Effect of dead volume on the efficiency and the cost to deliver medications in cystic fibrosis with four disposable nebulizers

Ho S L, Coates A L

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The use of disposable jet nebulizers to deliver medications in cystic fibrosis.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
Patients with cystic fibrosis. No further details were given.

Setting
Community and hospital. The study was carried out in Toronto, Ontario, Canada.

Dates to which data relate
Effectiveness data were collected from studies published between 1983 and 1998. The dates of resource use and cost data were not reported. The price year was not reported.

Source of effectiveness data
Effectiveness data were derived from product specifications provided by the respective manufacturers, and a review of the literature. Additionally, the authors tested 2 sets of 6 of each type of nebulizer under laboratory conditions.

Outcomes assessed in the review
The review assessed the following outcomes: dead volume (DV), respirable fraction (RF), the drug output within the RF (ORF), and the time required to complete nebulisation.

Study designs and other criteria for inclusion in the review
Not stated.

Sources searched to identify primary studies
Product specifications provided by the respective manufacturers, a review of the literature, and laboratory tests carried out by the authors.
Criteria used to ensure the validity of primary studies
Not stated.

Methods used to judge relevance and validity, and for extracting data
Graphs summarising results were used.

Number of primary studies included
At least 15 primary studies were included.

Methods of combining primary studies
Not stated.

Investigation of differences between primary studies
Differences were reported, but not investigated.

Results of the review
Updraft II was consistently the most efficient nebulizer, while the WJ was consistently the least efficient.

The differences between the Misty-Neb or the Acorn II and the Updraft II were not large, but all three types of nebulizer were strikingly more efficient than the WJ.

DV was higher for saline than for the 4 ml medication charges, which were virtually identical.

The Updraft II produced the highest mean RF and a low mean DV, while the WJ produced the lowest mean RF and the highest mean DV.

The Updraft II had the best recorded nebulisation time.

The Updraft II yielded the largest estimated pulmonary drug deposition (DE) for each drug trial, while the WJ consistently yielded the lowest.

Measure of benefits used in the economic analysis
Benefit measures included DV, RF, ORF, and the time required to complete nebulisation. As such, this study was a cost-consequences analysis.

Direct costs
Direct costs were not discounted given the short time frame of the study (less than 1 year). Quantities and costs were not reported separately. Direct costs included the cost of the medication, the device and the cost for the administration by a respiratory therapist. The quantity/cost boundary adopted was that of the health service. The estimation of quantities and costs was based on actual data. The source of cost data was not reported. The price year was not stated.

Statistical analysis of costs
Not reported.

Indirect Costs
Not included.
Currency
Canadian dollars (Can$)

Sensitivity analysis
Not reported.

Estimated benefits used in the economic analysis
See results of the review above.

Cost results
For Salbutamol (2.5mg) the total cost results were Can$4.90 (Updraft II), Can$6.01 (Acorn II), Can$5.60 (Misty-Neb) and Can$5.70 (WJ). Results were also provided for Tobramycin (80mg). The Updraft II, however, generated the lowest costs irrespective of the drug regimen used. The total cost of aerosol administration, when attempting to achieve the same estimated pulmonary drug deposition attained when using Updraft II, was again lowest for Updraft II.

Synthesis of costs and benefits
Although the Misty-Neb had the lowest unit cost per nebulizer, the Updraft II demonstrated the best cost-effectiveness overall. In assessing the total cost for a single aerosol treatment, the WJ proved to be the most expensive nebulizer to use, while delivering the least medication.

Authors' conclusions
The study demonstrates that four commonly used disposable jet nebulizers were clearly different in efficiency and performance, and it has shown that the data provided by each manufacturer are insufficient to evaluate the efficiency of a device.

CRD COMMENTARY - Selection of comparators
The comparators represented current practice in the authors' setting. The survey carried out to determine which nebulizers were being used in the chosen setting found that no institution was using reusable breath-enhanced nebulizers. You, as a user of the database, should decide if the comparator represents current practice in your own setting.

Validity of estimate of measure of benefit
The authors did not state that a systematic review of the literature had been undertaken. Effectiveness estimates were combined using narrative methods and graphs. The authors reported differences between the primary studies, but these differences were not further investigated. The authors did not derive a summary measure of health benefit and the analysis may therefore be considered to have been of cost-consequence design.

Validity of estimate of costs
All categories of costs relevant to the perspective adopted were included in the analysis. For each cost category, all relevant costs were included. Costs and quantities were not reported separately. No statistical analysis of quantities or prices was performed. The price year was not reported thus limiting the generalisability of the cost data.

Other issues
The authors did make appropriate comparisons of their findings with those from other studies, but the issue of
generalisability to other settings was not addressed. The authors did not present their results selectively. The study compared four types of disposable jet nebulizers and this was reflected in the authors’ conclusions. The authors avoided performing statistical analyses because the small differences observed in some of the data, while having no clinical significance, may have achieved statistical significance due to the small standard deviations in the data.

**Implications of the study**
The findings suggest that changing from a less efficient to a more efficient nebulizer such as Updraft II can increase pulmonary availability more than twofold without increasing the dose or frequency of medication, and be cost saving. Caution must be exercised when interpreting studies that use different jet nebulizers. Standardisation of the performance of aerosol administration systems is necessary to allow clinicians to specify the device to be used when prescribing a specific drug dose.

**Source of funding**
None stated.

**Bibliographic details**
Ho S L, Coates A L. Effect of dead volume on the efficiency and the cost to deliver medications in cystic fibrosis with four disposable nebulizers. Canadian Respiratory Journal 1999; 6(3): 253-60

**PubMedID**
10393287

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Administration, Inhalation; Albuterol /administration & dosage; Canada; Confidence Intervals; Cost-Benefit Analysis; Cystic Fibrosis /drug therapy; Data Collection; Disposable Equipment /economics; Equipment Design; Female; Humans; Male; Nebulizers and Vaporizers /economics; Respiratory Dead Space /drug effects /physiology; Sensitivity and Specificity; Sodium Chloride /administration & dosage; Tobramycin /administration & dosage

**AccessionNumber**
21999006826

**Date bibliographic record published**
30/09/2000

**Date abstract record published**
30/09/2000