

BACKGROUND

- Mechanical ventilation, used in combination with nebulised therapeutics, plays an integral role in the management of patients with respiratory disease.
- Disease type and severity alters pulmonary function and therefore could potentially affect aerosol drug delivery during mechanical ventilation.

OBJECTIVE

To assess the effects of respiratory disease severity on aerosol drug delivery in adults and paediatrics during simulated mechanical ventilation.

Table 1. Recorded resistance, compliance and tidal volumes for each patient type and lung disease considered.

| Patient Type | Lung Disease | Simulated Airway Resistance (cmH ₂ O/L/S) | | Simulated Lung Compliance (mL/cmH ₂ O) | Simulated V _T (mL) |
|--------------|---------------------|--|-----|---|-------------------------------|
| | | INSP | EXP | | |
| Adult | COPD ² | 21 | 23 | 53 | 472 |
| | ARDS ² | 11 | 16 | 30 | 458 |
| | Normal ¹ | 6 | 6 | 50 | 500 |
| Paediatric | Asthma ² | 15 | 75 | 20 | 263 |
| | POLD ² | 50 | 50 | 10 | 230 |
| | Normal ¹ | 15 | 15 | 20 | 300 |

EXPERIMENTAL DETAILS

- Nebuliser: Vibrating Mesh Nebuliser (VMN) (Aerogen Solo & Pro-X controller, Aerogen, IRE)
- Drug: 2500 µg Salbutamol (TEVA, IRE)
- Patient Type: Adults & Paediatrics
- Disease State: Normal, COPD, ARDS, Asthma, Paediatric Obstructive Lung Disease (POLD).
- Ventilator: Servo-I (Maquet, SWE) - Volume support - Adult V_T: 500 mL, Paediatrics V_T: 300 mL
- Breathing Simulator: ASL 5000 (IngMar Medical, US)
- Mass of dose captured on the filter determined via UV spectrophotometry at 276 nm.

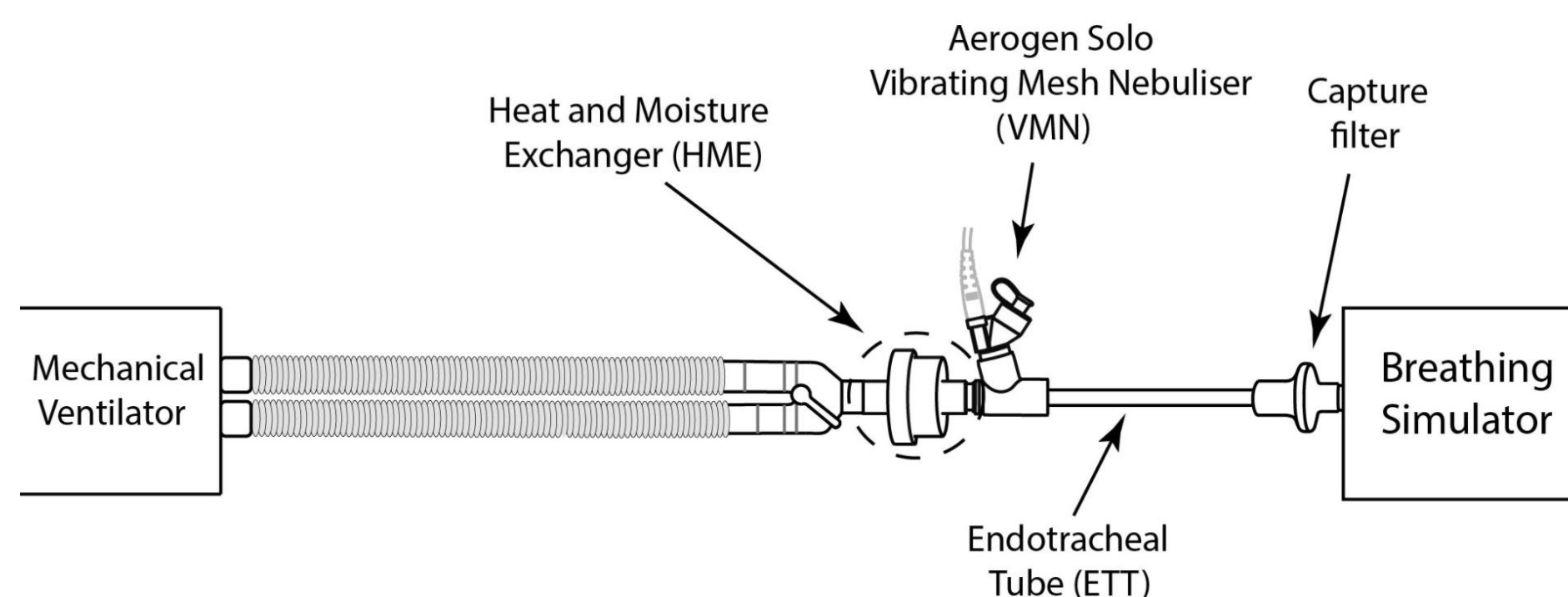


Figure 1. Schematic illustration of the experimental test setup³. A mechanical ventilator provided respiratory support to the respective simulated intubated patient.

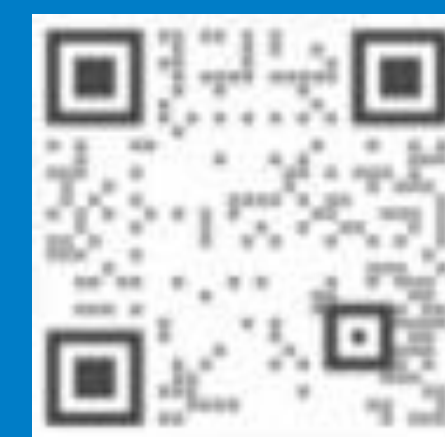
Aerosol delivery is significantly affected by *disease state* in ventilated adults and paediatrics

Title: Assessment of Aerosol Drug Delivery to Simulated Adult and Paediatric Patients with Varying Lung Diseases during Mechanical Ventilation

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RESULTS

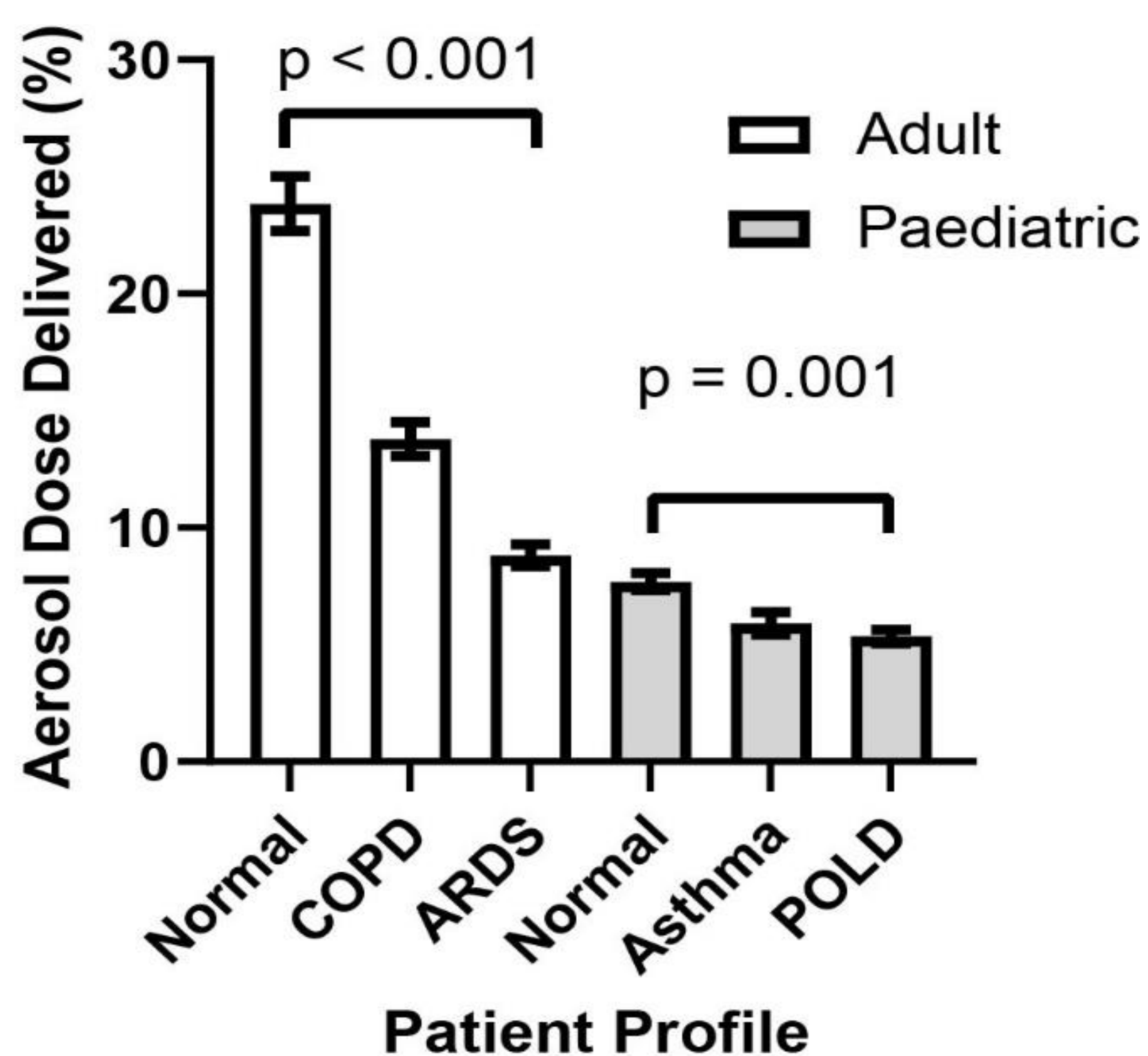


Figure 2. Comparison of the aerosol dose delivered (%) (mean ± standard deviation) for the different patient types and lung diseases.

CONCLUSION

- For both patient types, a statistically significant larger aerosol dose was delivered to normal healthy lungs compared to diseased lungs.
- For adults, restrictive lung diseases, such as ARDS, had a detrimental effect on aerosol drug delivery due to reduced lung volume.
- For paediatrics, there was no statistically significant difference in the aerosol dose delivered between the two obstructive diseased lung states examined.
- These obstructive diseases (Asthma, POLD) have a higher airway resistance compared to a normal lung, but comparable levels of lung compliance indicating that airway resistance has greater effect on aerosol dose delivery.

REFERENCES

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