

# Physicochemical aspects and efficiency of albuterol nebulization: comparison of three aerosol types in an in vitro pediatric model.

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## Abstract

**Background:** Advances in nebulizer design have produced both ultrasonic nebulizers and devices based on a vibrating mesh (vibrating mesh nebulizers), which are expected to enhance the efficiency of aerosol drug therapy. The aim of this study was to compare 4 different nebulizers, of 3 different types, in an in vitro model using albuterol delivery and physical characteristics as benchmarks.

**Methods:** The following nebulizers were tested: Sidestream Disposable jet nebulizer, Multisonic Infra Control ultrasonic nebulizer, and the Aerogen Pro and Aerogen Solo vibrating mesh nebulizers. Aerosol duration, temperature, and drug solution osmolality were measured during nebulization. Albuterol delivery was measured by a high-performance liquid chromatography system with fluorometric detection. The droplet size distribution was analyzed with a laser granulometer.

**Results:** The ultrasonic nebulizer was the fastest device based on the duration of nebulization; the jet nebulizer was the slowest. Solution temperature decreased during nebulization when the jet nebulizer and vibrating mesh nebulizers were used, but it increased with the ultrasonic nebulizer. Osmolality was stable during nebulization with the vibrating mesh nebulizers, but increased with the jet nebulizer and ultrasonic nebulizer, indicating solvent evaporation. Albuterol delivery was 1.6 and 2.3 times higher with the ultrasonic nebulizer and vibrating mesh nebulizers devices, respectively, than with the jet nebulizer. Particle size was significantly higher with the ultrasonic nebulizer.

**Conclusions:** The in vitro model was effective for comparing nebulizer types, demonstrating important differences between nebulizer types. The new devices, both the ultrasonic nebulizers and vibrating mesh nebulizers, delivered more aerosolized drug than traditional jet nebulizers.