Title: Face mask fit modifications that improve source control performance dataset

Introduction

SARS-CoV-2 is a highly infectious respiratory virus that is primarily transmitted by respiratory aerosols and droplets emitted during activities such as talking, breathing, and coughing. Because symptomatic and asymptomatic individuals with COVID-19 can exhibit a high viral load of SARS-CoV-2 in their respiratory fluids, the CDC recommends that people wear a face mask that covers the nose and mouth to reduce community transmission during the COVID-19 pandemic. Wearing a face mask to protect others from potentially infectious droplets, called source control, has been shown to be a highly effective infection control strategy to limit the spread of COVID-19. The presence of mask face seal leaks enables respiratory aerosols to escape out rather than pass through the filtering materials of the mask, consequently reducing the benefits of wearing a face mask for source control. As such, the current investigation examines various modifications that improve the fit of a medical or cloth face mask and reduce the amounts of expelled aerosols during simulated coughs and exhalations.

Methods

1. **Aerosol and Source Control Simulator**
    a. The source simulator had a head form with pliable skin coughed and exhaled aerosols produced from a 14% w/v KCl and 0.4% sodium fluorescein solution nebulized by a single jet Collison atomizer.
    b. An Anderson Impactor operating at 28.3 L/min was used to collect the aerosolized particles into seven size fractions by their aerodynamic diameter: <0.6 mm; 0.6-1.1 mm; 1.1-2.1 mm; 2.1-3.3 mm; 3.3-4.7 mm, 4.7-7.0 mm; and >7 mm.
    c. After aerosol collection was completed, the impactor plates were rinsed with 0.1 M Tris solution and the fluorescence of the solution was measured using a fluorometer (SpectraMax M4, Molecular Devices).
2. **Environmental Chamber and Respiratory Simulators**
    a. System comprised of a simulator that expels a test aerosol (the source) and a breathing simulator (the recipient) inside an experimental chamber.
    b. The testing environment consisted of an environment chamber measuring 3.15 m x 3.15 m x 2.26 m (gross internal volume of 23.8 m^3). An internal re-circulating HEPA filtration system was used for ventilation.
    c. Six Grimm 1.108 optical particle counters (OPCs) were positioned at height of 152 cm throughout the chamber to measure salt aerosols.
3. **Experimental Procedure**
    a. For experimental simulations, either a medical or cloth face mask (fit modified or unmodified) was placed on the respective simulator and fit measured using the PortaCount Pro+ in the N95 mode.
    b. The test aerosol was then generated and propelled with either a simulated cough or exhalation through the headform.

c. The total aerosol mass (µg) was used to measure the collection efficiency of face masks (with and without fit modification) and were compared with no mask controls using the source control measurement system.
d. For respiratory simulations, the mean mass aerosol concentration ($\mu g/m^3$) at the mouth of the unmasked recipient when no mask was worn by the source simulator was compared when a fit modified medical or cloth mask was worn.

4. Data Processing

a. Mask source control performance was assessed by calculating the collection efficiency which is defined as (= 1 –$M_{mask}/M_{control}$) where M_{mask} = total mass of the aerosol particles that passed through or around the fit modified source control device and was collected by the impactor and $M_{control}$ = total mass of the aerosol particles expelled by the source control measurement system without a face mask and collected by the impactor.
b. The mean mass aerosol concentration was calculated as the average mass concentration over the test duration and served as the exposure metric in exposure simulations.

Citation- Publications based on the dataset.

1. Blachere FM, Lemons AR, Coyle JP, Derk RC, Lindsley WG, Beezhold DH, Woodfork K, Duling MG, Boutin B, Boots T, Harris JR, Nurkiewicz T, Noti JD. Face mask fit modifications that improve source control. Am J Infect Control. In Preparation.
2. Lindsley WG, Blachere FM, Beezhold DH, Law BF, Derk RC, Hettick JM, Woodfork K, Goldsmith WT, Harris JR, Duling MG, Boutin B, Nurkiewicz T, Boots T, Coyle JP, Noti JD. A comparison of performance metrics for cloth masks as source control devices for simulated cough and exhalation aerosols. Aerosol Sci Technol. 2021:1-18.
3. Brooks JT, Beezhold DH, Noti JD, Coyle JP, Derk RC, Blachere FM, Lindsley WG. Maximizing Fit for Cloth and Medical Procedure Masks to Improve Performance and Reduce SARS-CoV-2 Transmission and Exposure, 2021. MMWR Morbidity and Mortality Weekly Report. 2021;70:254-7.

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