



Improving Nebulizer Safety: 93% Aerosol Reduction With a Novel Portable Shield



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INTRODUCTION

Respiratory illness is a highly prevalent set of diseases with secondary spread to health care workers contributing to the virulence of these disease processes.

- Preventing the spread utilizing barrier masks could blunt the effects of respiratory illnesses, however, compliance with masks is variable and could interfere with necessary treatment such as the use of nebulized medications which are common in patients with respiratory illnesses.

The Respiratory Shield (SafER Medical Products, Branson, Missouri), which is a portable negative pressure device, was designed to reduce the number of particles, pathogenic or pharmaceutical, released into the treatment environment. This is accomplished utilizing a negative pressure barrier mask that overlies the existing nebulizer mask, capturing and suctioning away particles exhaled by the patient.

We hypothesized that there would be at least a 25% reduction in fugitive aerosol particles emitted during simulated nebulizer treatments with utilization of the portable negative pressure device.

OBJECTIVES

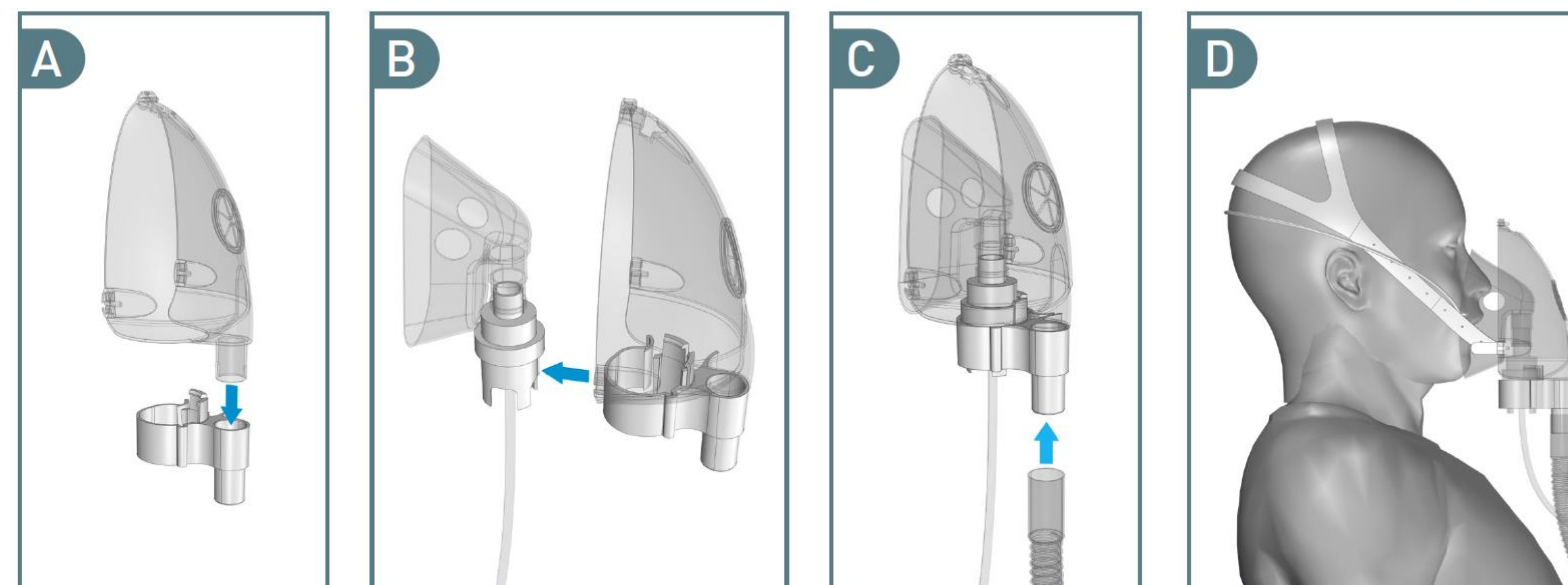
The purpose of the study was to determine if a novel portable shield device could be used to reduce the total number of aerosolized particles measured in a treatment area.



METHODS

- Utilized random crossover trial
- 10 participants (>18 years old, no active respiratory illness, healthcare personnel worker, able to provide consent)
- No excluded participants from study
- Initial treatment of nebulized 0.9% normal saline with or without PNP device with 5-minute washout periods in between treatments
- Total number of particles measured with particle counter

Size: 0.3					
Device	Mean	Std Dev	Median	Lower Quartile	Upper Quartile
No	9,814,180	368,830	9,999,999	9,721,869	9,999,999
Yes	835,880	1,474,001	276,095	134,396	690,187
Difference=8,978,300 (95% CI 7,463,767 to 10,492,832), p<0.0001					
Size: 0.5					
Device	Mean	Std Dev	Median	Lower Quartile	Upper Quartile
No	7,810,751	1,389,693	7,956,271	6,530,564	9,150,274
Yes	371,288	810,228	43,216	8,440	270,491
Difference=7,439,463 (95% CI 5,924,930 to 8,953,996), p<0.0001					
Size: 0.7					
Device	Mean	Std Dev	Median	Lower Quartile	Upper Quartile
No	1,790,659	595,379	1,769,430	1,207,065	2,328,700
Yes	42,221	120,051	0	0	3,148
Difference=1,748,438 (95% CI 233,905 to 3,262,970), p=0.0181					
Total particles					
Device	Mean	Std Dev	Median	Lower Quartile	Upper Quartile
No	19,415,589	2,242,280	19,758,428	17,459,498	21,478,973
Yes	1,249,389	2,399,543	341,665	135,535	963,826
Difference=18,166,200 (95% CI 16,651,667 to 19,680,733), p<0.0001					



RESULTS

- There was statistically significant particle reduction using PNP device (95% CI 16,651,667 to 19,680,733), p<0.0001). The difference carried statistically significant reduction across particle sizes of 0.3 - 0.7 microns.
- The use of this portable negative pressure device with nebulized treatments reduced the total number of particles which could represent a decrease in total viral particles or nebulized pharmaceutical particles.**

CONCLUSIONS

The use of the portable shield has many potential applications in the prehospital and hospital settings such as:

- decreasing exposure risks to first responders in the prehospital setting while providing treatment during transport
- use in emergency room triage areas to decrease time to treatment without exposing providers or other patients to nebulized respiratory particles.

REFERENCES

- Hodgroe SS, Glenn M, Breyre A, Lee B, Aldridge NR, Sporer KA, Koenig KL, Gausche-Hill M, Salvucci AA, Rudnick EM, Brown JF, Gilbert GH. Adult Patients with Respiratory Distress: Current Evidence-based Recommendations for Prehospital Care. West J Emerg Med. 2020 Jun 25;21(4):849-857. doi: 10.5811/westjem.2020.2.43896. PMID: 32726255; PMCID: PMC7390576.
- Delamare Fauvel A, Southerland LT, Panchal AR, Camargo CA Jr, Hansen ML, Wang HE. Emergency department course of patients with asthma receiving initial emergency medical services care- Perspectives From the National Hospital Ambulatory Medical Care Survey. J Am Coll Emerg Physicians Open. 2023 Aug 18;4(4):e13026. doi: 10.1002/emp2.13026. PMID: 37609001; PMCID: PMC10436788.
- Chiang CE, Li HH, Rowley DD, Fang TP, Lin HL. Influence of Aerosol Mask Design on Fugitive Aerosol Concentrations During Nebulization. Respir Care. 2023 Nov;68(11):1510-1518. doi: 10.4187/respcare.10578. Epub 2023 Jun 6. PMID: 37280074; PMCID: PMC10589112.
- Lindsley W G, Blachere F M, McClelland T L, Neu D T, Mnatsakanova A, Martin S B, ... Noti J D. (2019). Efficacy of an ambulance ventilation system in reducing EMS worker exposure to airborne particles from a patient cough aerosol simulator. Journal of Occupational and Environmental Hygiene, 16(12), 804-816. https://doi.org/10.1080/15459624.2019.1674858

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