## EVIDENCE SUMMARY

# Should protective physical barriers be used to prevent COVID-19?

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## RECOMMENDATIONS

We suggest against the use of protective physical barrier enclosures (e.g., aerosol boxes) for the prevention of COVID-19 among health care providers who perform aerosol generating medical procedures. *(Very low quality of evidence; Conditional recommendation)*

*Proper PPEs should be used by HCPs when performing AGP.

We suggest the use of protective physical barriers in the prevention of COVID-19 in areas where social distancing cannot be adhered to (e.g., offices, reception desk). *(Very low quality of evidence; Conditional recommendation)*

*The use of face masks, adequate ventilation, social distancing, and good personal hygiene should still be maintained to prevent COVID-19 infections. Regular cleaning and disinfection should be practiced.

### Consensus Issues

Protective physical barrier enclosures refer to passive protective barriers that were used to protect the health care workers during the early stages of the pandemic when PPE supplies were limited. The physical barrier enclosure can be used as an additional layer of protection in situations where the HCP does not have adequate PPE for aerosol generating procedures. However, these barriers should be used with suction or negative pressure devices to reduce the risk of transmission from secondary aerosols that are trapped underneath the plastic barrier. Previous studies showed that aerosols can still escape a physical barrier enclosure. In addition, concerns related to efficiency and usability of such barriers have also been reported, such as: (1) longer intubation time; (2) difficulty in maneuvering the arms because of the rigidity of the box; (3) view of the anesthesiologist or ER doctor is blocked by the plastic or acrylic box). The Philippine Society of Anesthesiologists (PSA) also no longer recommends the use of physical barrier enclosures.

The use of physical barriers is not mandatory, but an option in areas where social distancing cannot be maintained. The proper disinfection of these barriers is emphasized. It was noted that the World Health Organization and Centers for Disease Control and Prevention have specifications and instruction for disinfection of barriers.

## Key Findings

Two case series reported that there were no COVID-19 infections among health care providers who used protective barrier enclosures during aerosol generating procedures on COVID-19 patients. One systematic review reported that barrier devices were effective at either preventing or reducing the number of particles escaping the system only when negative pressure suction was applied. As for physical barriers (i.e., sneeze guards), we did not find any studies on its efficacy in preventing COVID-19 infections. Two computational fluid-particle dynamics (CFPD) simulation studies, however, showed that physical barriers could potentially reduce aerosol transmission within shared spaces such as classrooms or airplane cabins.

## Introduction

The transmission of SARS-CoV-2 from an infected person is mainly through the air in the form of droplets and aerosol particles. A protective physical barrier is a form of engineering control to reduce the transmission of SARS-CoV 2 by blocking droplets and aerosols as they adhere to the barrier. When physical distancing is not possible, the transparent physical barrier allows workers, customers, health care workers to see through these barriers and interact normally. It is a supplement and not a substitute for masks and physical distancing [1].

This review covers two types of barriers:

1. Protective barrier enclosure for aerosolizing procedures: a transparent device consisting of either clear acrylic box or plastic drapes (suspended from a frame or laid over the patient) designed to cover a patient's head and upper body. It incorporates one or more ports (arm sheaths, gloves, or slits) through which the health care provider's hands are passed to perform medical procedures and airway management. It may be used alone or with suction devices to create a negative pressure. This type of barrier is intended to protect the health care provider from airborne pathogens [2] but the question remains: do they adequately protect health care providers against aerosolized SARS-CoV2 viral particles?

2. Physical barriers for public spaces ("sneeze guard"/ "cough guard"): one of the commonly used measures to reduce COVID-19 transmission in transportation, indoor or work spaces is the use of sneeze guards in the form of transparent glass or plastic barriers. A sneeze guard is typically made from either plexiglass, acrylic, or clear plastic sheets. It works by blocking spittle or spray from a person's nose or mouth before it can infect other areas. Since the 1970s, the U.S. Food and Drug Administration (FDA) has required that all unpackaged food on display be protected by clear glass or plastic cases (sneeze guards), especially at buffets [3]. Styles of sneeze guards

are: free-standing, cubicle, hanging, or portable. The types of plastic used are either polymethyl methacrylate (acrylic), polycarbonate, or polyethylene terephthalate (PETG). Fire-resistant material (polycarbonate) is recommended for fixed barriers [4].

Physical barriers have increased in use since the onset of the COVID-19 pandemic, however, the evidence on their protective efficacy and safety is not well-established.

## Review Methods

We searched for existing traditional/ living systematic reviews and/or traditional/ living COVID-19 databases and CPGs, published studies (PubMed, Cochrane Library, Herdin), MedRxIV, and BioRxIV (search date up to May 24, 2020). Ongoing trials were searched in Clinicaltrials.gov Registry (search date up to May 24, 2020). We used the following keywords and MeSH terms: "plastic barrier," "glass barrier," "aerosol box," "sneeze guard," and COVID-19 related terms in the search strategy.

The following PICO criteria were used:

**Population**: people at risk for COVID-19
**Intervention**: protective physical barriers (enclosures/sneeze guards), any material (acrylic, plastic, glass)
**Comparator**: no barrier, other non-pharmacological intervention
**Outcomes**: incidence of COVID-19; Adverse events
**Study design**: systematic reviews, randomized controlled trials, controlled clinical trials, quasi-experimental, observational studies, case reports/series, simulation trials

## Results

**<u>Protective barrier enclosure for aerosol generating procedures</u>**

*Efficacy to prevent COVID-19 infection among health care providers*
We found two case series that reported COVID-19 infection rates among health care providers who used the protective barrier enclosures during intubation and other procedures on COVID-19 patients. No SARS-CoV-2 infections were recorded among health care providers after using a plastic sheet barrier on 8 COVID-19 cases [5] and in a private practice of 30 anesthesiologists who used an isolation biohazard hood (the Vacuum Assisted Negative Pressure Isolation Hood) for one month [6].

*Efficacy to contain particles/prevent contamination*
One systematic review assessed efficacy of barrier enclosure devices during medical aerosolizing procedures. Price et al. conducted a scoping qualitative review (N=123 studies; year 2000 to July 2020) but majority of the studies were letters and observational studies. Three studies were conducted prior to 2020 and did not involve COVID-19 cases (very low quality evidence).

Three general device types identified for use in airway management (intubation, extubation, tracheostomies or respiratory support) or general aerosolizing medical procedures.

1. acrylic box
2. plastic sheet with frame
3. plastic sheet without frame systems

In studies with qualitative visual assessment of droplets/smoke/smell (71%, n = 39/55), the use of a barrier device was effective in either preventing or reducing the number of particles escaping the system. In quantitative studies (77%, n = 17/22), particle counts only increased when negative pressure suction was applied [7].

**Physical barriers for public spaces ("sneeze guard"/ "cough guard")**

We did not find any clinical studies on the efficacy of physical barriers on the prevention of COVID-19 infection. Two computational fluid-particle dynamics (CFPD) simulation studies assessed the ability of physical barriers to reduce aerosol transmission within shared spaces as a means of COVID-19 mitigation.

The study of Abuhegazy [8] investigated aerosol removal and surface deposition in a realistic classroom environment. A model classroom with nine students and a teacher was constructed. Air conditioning and ventilation standards for acceptable indoor air quality were included. Four different factors were considered:
1) particle size (1 $\mu$m–50 $\mu$m),
2) source location (students 1, 2, 5, 8, and 9),
3) presence of barriers/sneeze guards, and
4) opening windows (10%–50% of window width).

On average, the total fraction of aerosols transmitted from a source student to others in the classroom decreased by ~92% in the case with screens. In the presence of screens, very few aerosol particles (<0.01%) are transmitted from student 1 to the others in the room, and self-deposition is significantly reduced from 1.5% to 0.3%. Sneeze guards/glass barriers were found to effectively reduce the transmission of 1 $\mu$m aerosol between students by ~92% on average. The effectiveness of screens varied depending on source location within the classroom with respect to the air conditioning system.

Talaat et al investigated different intervention measures to reduce aerosol transmission on a Boeing 737 aircraft cabin. The investigators simulated the flow of air and the movement of aerosol particles emitted from a patient onboard a Boeing 737. They considered three scenarios/models:

(a) Full capacity: 60 passengers across 10 rows of seats
(b) Reduced capacity of 40 passengers
(c) Full capacity of 60 passengers with sneeze guards/shields between passengers

The investigation considered a wide range of particle sizes (1–50 µm) which were released during exhalation, speech, and coughing.

Sneeze guards were more effective at directly stopping smaller particles than larger particles (8.6% of 20 µm particles deposited directly on sneeze guards compared to 9.8% of 1 µm particles). Only 4.3% of 50 µm particles deposited on the shields. The investigators reported that there was a 70% reduction in the inhalable fraction and 42% reduction in the total deposition fraction to passengers because shields were able to reduce lateral particle transfer. [8]

**Harms**

Time to Intubation (TTI) using the box system was reported by two systematic reviews (Price 4 out of 10 studies [7]; Lim: 12 studies [9]). Lim reported that, over-all, TTI was significantly longer when an aerosol box was used (MD 4.0 seconds; 95% CI: 2.4 to 5.6; P<0.001; $I^2$.38%).[9]

According to the US FDA, passive protective barrier enclosures may contribute to complications such as: increased intubation times, lower first-pass intubation success rates, increased patient hypoxia time, and damage or tearing to PPE from the enclosures. These complications may be due in part to "the barrier enclosure design characteristics and restricted mobility of the HCP's arms in a restricted space to maneuver the accessories needed to establish a definitive airway" [11].

## Recommendations from Other Groups

**Protective barrier enclosures**

US FDA has revoked its emergency license for barrier enclosures devices in August 2020 and now recommends the use of enclosures with suction devices in keeping with emerging objective evidence. "Protective barrier enclosures (with or without negative pressure) should never be a replacement for using PPE. Any protective barrier enclosure should be removed if it impedes the HCP's ability to perform a medical procedure on a patient." EUA has been issued for specific barrier enclosures with negative pressure [11].

**Physical barriers for public spaces**

WHO: "Use physical barriers to reduce exposure to the COVID-19 virus, such as glass or plastic windows. This approach can be implemented in areas of the healthcare setting where patients will first present, such as triage areas, the registration desk at the emergency department or at the pharmacy window where medication is collected" [12].

CDC: recommends the following:
1) Placing a barrier (e.g., sneeze guard) between employees and customers [13].
2) "Where possible, establish physical barriers between bus transit operators and passengers. Use strip curtains, plastic barriers, or similar materials to create impermeable dividers or partitions" [14].

3) "Install physical barriers, such as sneeze guards and partitions, particularly in areas where it is difficult for individuals to remain at least 6 feet apart. Barriers can be useful at reception areas, distribution counters, and other areas where remaining at least 6 feet apart is difficult" [15] [16].
4) When social distancing can not be maintained: additional control measures: Using physical barriers (e.g., plexiglass or similar materials, other impermeable dividers or partitions) to separate staff and students from each other in classrooms or other shared spaces [17].

US Dept of Labor Occupational Safety and Health Administration (OSHA): "Installing plexiglass, stainless steel, or other barriers between workers, such as on assembly lines, or between workers and customers, such as at points of sale" [18].

The National Sanitation Foundation (NSF) and U.S. Food and Drug Administration (FDA) requires that all food on display is protected by cases or sneeze guards [3].

## Research Gaps

There is a lack of clinical studies on COVID-19 infection rates among persons using the various protective physical barriers.

There are 3 registered clinical trials in ClinicalTrials.gov on the efficacy of aerosol boxes [19, 20, 21]. One trial plans to assess health care worker contamination [20].

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