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Prophylactic Dressings for Maintaining Skin Integrity of Healthcare Workers When Using N95 Respirators While Preventing Contamination Due to the Novel Coronavirus

A Quality Improvement Project

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ABSTRACT

PURPOSE: Extended use of N95 respirator masks is far more prevalent during the coronavirus disease 2019 (COVID-19) pandemic. As WOC nurses, we were tasked with formulating procedures for protecting the facial skin integrity of healthcare workers (HCWs) using personal protective devices when caring for patients with suspected or active COVID-19, while avoiding contamination when the masks are donned or doffed. This quality improvement project describes how we approached this project within the limited time frame available as we cared for patients with established and suspected COVID-19.

PARTICIPANTS AND SETTING: This project focused on HCW use of N95 respirator masks and dressings currently available in our facility. The 4 WOC nurses acted as quality improvement project directors and as participants. The setting for our project was our facility's simulation laboratory.

APPROACH: We evaluated 6 topical products (an alcohol-free liquid acrylate, thin film dressing, thin hydrocolloid dressing, hydrocolloid blister care cushion, thin foam transfer dressing, and thick foam dressing) applied to skin in contact with 3 N95 respirators; all are available on our facility's formulary and all are in widespread clinical use. After the product was applied to the face and nose, the N95 respirator was donned and evaluated for fit. Participants then wore the devices for 10 hours and doffed the mask using established facility procedures. In order to evaluate for potential contamination including possible aerosolization, we applied a commercially available fluorescent lotion to simulate the presence of infectious particles. Contamination was assessed using an ultraviolet light for all dressings except for the alcohol-free liquid acrylate. We also evaluated cutaneous responses (skin integrity, irritation, comfort) during this period.

OUTCOMES: We found that contamination of the simulated pathogen did not occur with removal of any of the protective products. No skin irritation was noted with any of the tested products after a 10-hour wear time underneath the N95 respirator masks, but mild discomfort was experienced with 3 of the dressings (thin film dressing and both hydrocolloid dressings).

CONCLUSION: Based on these experiences, we recommend application of an alcohol-free liquid acrylate film to prevent facial skin injury associated with friction from the extended use of an N95 respirator mask. We further recommend performing a fit test and user-performed seal check with the use of any topical dressing and especially those that add cushion. For the duration of the COVID-19 pandemic, we recommend use of protective dressings to maintain skin integrity and protection from coronavirus infection as HCWs continue to provide care to all of patients under their care.

KEYWORDS: Coronavirus, COVID-19, Healthcare worker, Masks, Medical device–related pressure injury, N-95 respirator mask, Prevention, Skin care.

INTRODUCTION

The novel coronavirus, which causes the disease COVID-19, is a new strain that has a high rate of transmission, morbidity, and mortality, resulting in a global pandemic.[1] Healthcare workers (HCWs) must use personal protective equipment (PPE), including an N95 respirator mask, to prevent transmission of the virus. However, prolonged use of PPE has led to nationwide shortages, resulting in optimization of supply usage. One

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of these strategies is to extend the use of disposable N95 respirator masks.[1] The Centers for Disease Control and Prevention (CDC) defines extended use as wearing the same N95 respirator mask between COVID-19 patient encounters without removal. This method is recommended because it carries the least risk for contamination associated with frequent donning, doffing, and manipulation of the PPE.[2] However, prolonged use has also resulted in skin damage among HCWs, especially on the nasal bridge and cheeks.[3] Thus, an immediate need for safe and effective guidelines for the healthcare community pertaining to facial skin breakdown from PPE has occurred.[3] Adequate skin protection not only provides overall comfort for the frontline HCW but also prevents pathogen entry via any break in the skin, the body's first line of defense.[4-6] According to the National Pressure Injury Advisory Panel (NPIAP), medical device–related pressure injury has been extensively discussed with numerous evidence-based practice guidelines on how to mitigate its occurrence in patients but not in HCWs.[5,7]

Protection of the skin is a core objective and value of WOC nursing; this mission extends to protecting colleagues' skin during prolonged wear time. We were also challenged to formulate a procedure that prevents contamination when donning and doffing of N95 respirator masks along with any protective topical dressing. Information regarding this topic is limited but rapidly evolving.[1,5,7,8] Early recommendations included application of protective ointments or thin film dressings to areas subject to adhesion, pressure, and friction, along with adequate hydration and maintenance of a daily skin care routine.[9-12] Evidence on whether the use of these products compromises the efficacy of the PPE and the safety of the HCW is sparse. In addition, no known skin protection product has been specifically tested for permeability to the novel coronavirus.[5,10]

To address this unique situation, our WOC nurse team compared 4 different categories of prophylactic dressings under N95 respirator masks. Our aims were to guide our facility's procedures in the areas of (1) prevention of facial skin breakdown of HCWs while maintaining the appropriate fit of N95 respiratory masks and (2) prevention of self-contamination via aerosolization while doffing these topical devices. We used the outcomes of this quality improvement project to assist the WOC team in formulating a guideline for HCWs in our facility.

APPROACH

We evaluated 3 N95 respirator masks already in widespread use in our facility; 2 are masks that have no added features for comfort (Figures 1 and 2), and 1 mask has built-in padding for the nose (Figure 3). The N95 respirator masks we used were the N95 Moldex 1500 Series (Moldex, Culver City, California), N95 Healthcare and Surgical Mask, Halyard FLUIDSHIELD* N95 Particulate Filter Respirator and Surgical Mask (Halyard, Alpharetta, Georgia), and 3M Disposable Respirator 1870+ (3M, Minneapolis, Minnesota). All of these personal protective devices were applied using current facility procedures.

Figure 2. N95 respirator mask 2 with goggles.

In order to protect skin in contact with these devices, we selected 6 products (5 dressings and a liquid polymer acrylate). Five were already on our facility's formulary, and one was bought at a local drugstore, with the intention of adding it to the formulary pending the results of this study. The products we evaluated were an alcohol-free liquid acrylate dressing (Adapt No Sting Skin Protective Wipe; Hollister, Libertyville, Illinois), a thin film dressing (3M, Saint Paul, Minnesota), a thin hydrocolloid dressing (Convatec, Bridgewater, New Jersey), a hydrocolloid blister care cushion (Band-Aid; Johnson & Johnson Consumer Health, Skillman, New Jersey), a silicone-based thin foam transfer dressing (Mölnlycke, Peach Tree Corner, Georgia), and a hydrophilic polyurethane membrane matrix with a semipermeable polyurethane dressing as a thicker foam element (Ferris Mfg Corp, Fort Worth, Texas). Dressings were selected that met the following characteristics: (1) designed to protect the skin from friction, pressure, or moisture; (2) comfortable to wear on the face; and (3) easy to don and doff (ie, easy to apply and remove). Since our target audience was HCWs practicing in our facility, 4 WOC nurses in our department applied masks and dressings to themselves. Thus, they acted both as project administrators and participants in this quality improvement project.

Each WOC nurse applied each of the 5 dressings on the bridge of the nose and the cheekbones, performed a seal check using procedures described elsewhere,[13-15] wore the mask and dressing for 3 to 10 hours underneath the 2 N95 respirator masks that covered the nose and mouth, and made note of any skin irritation or discomfort associated with wearing the mask. Because the third N95 respirator included a nose cushion, we limited our evaluation of this device to the alcohol-free liquid acrylate dressing. We made this decision because the additional padding provided by the foam and thin hydrocolloid dressings was deemed duplicative and might adversely affect device fit (Figures 1-3). The thin hydrocolloid dressing was cut into strips and applied to the bridge of the nose and cheekbones. This process was repeated for all dressings that we have tested under the N95 respirator masks (Figures 4A, 4B, 5A, and 5B).

Figure 1. N95 respirator mask 1.

Figure 3. N95 respirator mask 3.

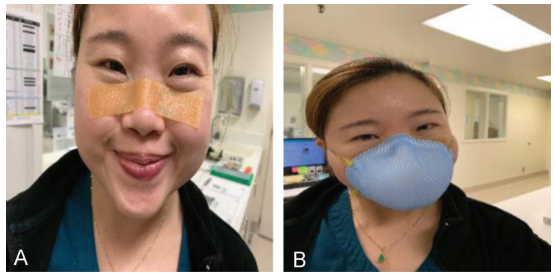

Figure 4. (A, B) Thin hydrocolloid dressing and N95 respirator mask 1. (A) Thin hydrocolloid dressing applied to the bridge of the nose and cheekbones. (B) Appearance of thin hydrocolloid dressing after mask 1 is applied and checked for fit.

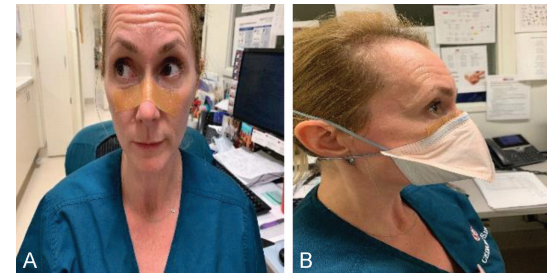

Figure 5. (A, B) Thin hydrocolloid dressing with N95 respirator mask 2. (A) Thin hydrocolloid dressing applied to the bridge of the nose and cheekbones. (B) Appearance of thick hydrocolloid dressing after N95 respirator mask 2 is applied and checked for fit.

We applied the alcohol-free liquid acrylate to the bridge of the nose, cheekbones, chin, and areas behind the ears to match the contours of the N95 respirator it was tested with, as well as the forehead for protection from goggles if worn by staff (Figures 6A-6D). At the time of this study, our facility was not yet providing eye protection to all staff members. We observed some staff members using store-bought goggles; therefore, we took its use into consideration.

Using the simulation laboratory at our facility, we observed for self-contamination while doffing PPE and removal of the protective dressing under ultraviolet (UV) light. A commercially available fluorescent lotion (Glo Germ lotion; Glo Germ Co, Moab, Utah) was used to simulate the presence of infectious particles. This lotion has been repeatedly used at our hospital to train staff in the proper technique for handwashing and donning and doffing of PPE by observing users' hands under UV light to see if the simulated germs were effectively washed away or if the user was self-contaminated in the doffing process. Previous studies have used a similar germ-simulating product to visualize cross contamination in the food industry and the healthcare setting.[16-19]

The germ-simulating lotion was liberally applied to each dressing on the participant's face to represent respiratory droplets. The mask was applied using CDC-recommended guidelines for donning and doffing.[20] Dressings were also applied and removed using manufacturer instructions and facility policies. After wearing, the participant then removed each dressing as quickly and comfortably as possible in an attempt to simulate aerosolization or other contamination of infectious particles. While under a UV light, 3 members of the WOC nurse team (who had worn the mask and dressing) observed for evidence of aerosolization or other contamination upon doffing, and we carefully inspected the WOC nurse's face who had worn the mask and dressing for any other areas of contamination. We documented contamination using photography and videos taken using a mobile camera (iPhone; Apple, Cupertino, California). Photographs and videos were carefully scrutinized at the end of the simulation for additional evidence of aerosolized droplets in the air or on the subject's clothing, hands, face, neck, and hair and for other evidence of contamination.

The alcohol-free liquid acrylate was excluded from UV testing. Removal of this product involves use of an adhesive remover wipe and washing with soap and water. In theory, the vigorous scrubbing needed to remove all residues should also remove potential infectious particles, as with handwashing. In our experience, the fluorescent lotion is difficult to completely wash away. Therefore, observation of removal under UV light may have been misleading. Since the liquid acrylate wears like a "second skin," we hypothesize it does not prompt possible self-contamination via readjustment of the mask or dressing as much as the other products tested.

OUTCOMES

We found no evidence of contamination of the germ-simulating lotion with removal of any of the 5 dressings we evaluated (Table). In addition, we did not experience skin irritation or loss of skin integrity with any of the tested products after a 10-hour wear time underneath the N95 respirator masks (Table). We found that all dressings provided protection from friction. Thicker dressings provided more padding for pressure relief. Indentations from the mask were still noted on the wearer's face with all dressings except the hydrophilic polyurethane membrane matrix (thick foam) dressing. However, the added bulk of this dressing made it difficult to achieve an occlusive seal and caused the N95 respirator to slip from the bridge of the wearer's nose, creating a possibility of contamination.

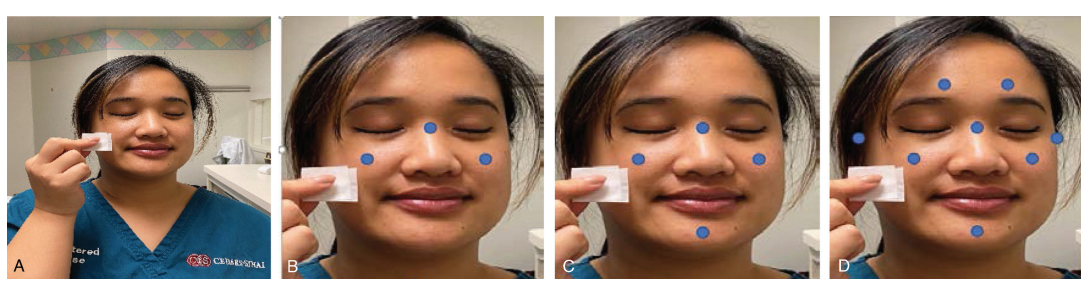

Figure 6. (A-D) Alcohol-free liquid acrylate film skin barrier. (A) Alcohol-free liquid acrylate film skin barrier applied starting at the right side of the cheeks. (B) Application of alcohol-free liquid acrylate film skin barrier continued to dotted areas of bilateral cheeks and the bridge of the nose. (C) Application of alcohol-free liquid acrylate film skin barrier continued to dotted area on the chin. (D) Application of alcohol-free liquid acrylate film skin barrier continued to dotted areas of the forehead and behind the ears.

TABLE 1.
Dressing Comparison Result

Dressing Type	Type of Protection Provided	Comfortable	Easy to Apply	Easy to Remove	Disruption of Mask Seal (Fit)	Skin Irritation Associated With the Mask	Contamination	Additional Notes
Alcohol-free liquid acrylate dressing	Friction	Yes	Yes	Yes	No	No	No	
Thin hydrocolloid dressing	Friction Pressure	Yes	Yes	Yes, but painful	No	No	No	Customizable Adhesive
Hydrocolloid blister care cushion	Friction Pressure	Yes	Yes	Yes, but painful	No	No	No	Adhesive Premade, compact dressing size User-friendly application
Thin film dressing	Friction	Yes	Yes	No	No	No	Likely	Adhesive Difficult to remove
Silicone-based transfer dressing (thin foam)	Friction Pressure	Yes	Yes	Yes	No	No	Yes	Minimally adherent Customizable Easily falls off or slides out of place.
Hydrophilic polyurethane membrane matrix with a semipermeable polyurethane dressing (thick foam)	Friction Pressure	Yes	No	Yes	Yes	No	No	Nonadhesive Must be used with tape or adherent dressing.

Otherwise, all other dressings passed the user-performed seal check.

PROJECT LIMITATIONS

Due to the urgency of the need that drove our quality improvement project, we acknowledge limitations to findings. All dressings were tested and evaluated exclusively by 4 WOC nurses, resulting in a small test population. All findings in this study are observational and influenced by our experience as clinicians, by individualized pain tolerance, and by individualized characteristics of our skin. At the time of the study, our hospital was limiting the use of Qualitative Fit Test Kits and N95 respirator masks for direct patient care needs alone. Therefore, we were not able to fit test our N95 respirator masks after the application of these products, so a user-performed seal check was done instead. This test alone is not typically used to determine proper fit.[13-15] In the simulation laboratory, we had limited ability to simulate aerosolization of germ-simulating lotion. In order to address this limitation, we liberally applied the product and purposely simulated rough handling of the dressings. We have previously observed this phenomenon in germ-simulating powder from a previous training setting, but this formulation was not available for use at the time of this study.

DISCUSSION

Contamination was not observed with removal of any of dressings we evaluated. While we found that 3 of the dressings created discomfort with removal of topical adhesives, we ultimately concluded that this outcome may have paradoxically limited aerosolization or other contamination since it required the wearer to handle the dressing more carefully. The alcohol-free liquid acrylate film dressing was removed with an adhesive remover and washing with soap and water. Because

Figure 7. (A-D) Silicone-based thin foam transfer dressing. (A) Germ-simulating lotion as seen under UV light applied on the surface of the silicone-based thin foam transfer dressing; the dressing was applied from one side of the cheek to the other side across the bridge of the nose. (B) Removal of the silicone-based thin foam transfer dressing started at the right side of cheek. (C) Removal of the silicone-based thin foam transfer dressing ending toward the left side of cheek, with no visible contamination of facial skin. (D) Silicone-based thin foam transfer dressing completely removed with no contamination on facial skin.

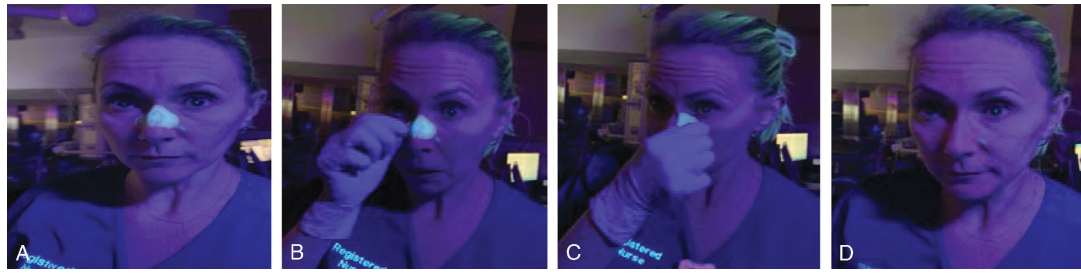

Figure 8. (A-D) Hydrocolloid blister care cushion. (A) Germ-simulating lotion as seen under UV light applied to the surface of hydrocolloid blister care cushion dressing; the dressing was applied to the bridge of the nose. (B) Removal of dressing started at one side of the hydrocolloid blister care cushion dressing. (C) Removal of hydrocolloid blister care cushion dressing is completed. (D) Hydrocolloid blister care cushion dressing is completely removed with visible skin contamination intended by the wearer to simulate infectious particles but no aerosolization noted.

there was no adhesive appliance to remove, we hypothesize there was nothing to aerosolize.

We found the dressings evaluated were comfortable to wear, easy to apply, and easy to remove. The foam dressings and the thin hydrocolloid dressing were easily customized in a cut-to-fit fashion to the wearer's preference. We hypothesize that a cut-to-fit approach of the thin hydrocolloid dressing may be a cost-effective solution since 1 unit of product may be cut into multiple pieces (Figures 7A-7D). However, this may be more time-consuming in preparation and application. The hydrocolloid blister care cushion was commercially ready-made and potentially more user-friendly (Figures 8 A-8D). The thick foam dressing (hydrophilic polyurethane membrane matrix with a semipermeable polyurethane) was nonadherent and required the use of an additional adhesive product, as well as more surface area for dressing application. In this case, the dressing's border was extended near the subject's eyes. The thin foam dressing was minimally adherent. The use of a secondary adhesive product would help with securement, but similar issues with the need for additional surface area would then arise. We experienced mild pain upon removal of the thin film dressing, and both hydrocolloid dressings. Removal of the customized hydrocolloid strips may have been mildly painful due to the larger application surface. Pain was reduced with the use of a skin adhesive remover wipe.

In addition to aerosolization, our observations led us to conclude that other avenues for self-contamination may occur. The thin film dressing, which has the lowest profile of all the topical adhesive dressings, was difficult to remove with tactile cues alone. We assert this may produce a potential for contamination since it required the most manipulation to remove (Figures 9A-9D). The thin foam dressing (silicone-based transfer dressing) allowed the germ-simulating lotion to transfer directly onto the skin underneath. This implies that porous dressings may allow the transfer of fluids or microorganisms to the skin. If using a foam dressing, the outer layer should be nonpermeable (Figures 10A-10D). The bulky nature of the thick foam dressing (hydrophilic polyurethane membrane

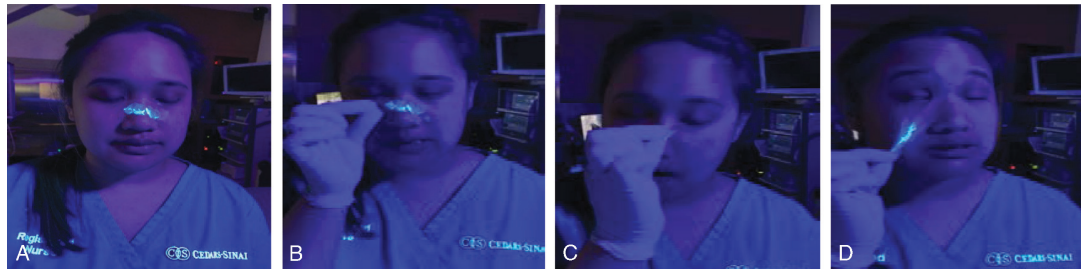

Figure 9. (A-D) Thin film dressing. (A) Germ-simulating lotion as seen under UV light applied to the surface of thin film dressing that was applied to the bridge of the nose. (B) Removal of thin film dressing started at one side and then across the bridge of the nose. (C) Removal of thin film dressing continued across the bridge of the nose. (D) Removal of thin film dressing ended with difficulty noted from the wearer with tactile cues provided by the WOC nurses observing the removal; no visible contamination of facial skin.

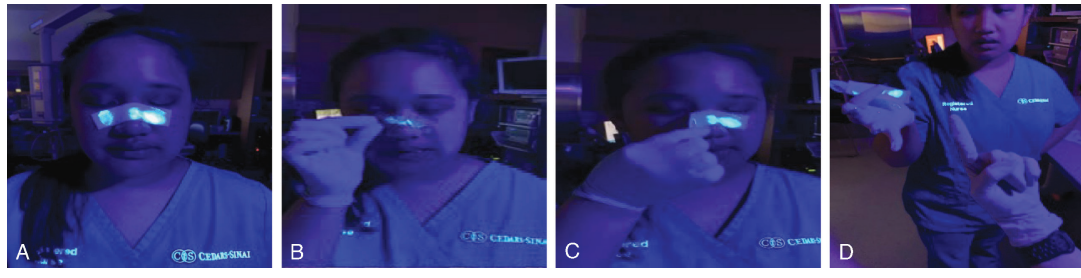

Figure 10. (A-D) Silicone-based transfer dressing. (A) Germ-simulating lotion as seen under UV light applied to the surface of silicone-based transfer dressing—dressing applied to the bridge of the nose. (B) Removal of silicone-based transfer dressing started at one side and then across the bridge of the nose. (C) Removal of silicone-based transfer dressing continued across the bridge of the nose. (D) Silicone-based dressing is completely removed, with no visible contamination of facial skin; noted transfer of germ-simulating lotion onto glove from skin side of silicone-based transfer dressing.

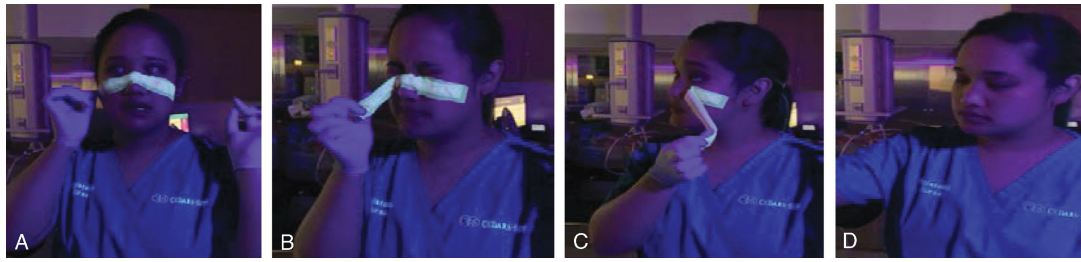

Figure 11. (A-D) Hydrophilic polyurethane membrane matrix with a semipermeable polyurethane plus thin hydrocolloid. (A) Germ-simulating lotion as seen under UV light applied to the surface of thin hydrocolloid dressing securing the hydrophilic polyurethane membrane matrix with a semipermeable polyurethane—dressing applied across the bridge of the nose and from one side of the cheek to the other. (B) Removal of dressing started at the right cheek and proceeded across the bridge of the nose. (C) Removal of dressing continued across the bridge of the nose toward the left cheek. (D) Hydrophilic polyurethane membrane matrix with a semipermeable polyurethane plus thin hydrocolloid as a secondary dressing is completely removed. Difficulty was noted during removal, but no visible contamination of the facial skin was observed.

matrix with a semipermeable polyurethane) caused the N95 respirator mask to be easily displaced. This resulted in frequent manipulation and readjustment of the mask by the wearer (Figures 11A-11D).

Our observations during this procedure also led us to conclude that contamination of surfaces and exposure to airborne particles are possible during dressing changes of colonized wounds.[21] Nevertheless, we searched the literature and found no specific studies demonstrating aerosolization of respiratory droplets while doffing facial PPE.

Next Steps and Recommendations for Practice

The results of this initiative guided creation of a resource for our facility's inpatient staff regarding skin protection with extended wear of the N95 respirator mask during this COVID-19 pandemic. The alcohol-free liquid acrylate dressing was the only prophylactic dressing at our facility that met all the criteria established at the beginning of this study. Application of this product before donning of the N95 respirator mask provides comfort and protection from friction, maintains an accurate seal, and offers easy application and removal with nothing to aerosolize for potential of self-contamination. It does not provide pressure relief. Preliminary findings demonstrate the successful use of thin hydrocolloid dressings without contamination and aerosolization upon dressing removal. However, we recommend caution when exploring topical dressing options that offer more padded protection from tight-fitting respirators, since these may affect the appropriate fit and thereby compromise the safety of the HCW. Regulatory entities and all manufacturers' guidelines at the time of this study indicated that the application of any topical dressing between the HCW and the N95 respirator mask is discouraged and would require a fit test with each application.[1,2,13-15,22]

CONCLUSIONS

Based on outcomes of this quality improvement project, we recommend application of an alcohol-free liquid acrylate film dressing to prevent facial skin injury associated with friction from the extended use of an N95 respirator mask. We further recommend performing a fit test and user-performed seal check with the use of any topical dressing and especially those that add cushion. For the duration of the COVID-19 pandemic, HCWs in our facility will continue to use protective dressings to maintain skin integrity and protection from coronavirus infection as HCWs continue to provide care to all of patients under their care.

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REFERENCES

1. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19) interim guidance for conserving and extending filtering facepiece respirator supply in non-healthcare sectors. https://www.cdc.gov/coronavirus/2019-ncov/community/conserving-respirator-supply.html. Accessed April 23, 2020.
2. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19) strategies for optimizing the supply of N95 respirators. https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html. Accessed April 23, 2020.
3. Lan J, Song Z, Miao X, et al. Skin damage among health care workers managing coronavirus disease-2019. *J Am Acad Dermatol*. 2020;82(5):1215-1216.
4. Yan Y, Chen H, Chen L, et al. Consensus of Chinese experts on protection of skin and mucous membrane barrier for health-care workers fighting against coronavirus disease 2019. *Dermatol Ther*. 2020:e13310. doi:10.1111/dth.13310.
5. Gefen A, Ousey K. Update to device-related pressure ulcers: SECURE prevention. COVID-19, face masks and skin damage. *J Wound Care*. 2020;29(5):245-259.
6. Tao J, Song Z, Yang L, Huang C, Feng A, Man X. Emergency management for preventing and controlling nosocomial infection of the 2019 novel coronavirus: implications for the dermatology department. *Br J Dermatol*. 2020;182(6):1477-1478.
7. Gefen A, Alves P, Ciprandi G, et al. Device-related pressure ulcers: SECURE prevention. *J Wound Care*. 2020;29(suppl 2a):S1-S52.
8. WOCN Taskforce Board of Directors. Guidance for maintaining skin health when utilizing protective masks for prolonged time intervals. *J Wound Ostomy Continence Nurs*. 2020;47(4):317-318.
9. Alves P, Moura A, Vaz A, Ferreira A, Malcato E, Mota F, et al. PRevenção de lesões cutâneas causadas pelos Equipamentos de Proteção Individual (Máscaras faciais, respiradores, viseiras e óculos de proteção). *J Tissue Healing Regen*. 2020 (Supplement to October/March XV edition):1-8.
10. Gefen A, Alves P. Protect your facial skin to reduce your risk of infection: practical guidance to clinicians [white paper]. https://cdn.ymaws.com/www.wocn.org/resource/dynamic/forums/20200401_101834_30410.pdfAvailable; https://www.wocn.org/forums/Posts.aspx?topic=1540266. Published 2020. Accessed April 23, 2020.
11. Zhou NY, Yang L, Dong LY, et al. Prevention and treatment of skin damage caused by personal protective equipment: experience of the

first-line clinicians treating 2019-nCoV infection. *Int J Dermatol Venereol*. 2020. doi:10.1097/JD9.0000000000000085.
12. Kelechi TJ, Brunette GL, Lee LW. Personal protective equipment-related equipment dermatitis: a view from here. *J Wound Ostomy Continence Nurs*. 2020;47(4):324-325.
13. 3M. 3M Disposable Respirator 1870+, N95 technical data sheet. https://multimedia.3m.com/mws/media/1538980O/3m-disposable-respirator-1870-technical-data-sheet.pdf. Accessed April 6, 2020.
14. Halyard. Respiratory Protection Program qualitative fit test instructions. https://www.halyardhealth.com/media/128701/c15445_respirator_fit_test_instructions_brochure.pdf. Accessed April 6, 2020.
15. Moldex. Data sheet 1500 Series N95 healthcare and surgical mask. https://www.moldex.com/wp-content/uploads/1500-807-REV-A-1-19-data-sheet.pdf. Accessed April 6, 2020.
16. Blenkharn JI. Luminol-based forensic detection of latent blood; an approach to rapid wide-area screening combined with Glo-Germ™ oil simulant studies. *J Hosp Infect*. 2008;69(4):405-406.
17. Mittal MK, Morris JB, Kelz RR. Germ simulation: a novel approach for raising medical students awareness toward asepsis. *Simul Healthc*. 2011;6(2):65-70.
18. Osei-Bonsu K, Masroor N, Cooper K, et al. Alternative doffing strategies of personal protective equipment to prevent self-contamination in the health care setting. *Am J Infect Control*. 2019;47(5):534-539.
19. Schirmer A, Swan C, Hughes SJ, et al. Break scrub to take that phone call? *J Am Coll Surg*. 2018;226(6):1117-1121.
20. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19) using PPE. https://www.cdc.gov/coronavirus/2019-ncov/hcp/using-ppe.html. Published 2020. Accessed April 23, 2020.
21. Sergent AP, Slekovec C, Pauchot J, et al. Bacterial contamination of the hospital environment during wound dressing change. *Orthop Traumatol Surg Res*. 2012;98(4):441-445.
22. Occupational Safety and Health Administration. *Occupational Safety and Health Standards, in 1910 Subpart I. Personal Protective Equipment. Respiratory Protection*. Washington, DC; OSHA; 2019.