VIEWPOINT

Moving Personal Protective Equipment Into the Community
Face Shields and Containment of COVID-19

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On March 19, 2020, California became the first state to issue a stay-at-home order in response to the evolving coronavirus disease 2019 (COVID-19) pandemic. It was quickly recognized that widespread diagnostic testing with contact tracing, used successfully in countries such as South Korea and Singapore, would not be available in time to significantly contain the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1,2] Over the following month, additional nonpharmaceutical mitigation strategies, including school closures, bans on large in-person gatherings, and partial closures of restaurants and retail stores, were applied to "flatten the epidemic curve" and limit the peak effects of a surge of patients on health care systems. Yet, even as the benefits of mitigation bundles have not fully been realized, there are widespread calls to reopen businesses, given the immense economic and social consequences of extreme physical distancing strategies.

Recently, public health, infectious disease, and policy experts have outlined recommendations for gradually reopening society using combinations of containment and mitigation strategies.[3,4] Proposed containment strategies have followed the South Korean model and include rapidly expanding public health infrastructure for widespread testing and data-driven contact tracing, while ensuring that safe medical care is delivered by health care workers wearing adequate personal protective equipment (PPE), such as N95 respirators, medical masks, eye protection, gowns, and gloves. However, there is growing recognition that containment strategies that rely on testing will be inadequate because the necessary testing capacity may not be available for weeks to months, and in the US the ability to track, trace, and quarantine is unclear. In addition, countries where testing was not limited and containment was achieved, eg, Singapore, have seen substantial second waves of infection and mandated extreme distancing interventions that the US and other countries are trying to scale back.

> Face shields, which can be quickly and affordably produced and distributed, should be included as part of strategies to safely and significantly reduce transmission in the community setting.

The Infectious Diseases Society of America (IDSA) has included societal use of PPE, such as masks and face shields, in its recommendations for easing restrictions.[4] Experience and evidence, even during this pandemic, suggest that health care workers rarely acquire infections during patient care when proper PPE is used and that most of their infections are acquired in the community where PPE is typically not worn.[5] Thus, it becomes important to know if practice from occupational safety can be used in the community as a bridge to longer-lasting measures, such as vaccines. Could a simple and affordable face shield, if universally adopted, provide enough added protection when added to testing, contact tracing, and hand hygiene to reduce transmissibility below a critical threshold?

COVID-19 Transmission in the Community

The mode of transmission of respiratory viruses has long been a subject of debate. Evidence to date suggests that SARS-CoV-2 is spread like other respiratory viruses: by infectious droplets emitted in close proximity (ie, within 6 feet) to the eyes, nose, or mouth of a susceptible person, or by direct contact with those droplets (eg, touching a contaminated surface and then touching the eyes, nose, or mouth).[6] Although droplet vs airborne transmission is likely to be a continuum, with smaller droplets able to be propelled further than 3 to 6 feet and remaining airborne longer after certain respiratory emissions,[7] the implications of limited aerosol spread are most important in health care settings after aerosol-generating procedures, such as open suctioning of airways and endotracheal intubation or extubation.

Contact investigations for SARS-CoV-2 have confirmed community transmission rates that are consistent with droplet and contact spread (household attack rates of 10%, health care and community attack rates of <1%, and R_0 [the effective reproduction number, or average number of new infections caused by an infected individual during their infection] of 2-3),[5] and much different than for airborne viral pathogens, such as varicella zoster virus or measles (household attack rates of 85%-90% and R_0 of 10-18).

This implies that simple and easy-to-use barriers to respiratory droplets, along with hand hygiene and avoidance of touching the face, could help prevent community transmission when physical distancing and stay-at-home measures are relaxed or no longer possible. The 2 major options for such barriers are face masks and face shields.

Face Masks and Face Shields

The supply chain for medical masks is concentrated in China and the origin of the outbreak there resulted in factory closures and critical shortages. To preserve medical masks for health care facilities, the Centers for Disease Control and Prevention has recommended that

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all persons wear a cloth mask in public for source control. Cloth masks have been shown to be less effective than medical masks for prevention of communicable respiratory illnesses,[8] although in vitro testing suggests that cloth masks provide some filtration of virus-sized aerosol particles.[9] Face shields may provide a better option.

Face shields come in various forms, but all provide a clear plastic barrier that covers the face. For optimal protection, the shield should extend below the chin anteriorly, to the ears laterally, and there should be no exposed gap between the forehead and the shield's headpiece. Face shields require no special materials for fabrication and production lines can be repurposed fairly rapidly. Numerous companies, including Apple, Nike, GM, and John Deere, have all started producing face shields. These shields can be made from materials found in craft or office supply stores. Thus, availability of face shields is currently greater than that of medical masks.

Face shields offer a number of advantages. While medical masks have limited durability and little potential for reprocessing, face shields can be reused indefinitely and are easily cleaned with soap and water, or common household disinfectants. They are comfortable to wear, protect the portals of viral entry, and reduce the potential for autoinoculation by preventing the wearer from touching their face. People wearing medical masks often have to remove them to communicate with others around them; this is not necessary with face shields. The use of a face shield is also a reminder to maintain social distancing, but allows visibility of facial expressions and lip movements for speech perception.

Most important, face shields appear to significantly reduce the amount of inhalation exposure to influenza virus, another droplet-spread respiratory virus. In a simulation study, face shields were shown to reduce immediate viral exposure by 96% when worn by a simulated health care worker within 18 inches of a cough.[10] Even after 30 minutes, the protective effect exceeded 80% and face shields blocked 68% of small particle aerosols,[10] which are not thought to be a dominant mode of transmission of SARS-CoV-2. When the study was repeated at the currently recommended physical distancing distance of 6 feet, face shields reduced inhaled virus by 92%,[10] similar to distancing alone, which reinforces the importance of physical distancing in preventing viral respiratory infections. Of note, no studies have evaluated the effects or potential benefits of face shields on source control, ie, containing a sneeze or cough, when worn by asymptomatic or symptomatic infected persons. However, with efficacy ranges of 68% to 96% for a single face shield, it is likely that adding source control would only improve efficacy, and studies should be completed quickly to evaluate this.

Major policy recommendations should be evaluated using clinical studies. However, it is unlikely that a randomized trial of face shields could be completed in time to verify efficacy. No clinical trial has been conducted to assess the efficacy of widespread testing and contact tracing, but that approach is based on years of experience. Taken as a bundle, the effectiveness of adding face shields as a community intervention to the currently proposed containment strategies should be evaluated using existing mathematical models. The implicit goal of face shields alone or in combination with other interventions should be to interrupt transmission by reducing the R_0 to less than 1. Notably, effective control of even the most infectious pathogens, such as measles, does not require a vaccine with 100% efficacy. No burden of 100% efficacy should be placed on face shields or any containment policy because this level of control is both impossible to achieve and unnecessary to drive SARS-CoV-2 infection levels into a manageable range.

Conclusions

The COVID-19 pandemic arrived swiftly and found many countries unprepared. Even highly prepared countries are now facing second-wave outbreaks that have forced implementation of extreme social distancing measures. To minimize the medical and economic consequences, it is important to rapidly assess and adopt a containment intervention bundle that drives transmissibility to manageable levels. Face shields, which can be quickly and affordably produced and distributed, should be included as part of strategies to safely and significantly reduce transmission in the community setting. Now is the time for adoption of this practical intervention.

ARTICLE INFORMATION

Published Online: April 29, 2020. doi:10.1001/jama.2020.7477

Conflict of Interest Disclosures: Dr Diekema reported receiving research funding from bioMerieux. No other disclosures were reported.

Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the US government.

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