A prospective, randomized comparison of an in-line heat moisture exchange filter and heated wire humidifiers: rates of ventilator-associated early-onset (community-acquired) or late-onset (hospital-acquired) pneumonia and incidence of endotracheal tube occlusion

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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
In-Line Heat Moisture Exchange Filter (HMEF) in mechanical ventilator circuits.

Type of intervention
Treatment; Prevention.

Economic study type
Cost-effectiveness analysis.

Study population
Male and female intubated trauma victims who required mechanical ventilatory support in a 20-bed trauma ICU (TICU).

Setting
Hospital. The economic study was conducted in Florida, USA.

Dates to which data relate
The main effectiveness data were derived from a single study conducted in 1996. Resource and cost data were obtained from 1996 sources. The price date was not stated.

Source of effectiveness data
The estimates of the early/late-onset, hospital-acquired VAP rate, the incidence of nosocomial pneumonia and ventilator-associated pneumonia (VAP), number of ventilator days associated with the development of no pneumonia, community-acquired pneumonia and nosocomial pneumonia and the rate of endotracheal tube occlusion were derived in a single trial.

Link between effectiveness and cost data
The costing was undertaken prospectively on the same patient sample as that used in the effectiveness study.

Study sample
Overall, 280 consecutive trauma patients in a 20-bed TICU were randomized to either an in-line HMEF (n=140) or a H-wH in the breathing circuit (n=140). The patient ages ranged from 15 to 95 years in the HMEF group, and 16 to 87 years in the H-wH group (p<0.5) with a mean age of 46 years and 48 years, respectively. The male to female ratio ranged between 78% and 82% to 22% and 18%, respectively. Fifty-five percent of all admissions were related to blunt trauma.
trauma, 40% secondary to penetrating trauma and 5% to burns. There was no difference in Injury Severity Score between the two groups: HMEF was 22 (+/- 10) and H-wH was 20 (+/- 10), (p>0.1). The study was designed to provide for a 5% alpha and beta error or a 95% certainty that a difference truly existed to achieve a 15% reduction in the rate of nosocomial pneumonia, requiring 140 patients in each study group arm.

Study design
This study was a randomised non-blinded trial with concurrent controls. The duration of the follow-up was 6 months. There was no loss to follow-up.

Analysis of effectiveness
The analysis of effectiveness was based on the intention to treat principle. The primary health outcomes were the early/late-onset, hospital-acquired VAP rate, the incidence of nosocomial pneumonia and ventilator-associated pneumonia (VAP), number of ventilator days associated with the development of no pneumonia, community-acquired pneumonia and nosocomial pneumonia and the rate of endotracheal tube occlusion.

Effectiveness results
The late-onset, hospital-acquired VAP rate for the HMEF group was 6% compared to 16% for the H-wH group, (p<0.05). The HMEF group exhibited the same rate of early-onset, community-acquired VAP as the H-wH group. The incidence of nosocomial pneumonia and ventilator-associated pneumonia (VAP) was 24 and 22 in the H-wH group and 26 and 9 in the HMEF group, (p<0.05). The number of ventilator days associated with the development of no pneumonia was 2.4 (+/- 2.2) with H-wH and 2.4 (+/- 2.9) with HMEF. The corresponding figures for community-acquired pneumonia were 7.9 (+/- 4.6) and 11.4 (+/- 6.7) and for nosocomial pneumonia were 16.3 (+/- 13.7) and 20.4 (+/- 15.3). The rate of endotracheal tube occlusion (0-25%) was 129 in the H-wH group and 132 in the HMEF group.

Clinical conclusions
The HMEF was shown to reduce the incidence of late-onset, hospital-acquired VAP, but not to reduce early-onset, community-acquired VAP, compared to the conventional H-wH circuit. This was associated with a significant reduction in total ICU stay.

Measure of benefits used in the economic analysis
No summary benefit measure was used in the analysis and as such the authors conducted a cost and consequences analysis. As such the benefits are represented by the health outcomes reported earlier.

Direct costs
Ventilator circuit costs were included in the analysis. Resource and cost data were reported separately. The quantity/cost boundary adopted was the hospital. Discounting was not undertaken due to the short study period. The price year was not stated.

Statistical analysis of costs
Analysis of variance, unpaired student's t tests and p values.

Indirect Costs
Not considered.

Currency
US dollars ($).
Sensitivity analysis
Not undertaken.

Estimated benefits used in the economic analysis
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Cost results
The circuit costs per group were $3,892.56 in the H-wH group and $2,443.84 in the HMEF group. The median dollars per patient were $27.80 and $17.46, respectively.

Synthesis of costs and benefits
Costs and benefits were not combined. The results suggest that the HMEF humidifier is the dominant strategy as it is both more effective and less costly than H-wH.

Authors' conclusions
The use of the HMEF is a cost-effective clinical practice associated with fewer late-onset, hospital-acquired VAPs and should result in improved resource allocation and utilization.

CRD COMMENTARY - Selection of comparators
The reason for the choice of the comparator is clear. The authors specifically chose HMEF (Pall BB-100, Pall Corporation, Eart Hills, NY) to compare with the H-wH system because it has been shown to be the only filter tested which maintained bacterial impermeability at 24 hours. You, as a user of this database, should consider whether this is a widely used health technology in your own setting.

Validity of estimate of measure of benefit
No summary benefit measure was used and as such the authors conducted a cost and outcomes analysis. However, a good quality RCT was undertaken with supporting power calculations to assure appropriate sample size, equal numbers in groups and statistical analysis of results.

Validity of estimate of costs
Resources were reported separately from the costs. The costing methodology lacked some details, without the price date being stated. Important cost items do not appear to have been omitted. However, as the authors noted, potential cost savings associated with eliminating the purchasing of circuit tubing water traps, the institutional weekly changing of inspiratory and expiratory filters in the Puritan-Bennett 7200ae ventilators were not included in the analysis.

Other issues
The issue of generalisability was not addressed. However, appropriate comparisons were made with other studies in terms of early/late-onset hospital-acquired VAP, pneumonia rates and reduction in ventilator circuit costs. Results do not appear to have been presented selectively.

Source of funding
Supported in part by the Departments of Surgery, Division of Surgical Critical Care, University of Miami and Department of Respiratory Therapy, Jackson Memorial Hospital.
Bibliographic details

PubMedID
9377917

Indexing Status
Subject indexing assigned by NLM

MeSH
Adolescent; Adult; Aged; Aged, 80 and over; Airway Obstruction /etiology; Burns /therapy; Catheterization /instrumentation; Community-Acquired Infections /etiology; Critical Care; Cross Infection /etiology; Equipment Design; Female; Filtration /instrumentation; High-Frequency Ventilation; Hospital Costs; Hot Temperature; Humans; Humidity; Incidence; Injury Severity Score; Intubation, Intratracheal /instrumentation; Male; Middle Aged; Pneumonia /etiology; Prospective Studies; Single-Blind Method; Suction /instrumentation; Ventilators, Mechanical /economics; Water; Wounds, Nonpenetrating /therapy; Wounds, Penetrating /therapy

AccessionNumber
21998007668

Date bibliographic record published
31/10/1999

Date abstract record published
31/10/1999