Fugitive aerosol mitigation using a portable negative pressure system during bronchoscopy: a randomized, controlled pilot study.

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Purpose: The COVID-19 pandemic surfaced the need for innovating barrier protective systems for healthcare personnel (HCP) during patient care. Airway intubations, general anesthesia and bronchoscopy have historically been considered high risk for aerosolization of virulent respiratory pathogens, including *SARS-CoV2* and *Mycobacterium Tuberculosis* (TB). Negative pressure system (NPS) rooms are used as an infection prevention measure during bronchoscopy. Yet, national and global guideline recommendations vary regarding their requirement for the safe performance of bronchoscopies. An opportunity exists for improving HCP safety and optimizing patient access to timely procedures which can be affected by institutional resource limitations. We evaluated the effectiveness of a portable negative pressure shield (PNPS) in reducing fugitive aerosols produced during bronchoscopy.

Methods: At a 1,280-bed tertiary care facility, 80 patients undergoing bronchoscopy were randomized to one of two arms of the study. The control arm utilized the built-in hospital NPS. The institution required the utilization of both the PNPS and the NPS in the experimental arm. Both groups included robotic, flexible, and rigid bronchoscopies. Bronchoscopies were performed under general or monitored anesthesia and utilized endotracheal, supraglottic, or mask airways. A particle meter measured aerosolized particles in the breathing zone of the bronchoscopist. A two sample T-test was performed to examine differences in average particle counts between control and experimental groups. Stratified two-sample T-tests were performed for each particle size, procedure type, airway, and paralytic subgroups to determine if there was a significant reduction in particles when the PNPS was used.

Results: Overall, there was a decline in average fugitive particles intraprocedural in both the control and experimental groups. However, the experimental group experienced a 28% greater decline that was statistically significant (p=0.0003). In the paralytic subgroup, a significant decline of particles in both control and experimental groups was observed, however, the experimental group change was more pronounced as compared to the control (p=0.0019 vs p=0.0056 respectively). The experimental group experienced a significant decline for all airway types except supraglottic. In the experimental group, when compared to the control, both robotic and rigid bronchoscopies demonstrated significant reductions in aerosolized particles (p=0.0171 and p=0.0387 respectively) Flexible bronchoscopies, despite showing a 96% relative reduction, was found not to be significant. When compared to the control group, concentrations of fugitive particles in the experimental group had

greater significant reductions, both as a whole and across all subgroups (p=<0.0001 – p=0.0433), except for procedures under monitored anesthesia (p=0.0655).

Conclusions: PNPS when compared with NPS resulted in significant reductions of fugitive aerosols generated in all groups except supraglottic airways and non-paralyzed patients. A study comparing the effects of the PNPS in isolation directly to that of a negative pressure room is warranted.

Clinical implications:
PNPS offers a safe and effective alternative to NPS for fugitive aerosol mitigation of all bronchoscopic procedures by isolating aerosols at the source. The system's portability broadens the settings where procedures may be safely performed, including where NPS resources are limited. Similarly, such portability offers opportunities for enhanced protection against nosocomial spread of TB, COVID-19 and other virulent conditions when transporting patients within the healthcare facility.