



## Clinical considerations to **optimizing aerosol delivery** to pediatric asthma patients

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**Pediatric asthma is quite common in the US, with up to 8.3% of approximately six million children according to the CDC.<sup>2</sup>** Because the treatment of asthma is tailored to the severity of condition, children with persistent asthma are treated with a daily inhaled controller medication and are also prescribed a quick-acting inhaled agent for treatment of bronchospasm. Aerosol delivery devices to meet pediatric patient's needs, are just as complex, if not more so, than adult respiratory treatment needs. While many children require accessories, like masks or valved holding chambers (VHCs), with their treatment devices, most adults will dose successfully with only a mouthpiece. In either case, respiratory treatment devices should fit the lifestyle and cognitive ability of the patient. An older adult with COPD may be sedentary and a table top stationary nebulizer device may be adequate, but for those oldsters on the go, and young children who tend to be active there is a need for a device that is portable and simple to operate. In all instances, the aspects which distinguish each individual patient ought to be taken into account when selecting their respiratory treatment devices.

In the U.S., nebulizers are often covered by private insurance and they are also covered under Medicare part B and Medicaid.<sup>3</sup> A prescription for home nebulizer is often fulfilled by a Durable Medical Equipment (DME) company who provides a compressor and jet nebulizer which may be selected with more of an eye to meet reimbursement criteria independent of performance with the prescribed medications. European countries have similar healthcare functions in place, but the law differs in that neb/compressor combinations must be tested with the drugs that will be used with them – which has not been adopted in the U.S.<sup>4</sup> This makes it all the more important for prescribing clinicians to evaluate the performance of the nebulizing device with the drug that is intended to treat the specific disease and patient population.<sup>4</sup>

For children less than four years of age, the primary aerosol device options are nebulizers or inhalers with spacers, and masks are often used as children under five may not have developed the breathing coordination.<sup>5</sup> An inhaler and spacer with a mask has long been considered a more portable alternative to bulky, classic compressor nebulizers, but due to advances in aerosol technology today's battery operated nebulizers can fit in the palm of the hand. Choosing a device that fits the portability and ease of use needs of the patient may be imperative to daily controller medication dosing as well as rescue medication.

Entry-level jet nebulizers and compressors are often large and intended primarily for home use. They usually don't have rechargeable batteries, are quite loud, and difficult to package and store away quickly. An active lifestyle is not compatible with this tier of respiratory drug products; many caregivers and patients may forgo dosing out of convenience, negatively impacting their long-term health. The alternative has been to duplicate prescriptions for different dosing forms such as inhalers with spacers which add mobility, but increase the cost of therapy.

Battery operated vibrating mesh nebulizers are often small and quiet due to piezo-mesh technology. This vibrating mesh technology contains a small vibrating metal plate with over a thousand precision-formed holes.<sup>6</sup> The size of the holes create a fine aerosol mist suited to help in deep respiratory deposition.<sup>7</sup> Many medications are most effective when deposited in the lower respiratory system, like albuterol.<sup>8</sup> These portable nebulizers are operated by electricity and do not require gas, and because the power requirements are low, a single charge may last for a week of treatments rather than a single day. Vibrating mesh devices also tend to be among the most efficient, wasting less medication than jet or ultrasonic nebulizers.<sup>6</sup>

## General considerations with nebulizers should include:

### Ease of maintenance

- Different devices have different recommendations for cleaning methods and frequency. Users will want their device's maintenance to fit easily into their lives.

### Ease of assembly

- Aerosol devices should require an assembly process that is easy to follow and difficult to do incorrectly. Ease of assembly minimizes problems in treatment and does not discourage patients from adhering to treatment. As a rule, two parts are easier to assemble than four parts, and four parts easier than eight. The more parts, the easier it is to misassemble.

### Durability

- If the device is durable, it will continue to aerosolize drug for at least 6 – 12 months without routine replacement of expensive parts.

### Noise

- Quiet nebulizers do not draw as much attention during use and are generally easier to integrate into patients' lives. Loud nebulizers can irritate and scare infants, and disturb other members of the household. Mesh nebulizers are quieter than compressor nebs.

### Performance and intended use

- The nebulizer manufacturer should provide data on performance of their system with the drugs to be administered. A nebulizer that works well with albuterol, which is a solution, may produce bigger particles with a suspension, like budesonide, delivering suboptimal delivery.

### Power delivery and battery life

- Many nebulizers need to be powered by an AC outlet, while others run off of a battery. The convenience of traveling with a nebulizer is dependent on how the device is powered. How many treatments a single battery can supply before being recharged is an additional consideration. Battery life may range from 40 minutes to more than 200 minutes.

### Treatment duration

- Different devices can vary significantly in the time needed to complete a treatment session.

Although each patient is fundamentally unique, the process by which treatment devices are selected is universal. Devices should be selected to fulfill as many of a patient's needs as possible. Intuitively, the foremost concerns entail the method of delivery efficacy and drug compatibility, but whether or not the patient uses the "best" methods ultimately determines their success. Recent technology has made it easier to deliver medication quickly and easily, allowing patients to make fewer compromises when adhering to treatment plans.

## References

1. Dr. James Fink has a business relationship with Philips. Dr. Fink's medical opinions are his own.
2. Zahran, K, et al. (2018) Vital Signs: Asthma in Children. MMWR Early release. CDC website, accessed July, 2019.
3. Nebulizers and nebulizer medications. CMS. Medicare.gov accessed July, 2019
4. Boe, J, et al. (2001) European Respiratory Society Guidelines on the use of nebulizers European Respiratory Journal.18; 228-242.
5. Gardenhire, D. et al. (2017) A Guide To Aerosol Delivery Devices for Respiratory Therapists 4th Edition. American Association for Respiratory Care. 1-61.
6. Kyong-Hoon Choi, K. et al. (2018) Fabrication and Characterization of Medical Mesh-Nebulizer for Aerosol Drug Delivery. Appl. Sci. 2018, 8(4), 604.
7. Ari A. (2014) Jet, Ultrasonic, and Mesh Nebulizers: An Evaluation of Nebulizers for Better Clinical Outcomes. Eurasian Journal of Pulmonology; 16: 1-7.
8. Labiris, N.R. et al. (2003) Pulmonary drug delivery. Part I: Physiological factors affecting therapeutic effectiveness of aerosolized medications. Br J Clin Pharmacol. 2003 Dec; 56(6): 588–599.

