, while bathing a patient, HCW perform intimate hygiene and then continue bathing the patient; in this case, they would need to remove gloves and apron to wash their hands. If they were wearing powder-free gloves, they could have removed them and cleansed their hands with ABHR from the bedside, what would encourage the practice of hand hygiene.

We observed an increase in ABHR use before contact with patients, thus increasing compliance in this opportunity, which might have been facilitated by the availability of ABHR at the bedside. If HCW sanitize their hands at a sink away from the bed, they can contaminate their hands again while returning to the patient's bed.

A study carried out in a 404-bed hospital in the Midwestern United States found that visibility and accessibility to the hand hygiene disinfectant at the entrance to the patient's room was statistically associated with higher compliance rates [(25)].

Another investigation was conducted with 350 HCW in the United States and Canada to identify factors interfering with hand-hygiene compliance. The study showed that more than 50% of participants agreed or strongly agreed that they would be more likely to clean their hands if the ABHR was closer to patients [(13)].

We also observed an increase in ABHR use before aseptic procedures. This might be due to the ABHR availability at the bedside and by the fact that gloves were powder-free, since HCW could use the ABHR to clean their hands immediately before performing any procedure.

A study carried out in Brazil showed a hand-hygiene percentage of compliance of 18.4% before aseptic procedures. The authors point out that the main reason might be that healthcare workers wears gloves and assumes that he does not need to perform hand hygiene [26]. It is possible that some HCW believe that wearing gloves can dispense with the need for hand hygiene. However, it is also true that there may be a difficulty in performing hand hygiene when using powdered gloves.

After contact with fluids and/or secretions, no significant changes were noted for hand-hygiene compliance or for ABHR use. However, hand hygiene was high (almost 100%) for either type of glove, showing that HCW are indeed concerned with their exposure to diseases after completion of procedures that included contact with fluids. In a study in a neonatal ICU in Brazil, HCW avoided ABHR after performing procedures, using ABHR only 1.7% of opportunities, while general compliance hand hygiene was 61.7% [27].

After contact with patients, hand-hygiene compliance was slightly lower with powder-free than with powdered gloves. The proportion of use of ABHR was also reduced. HCW claimed a preference for handwashing with soap and water after touching patients because they find it more effective.

Hand hygiene after contact with surfaces increased slightly, as well as ABHR use when using powder-free gloves. When touching surfaces, HCW may have a false sense of reduced risk of contamination, since they are not touching the patient or body fluids directly, leading them to assume that they could use ABHR instead of hand washing. The use of powder-free gloves enables the provider to make that choice.

In our study, all participant HCW in the unit reported preference for powder-free gloves because they cause less dry skin when compared to powdered ones. They also reported regular nasal discomfort due to powder inhaling when wearing powdered gloves. When comparing vinyl and latex gloves, workers reported no preference since both are resistant to care performance. Only two HCW reported some discomfort when wearing powder-free gloves, but even they still preferred to wear them to powdered gloves.

One of the limitations of this study was that we only tested the gloves in one ICU unit with 40 HCW. It would also be important to have a longer period of observation (more event opportunities) as well as some measures of comfort and hand conditions that could evaluate not only the compliance with hand hygiene, but also the effects on the HCW hand skin.

Conclusion

Our data indicate that replacing powdered gloves with powder-free gloves had a positive influence on hand-hygiene compliance among the HCW in the studied intensive care unit.

Abbreviations

HCW: healthcare workers; ABHR: Alcohol-based hand-rub; ICU: intensive care unit; WHO: World Health Organization; HAI: Healthcare-associated infections; 95% CI: 95% Confidence Interval; Food and Drug Administration (FDA); N: number.

Declarations

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

Authors' contributions: study concept and design: FBR; MGM; AML. Acquisition of data: MGM. Drafting of the manuscript: FBR; MGM; AML. Statistical analysis: MAC; MGM. Critical revision of the manuscript for important intellectual content: FBR; MGM; AML; MAC; SRMSC; EG; ABF; MAM. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This research was approved by the research ethics committee of the institution under number CAAE 69241417.8.0000.5440.

Consent for publication: not applicable.

Competing interests

The authors declare that they have no competing interest. None of the authors have any conflicts of interest to disclose.

Availability of data and materials: the anonymized datasets analyzed during the current study are available from the corresponding author (MGM; mayramengueti@eerp.usp.br) on reasonable request, as

long as this meets local ethics and research governance criteria.

Consent to participate: All study participants signed the informed consent form.

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Figures

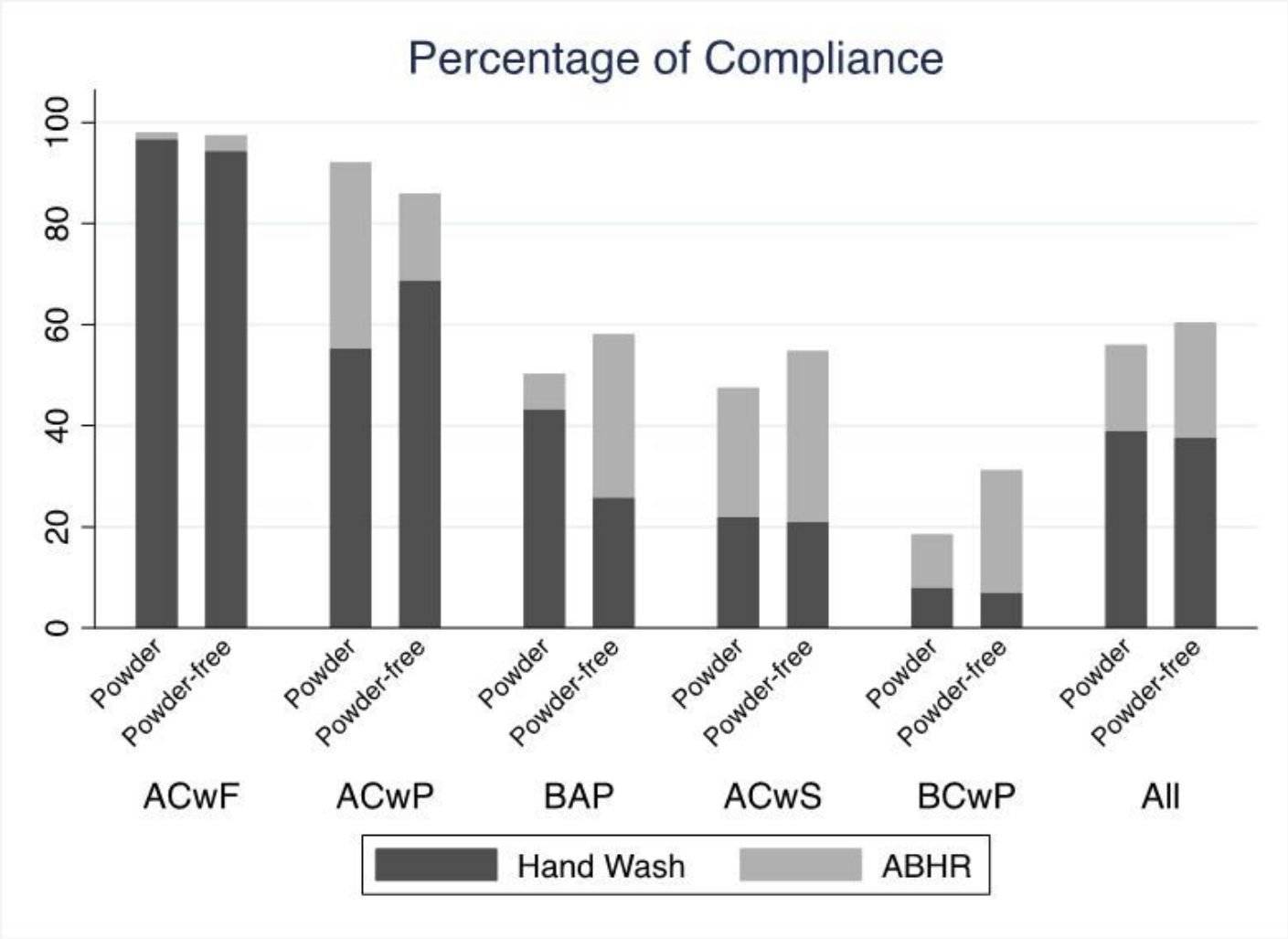

Figure 1

Percentages of compliance with hand hygiene practices with powdered and powder-free gloves, overall and by type of opportunity

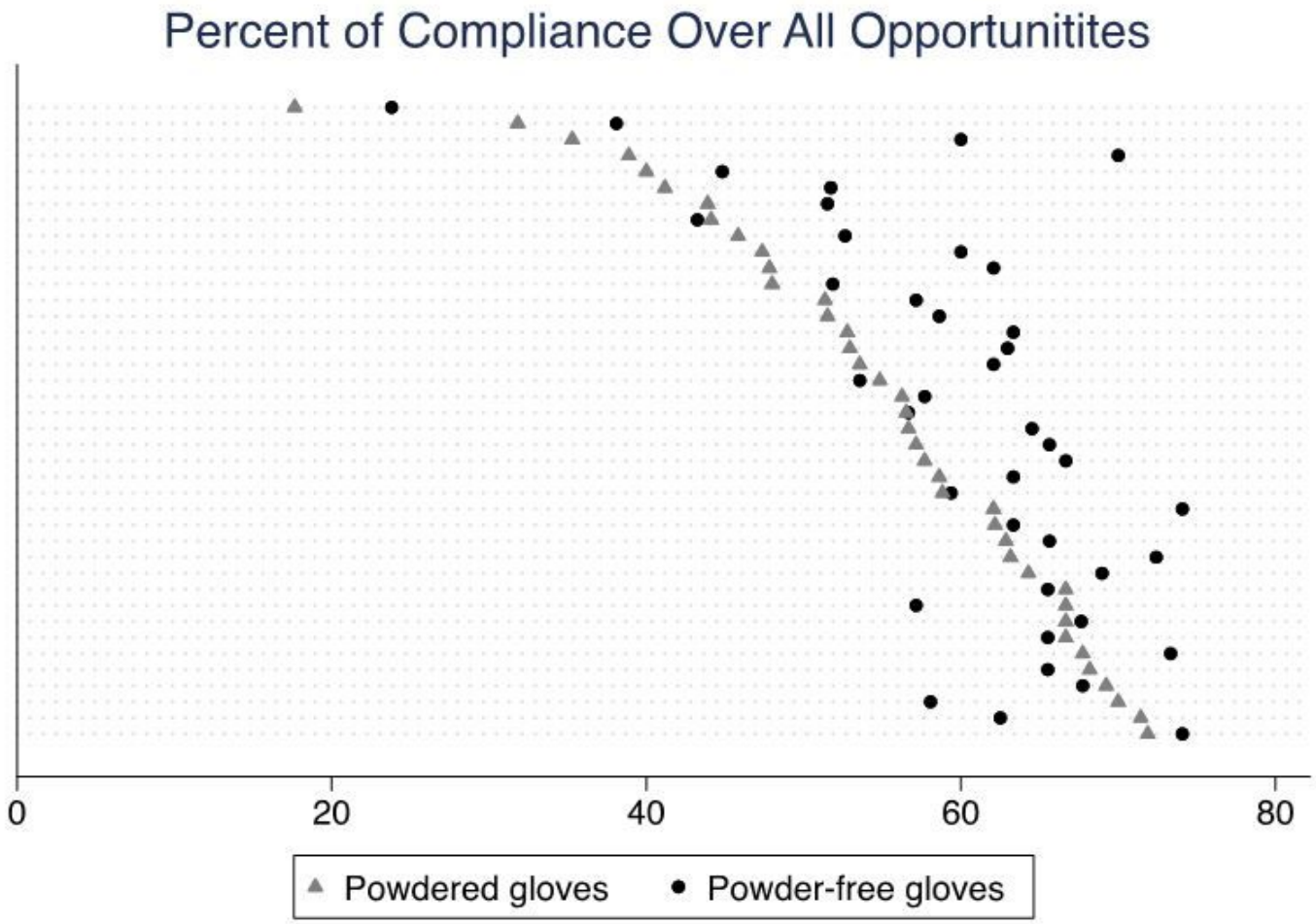

Figure 2

Compliance with hand hygiene for each studied healthcare workers, wearing each type of gloves

Supplementary Files

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