

QUANTIFYING AEROSOL DELIVERY IN SPONTANEOUSLY BREATHING PATIENTS WITH TRACHEOSTOMY USING DIFFERENT HUMIDIFICATION SYSTEMS WITH OR WITHOUT EXHALED HUMIDITY

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Background

Aerosol and humidification therapy are used in long-term airway management of critically ill patients with tracheostomy.

The purpose of this study was to determine delivery efficiency of jet (JN) and mesh (MN) nebulizers combined with different humidification systems in a spontaneously breathing adult lung model with tracheostomy with or without exhaled humidity.

Methods

Lung Model: An in-vitro model was used to simulate spontaneously breathing adults with tracheostomy using a teaching manikin attached to a test lung through a collecting filter (Respigard II, Vital Signs). Exhaled heat and humidity was simulated using a cascade humidifier set to deliver 37 °C and >95% relative humidity.

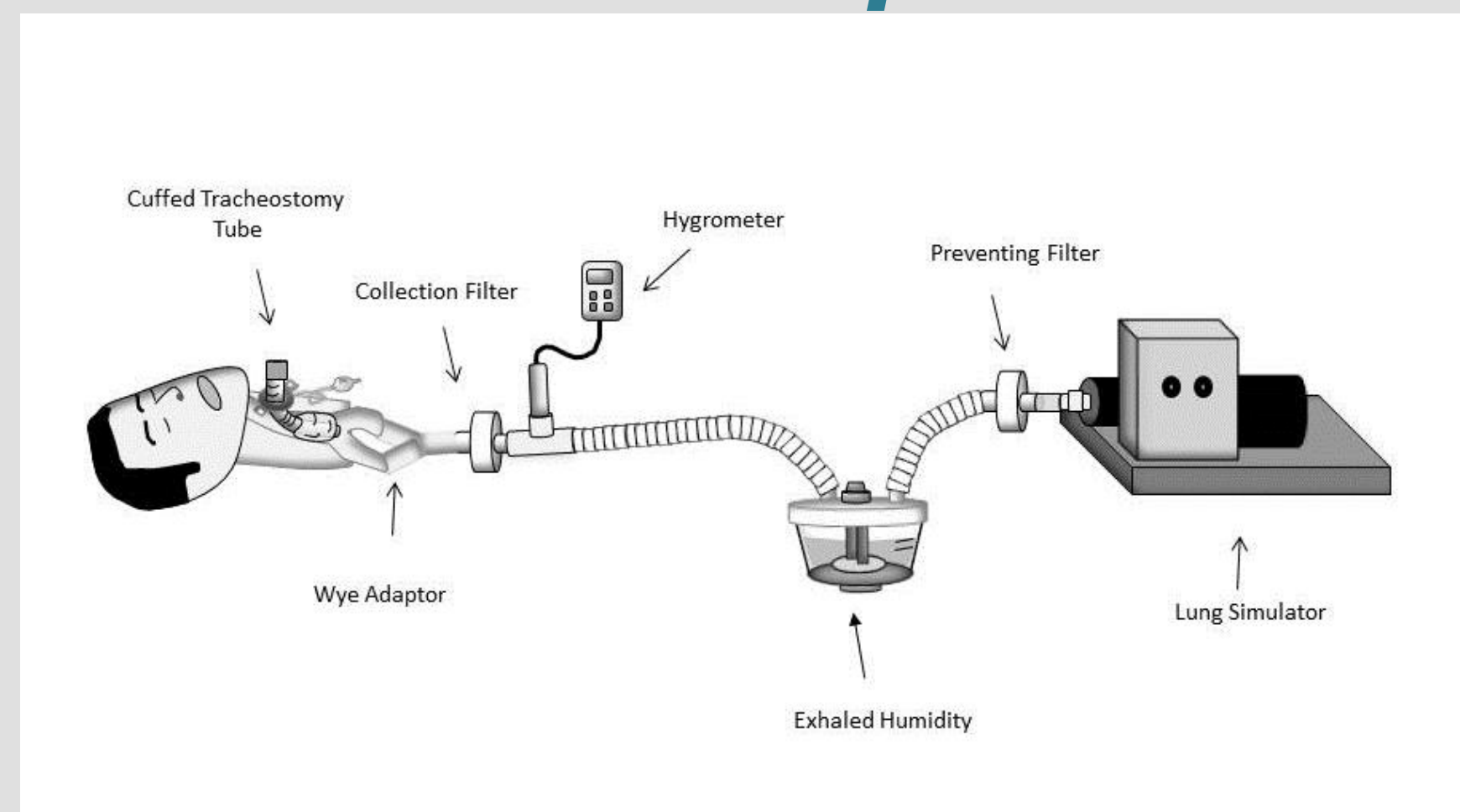
Breathing Parameters: Vt: 400 mL, RR: 20 bpm, and I:E ratio 1:2.

Nebulizers & Humidifiers: Albuterol sulfate (2.5mg/3mL) was administered through JN (Misty Max, Airlife) operated at 10 lpm and MN (Aeroneb Solo, Aerogen) using heated humidifier (HH), unheated large volume humidifier (LVH) at 40 lpm output and heat-moisture exchanger (HME).

Methods

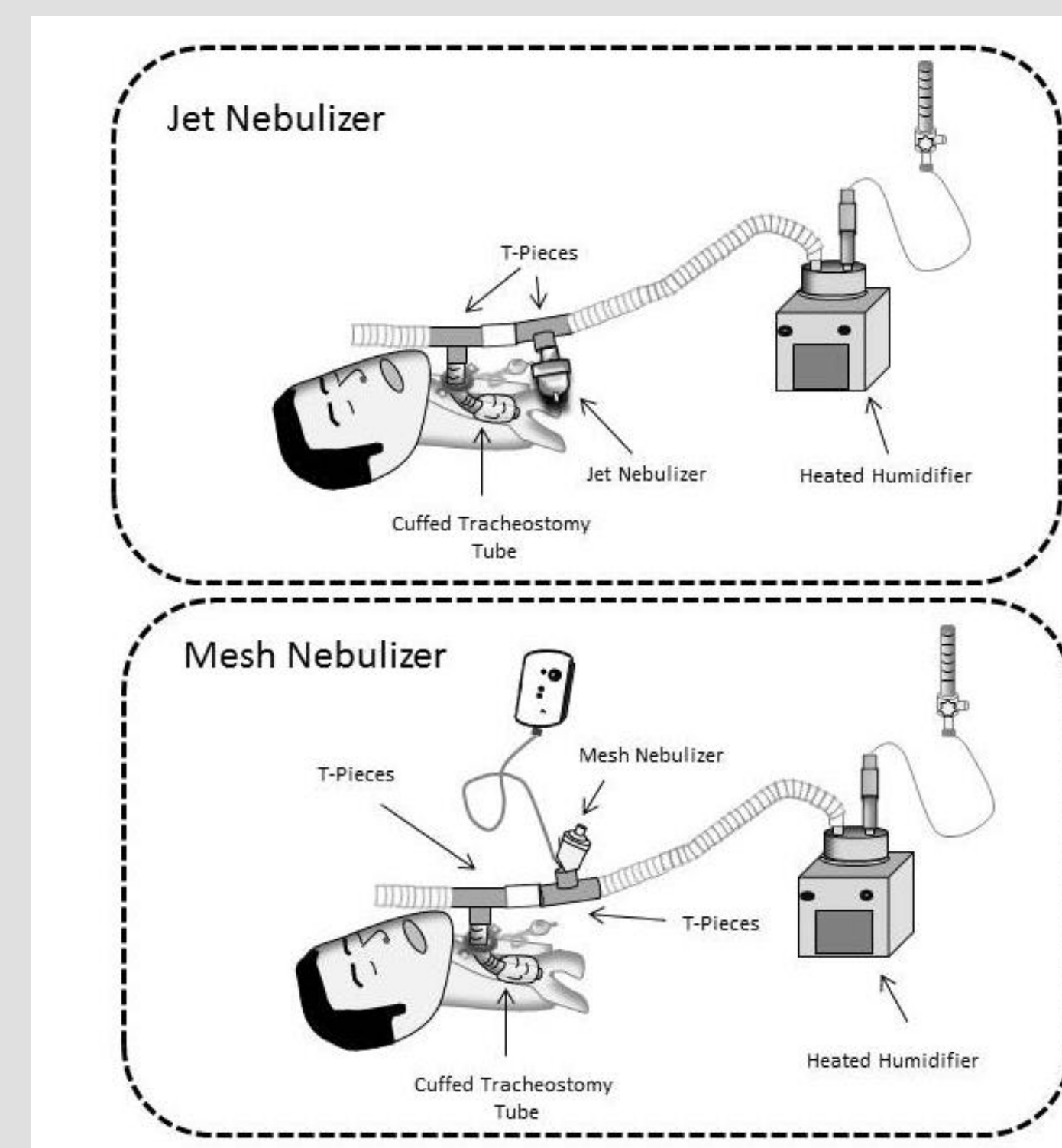
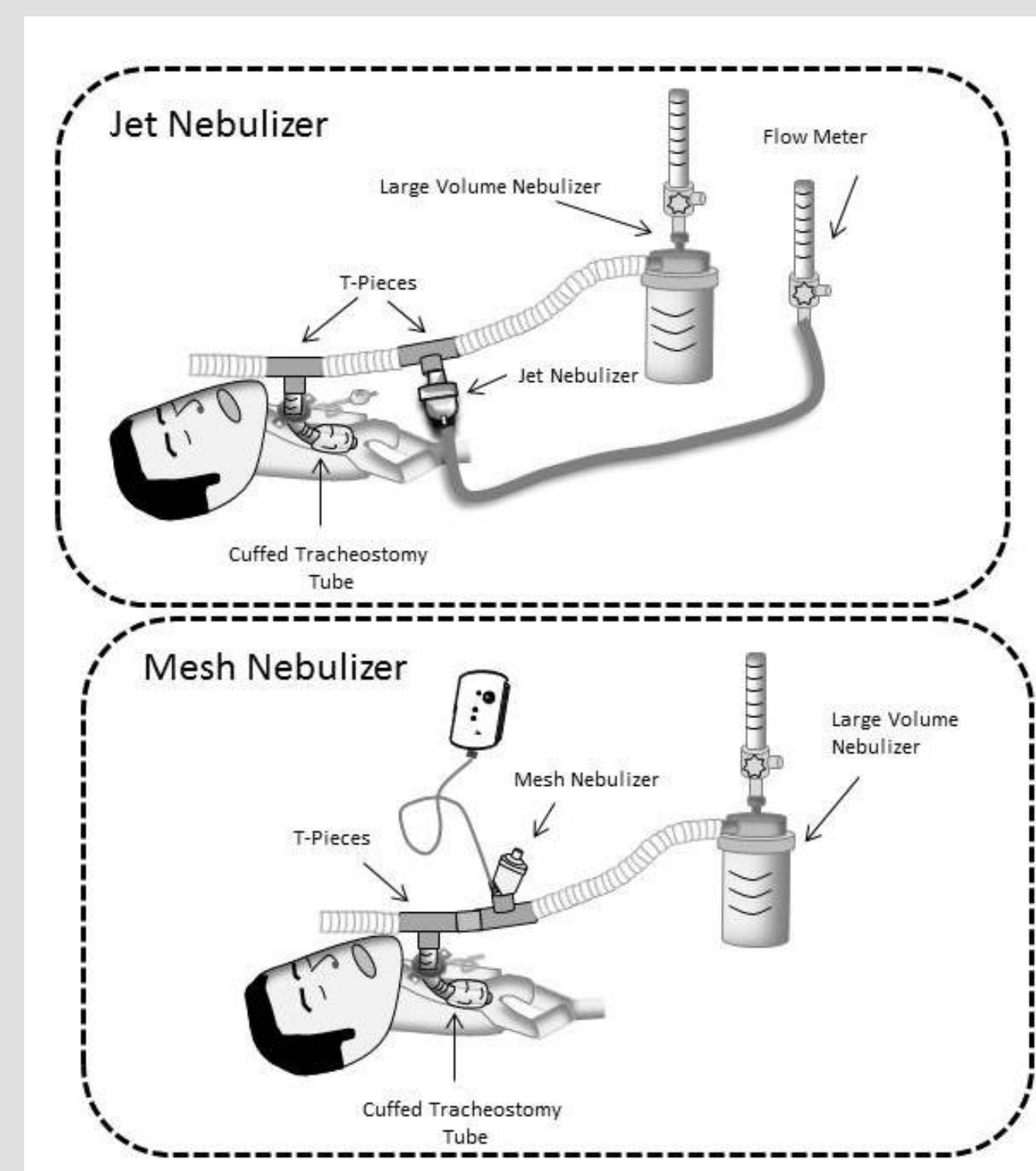
Data Collection & Analysis: Inhaled drug was collected on a filter during each experiment and analyzed via spectrophotometry (276 nm).

Experimental Set-up of the Study



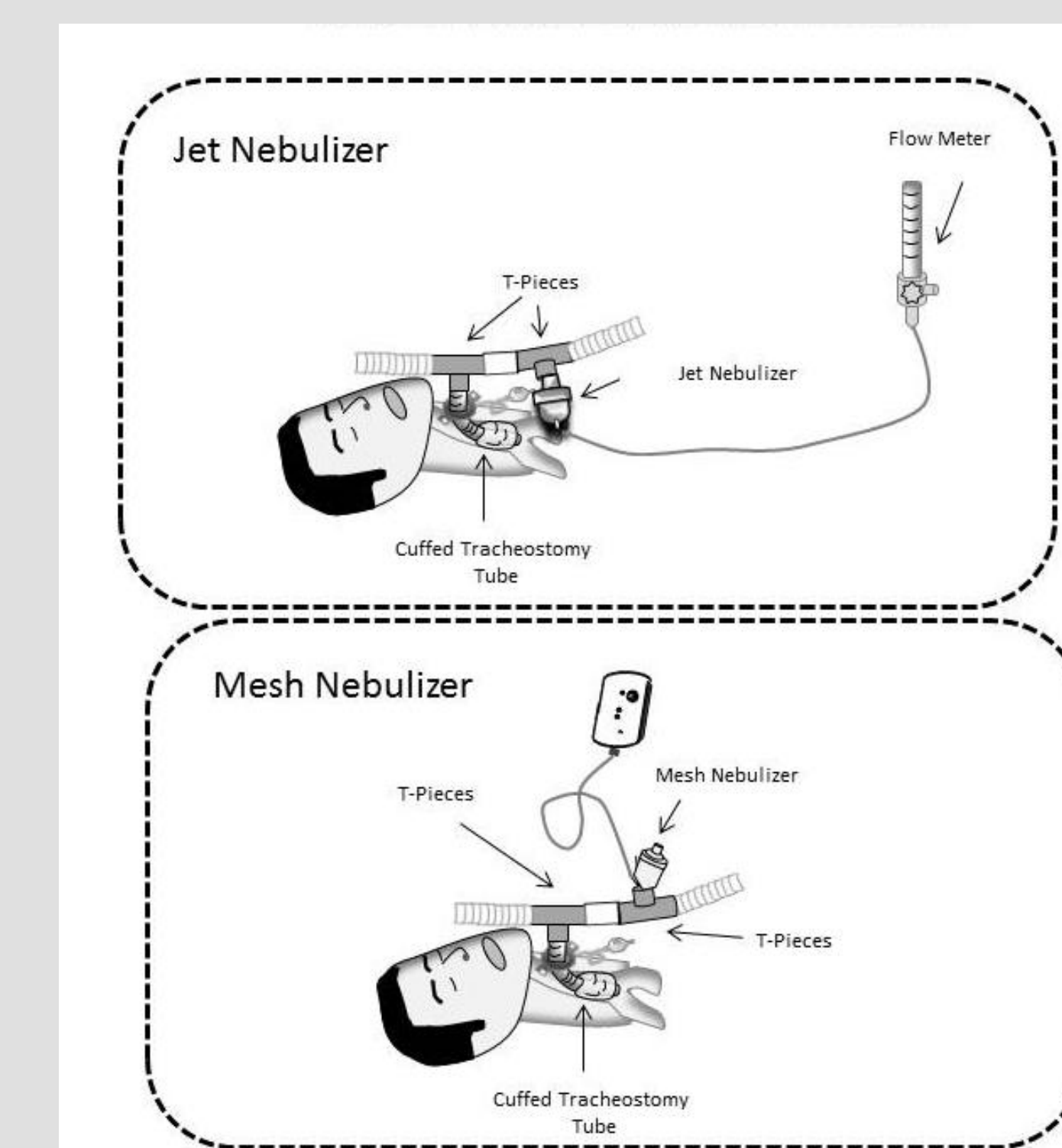
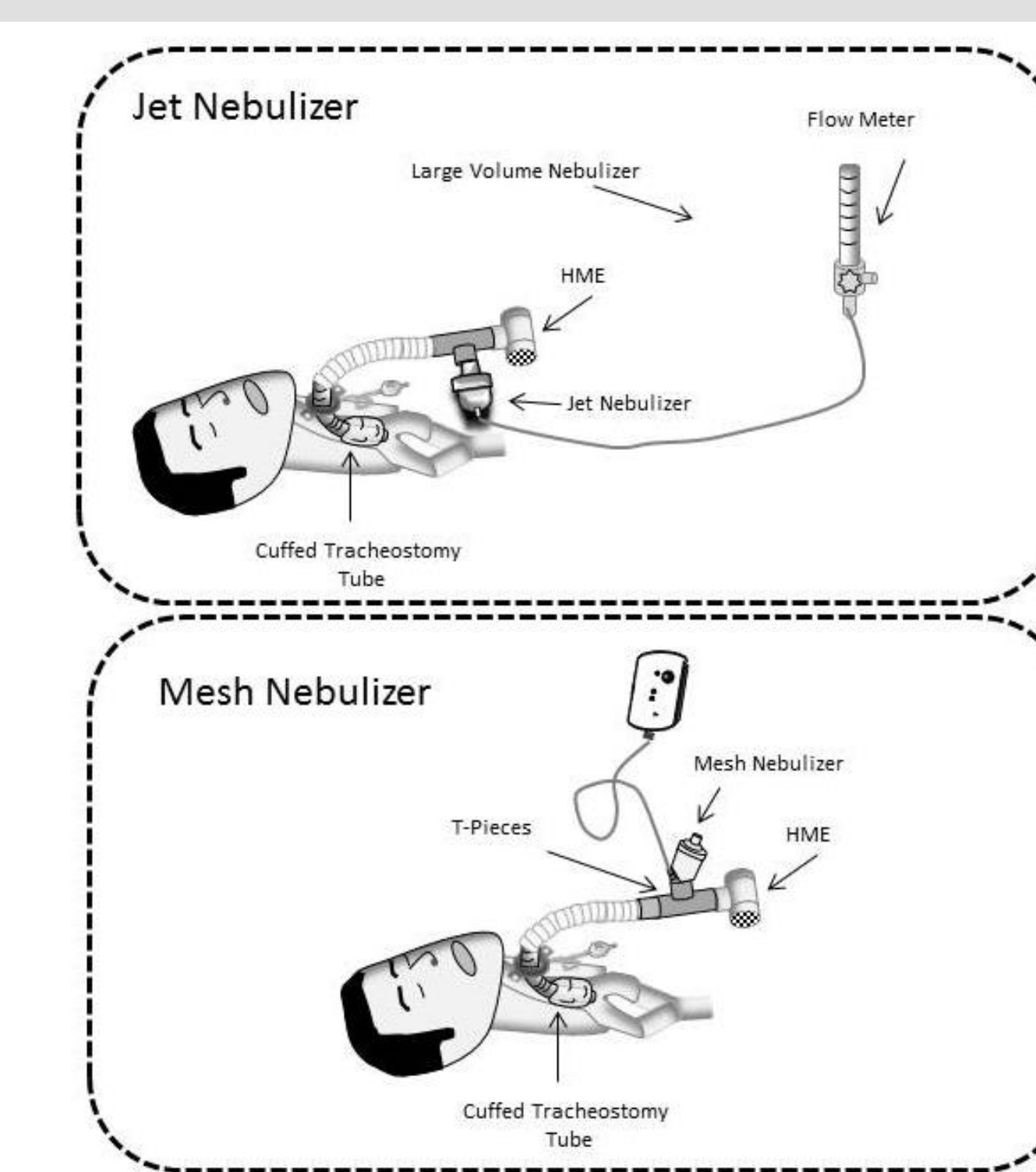
Unheated Jet and Mesh Nebulizers

Heated Jet and Mesh Nebulizers



HME with Jet and Mesh Nebulizers

Room Air with Jet and Mesh Nebulizers



Results

The table below shows percentage of nominal dose (mean ± SD) delivered distal to the trachea.

Delivery efficiency of JN was less than MN under all conditions (p<0.05). Aerosol delivery with each nebulizer was greatest in room air and lowest when HH with higher flows were used. Exhaled humidity decreased drug delivery up to 40%.

	With Exhaled Humidity		Without Exhaled Humidity	
	Jet Nebulizer	Mesh Nebulizer	Jet Nebulizer	Mesh Nebulizer
Heated Humidifier	1.40 ± 0.22%	3.05 ± 0.27%	2.49 ± 0.13%	3.10 ± 0.42%
Unheated Humidifier	3.09 ± 0.59%	4.61 ± 0.35%	3.70 ± 0.57%	4.76 ± 0.44%
Heat Moisture Exchanger (HME)	4.58 ± 0.9%	14.60 ± 0.88%	5.98 ± 0.84%	17.0 ± 0.45%
Room Air	6.61 ± 0.43%	15.78 ± 2.05%	6.59 ± 0.64%	17.67 ± 1.24%

Conclusion

JN was less efficient than MN in all conditions tested in this study.

Aerosol deposition with each nebulizer was lowest with heated humidifier. Exhaled humidity caused a reduction in drug delivery compared to nonheated/humidified exhalation.