Title: Fit evaluation of NIOSH Approved N95 filtering facepiece respirators with various skin protectants: a pilot study

Introductory Information

Widespread disease outbreaks can result in prolonged wear times of National Institute for Occupational Safety and Health (NIOSH) Approved® N95® filtering facepiece respirators by healthcare personnel. Prolonged wear times of these devices can cause the development of various adverse facial skin conditions. Healthcare personnel have been reported to apply "skin protectants" to the face to reduce pressure and friction of respirators. Because tight-fitting respirators rely on a good face seal to protect the wearer, it is important to understand if fit is affected when skin protectants are used.

In this laboratory study, volunteers performed quantitative fit tests to evaluate respirator fit while wearing skin protectants. Three NIOSH Approved® N95® filtering facepiece respirator models and three skin protectants (bandage-type, surgical tape, and barrier cream) were evaluated. Three replicate fit tests were performed for each combination of subject, skin protectant (including a control condition of no protectant), and respirator model.

Respirator users should follow the respirator manufacturer's guidance on the use of skin protectants. Fit testing should be performed with the skin protectant prior to use in the workplace.

Methods Collection

Subjects

- Ten subjects (four males and six females) provided informed consent.
- Each subject had face length and face width measured.
- These measurements were then used to classify each subject into 1 of 10 cells according to the NIOSH Bivariate Panel.

N95 Filtering Facepiece Respirators

- One size: 3M Aura 1870+ (tri-fold design, one size)
- Two Size (regular and small)
    - 3M 8210 /8110S (cup-shaped design), and
    - Kimberly-Clark Fluidshield 46767/46867 (duckbill design)

Skin Protectants

- Johnson & Johnson Band-Aid® Flexible Fabric Bandage (3/4" x 3)
- 3M Durapore™ Surgical Tape
- 3M Cavilon™ Durable Barrier Cream, product no. 3355
- At the time of the study, none of the above three skin protectants in this study were recommended for use with the N95 models in this study by the FFR manufacturers.
- Using these specific protectant/N95 combinations in the workplace would not be consistent with each N95 model's individual NIOSH respirator approval.

Quantitative Fit Testing

- Subjects had to pass a quantitative fit test (i.e., have a fit factor ≥100) under the control condition (no application of a skin protectant) on at least one of the three N95 models which

determined each subject's best-fitting N95 size per model (for those models available in two sizes) to be worn during the evaluation using the skin protectants.
- Males were clean-shaven and all subjects were not instructed to remove any applied facial products and makeup or wash their face prior to testing.
- Skin protectants were self-applied by the subjects to the vulnerable areas on their face related to pressure-induced injury: the nose bridge and cheeks.
- Subjects donned and self-adjusted their N95 filtering facepiece respirator.
- A user seal check was performed prior to fit testing.
- The subjects performed the Occupational Safety and Health Administration (OSHA) accepted ambient aerosol condensation nuclei counter quantitative fit testing protocol using the PortaCount® Respirator Fit Tester (8048, TSI, St. Paul, MN, USA) operating in "N-95 mode" in a test chamber using supplemented sodium chloride aerosol.
- Passing fit factor (FF) ≥100.

Attribution

NIOSH Approved and N95 are certification marks of the U.S. Department of Health and Human Services (HHS) registered in the United States and several international jurisdictions.

Citation – Publication based on the data set

Bergman MS, Grinshpun SA, Yermakov MV, Zhuang Z, Vollmer BE, Yoon KN. 2023. Fit evaluation of NIOSH-Approved N95 filtering facepiece respirators with various skin protectants: a pilot study. Journal of Occupational and Environmental Hygiene, DOI: 10.1080/15459624.2023.2226180

Acknowledgements – none

Project support

This work was supported by the Centers for Disease Control and Prevention's (CDC) under an Emergency Resource Request (ERR) in response to the COVID-19 pandemic.

Disclaimer

Mention of any company or product does not constitute endorsement by NIOSH or CDC.

Authors

Michael S. Bergman MS, vzb3@cdc.gov
Sergey A. Grinshpun PhD, Sergey.Grinshpun@uc.edu
Michael V. Yermakov MD, yermakm@ucmail.uc.edu
Ziqing Zhuang PhD, zaz3@cdc.gov
Brooke E. Vollmer BS, pqg8@cdc.gov
Katherine N. Yoon PhD, qek7@cdc.gov

Contact

For further information contact:

Research Branch (RB)
National Personal Protective Technology Laboratory (NPPTL)
National Institute for Occupational Safety and Health (NIOSH)
626 Cochrans Mill Road
Pittsburgh, PA 15236
PPEConcerns@cdc.gov