

## Beware the Adapters

In the February 2007 issue of *RESPIRATORY CARE*, the article by Douglas Johnson MD demonstrated ingenuity in developing innovative methods for adapting aerosol devices to deliver aerosol to types of patients for whom the devices were not designed.<sup>1</sup> I applaud Johnson for the creativity and the intent of the article. I also am impressed that he pointed out the limitations of his device adaptation system; that is, further studies need to be performed to validate certain assumptions, such as lower-respiratory-tract deposition, and to objectively monitor clinical response. Though the adaptation design he used was impressive, I am concerned about the clinical ramifications of the adaptation. As Johnson pointed out, much needs to be done prior to the commercial reproduction of a similar configuration.

Over the last few years, and with the impending phase-out of chlorofluorocarbons (CFCs) and the requirement to use hydrofluoroalkane (HFA) as the propellant in metered-dose inhalers (MDIs), there may be a more widespread problem we need to be concerned with. Respiratory care staff in intensive care units throughout the country often deliver either CFC-propelled or HFA-propelled MDI doses to patients on mechanical ventilators, through various adapters that were probably designed for the CFC propellant. I am not aware of any available adapter that was designed specifically for HFA MDIs. Further, I'm not aware of any study that specifically compares clinical effects of HFA-propelled and CFC-propelled medicines (when each are available in both formulations, such as albuterol) through any single adapter. Though we can see a spray come out of the MDI, we don't know much about the consistency of the plume, the aerosol particle size, or the deposition within the patient, the ventilator circuit, or the endotracheal or tracheostomy tube.

Jim Fink, an expert in aerosol therapy, indicated that the nozzle in the Ventolin (CFC) inhaler is 0.53 mm in diameter whereas the Proventil inhaler nozzle is 0.28 mm.<sup>2</sup> My guess is that if you deliver a medicine designed to be injected through a nozzle about half the size of the one

being used, you will probably get a very different aerosol, and probably a very different therapeutic effect than anticipated. Fink's article<sup>2</sup> pointed out many variables that need to be considered when administering any aerosol. When we start deviating from the mechanics of aerosols built into and then examined by carefully controlled clinical trials by the manufacturers of the medicines we use, we need to be concerned with how these variables might affect outcomes. In fact, we are probably altering the quality of the aerosol every time we use any adapter not designed by the manufacturer. The effect these deviations may have on patient care is unclear. Spacers or valved holding chambers that enable the use of the manufacturer-designed mouthpiece are fine. Studies have demonstrated improved efficacy with those devices. But we need to exercise caution when we do anything different than intended by the device manufacturer.

My point is that, while we can make a system work to accommodate the physician's or respiratory therapist's desire to get a medicine into a patient despite the limitations imposed by ventilator circuitry or spontaneously breathing patients, we need to consider how the adaptations will affect the many variables of aerosol delivery, and, perhaps most importantly, define, observe, and document clinically meaningful outcomes that can be tracked or trended to our adaptations. Though we probably aren't going to hurt any patients with our adaptations and medicines (especially if they are delivered at subtherapeutic doses), we really need to evaluate whether our time and effort are offset by our ability to actually benefit the desired patient outcome.

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Mr Hayton is an employee of GlaxoSmith-Kline, but reports no other conflicts of interest related to the content of this letter.

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*Dr Johnson replies:*

Powder medications can be easily administered via tracheostomy tube, using interfaces.<sup>1</sup> I think it very likely the powder was effectively delivered to the lung, since the powder was not left in the capsule and the patients seemed to do well clinically. However, the study was not designed to assess lower-respiratory-tract deposition or clinical response. I fully agree that further studies are needed.

There are theoretical differences in drug delivery that are dependent upon interfaces and possible differences between HFA and CFC propelled medications. Studies have found comparable clinical effects from some HFA and CFC propelled medications,<sup>2,3</sup> and increased lung deposition of Proventil HFA compared to albuterol CFC.<sup>4</sup>

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The author of this letter reports no conflict of interest.

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*Dr Fink replies:*

Bruce Hayton makes a good point that makeshift devices are not ready for “prime time.” He also rightly points out the risk of third-party devices, such as spacers and adapters, for administration of MDI medications in ventilator circuits that are not redesigned as the MDI itself is redesigned. Both of these can place the consumer and patient at some risk.

In response to his example, differences in output between CFC and HFA MDIs were identified soon after the transition occurred. The output difference was less than 20% of the delivered dose, which in the case of albuterol would be too small to have a clinically important effect.<sup>1</sup> Subsequent researchers quantified the overall delivery in vitro with a few of these devices, to make clinicians aware of the potential performance differences.<sup>2</sup>

I for one would have hoped that the manufacturers of these spacers would have universally redesigned their devices, or made some effort to inform their customers of how device performance would be different with the new propellants. As a consumer I would give my business to the companies that responded to the CFC-to-HFA change by either sponsoring published research or modifying their design or marketing materials. This is a “vote with your feet” scenario.

What makes clinicians—whether physicians or respiratory therapists—uniquely

qualified to identify the limitations of current methods? First, these limitations affect our practice and our patients. Is there value in physicians or respiratory therapists designing prototypes to overcome these perceived limitations? If not us, who? Some of the greatest innovations and early prototypes of medical devices came from the minds of clinicians, not full-time professional researchers.

We have to be safe, so every in-house evaluation of an adaptation should go through the investigational review board and require signed consent.

Is the investment in time and effort offset by our ability to actually benefit the desired patient outcome? This type of investigation can provide the clinician with excellent insights as to what works and what doesn't work. If one group sees a problem or methods limitation, others probably have as well. The only way to assure that such explorations have a further-reaching desired impact is to have them written up, submitted to a peer-reviewed journal, and published. Many a small study has changed the industry.

I would suggest that more rather than less of these types of explorations should be pursued. They cost relatively little money and staff time, compared to the potential long-term benefits. Those benefits are as great in learning what not to do as in the great successes.

A major barrier to the use of “passive” powder inhalers (ie, that require substantial inspiratory effort to mobilize the powder

from the device and aerosolize it) is that they can't be used with small children and patients with artificial airways. In some cases the only way to access a valuable formulation is with a powder inhaler. Johnson's paper<sup>3</sup> is a valuable first step in studying how powdered medications can be administered to those patients—which is a vital step for any new product innovation or development.

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The author of this letter reports no conflict of interest.

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