A cost-benefit analysis of gown use in controlling vancomycin-resistant Enterococcus transmission: is it worth the price

Puzniak L A, Gillespie K N, Leet T, Kollef M, Mundy L M

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 study examined the use of gown and gloves when entering rooms of patients colonised or infected with vancomycin-resistant Enterococcus (VRE), to prevent the transmission of VRE.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients staying more than 24 hours in a medical intensive care unit (MICU).

Setting
The setting was secondary care. The economic study was carried out in an MICU at Barnes-Jewish Hospital, Missouri, USA.

Dates to which data relate
The effectiveness evidence and part of the resource use data were collected from 1 July, 1997 to 31 December, 1999. No price year was reported.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing appears to have been undertaken retrospectively, either on the same patient sample as that used in the effectiveness study or on a sub-sample of them.

Study sample
All patients staying more than 24 hours in a 19-bed MICU at Barnes-Jewish Hospital from 1 July, 1997 to 31 December, 1999 were eligible. No power calculations were reported to have been performed. The overall number of patient finally included in the study was 1,164 in the gown and gloves group and 708 in the gloves only group. The authors did not state whether any individuals refused to participate in the study, or whether any were excluded from the initial sample. No evidence was provided that the study sample was representative of the study population.
Study design
This appears to have been a comparison study with non-concurrent controls, which was performed at a single centre. It is not possible to infer whether the effectiveness study was prospective or retrospective. The duration of follow-up was not explicitly stated, but it seems to have been the hospitalisation period.

Analysis of effectiveness
The effectiveness outcomes included as input parameters in the decision tree were:

- the number (and percentage) of patients in each group (i.e. during gown use versus no gown use) who were VRE positive on admission;
- the number (and percentage) of those infected on admission who had either VRE colonisation or VRE infection;
- the number (and percentage) of patients who were VRE negative on admission and who acquired VRE during hospitalisation; and
- the number (and percentage) of those infected during the hospitalisation who acquired either VRE colonisation or VRE infection.

Patients in the gown group were not shown to be comparable to patients in the no gown group.

Effectiveness results
The number of patients who were VRE positive on admission was 94 (8%) during the gown period versus 88 (12%) during the no-gown period.

The number of patients infected on admission who had VRE colonisation was 89 (95%) during the gown period versus 79 (90%) during the no-gown period.

The number of patients infected on admission who had VRE infection was 5 (5%) during the gown period versus 9 (10%) during the no-gown period.

The number of patients who were VRE negative on admission and who acquired VRE during hospitalisation was 59 (6%) during the gown period versus 68 (11%) during the no-gown period.

The number of patients infected during hospitalisation who acquired VRE colonisation was 55 (93%) during the gown period versus 61 (91%) during the no-gown period.

The number of patients infected during hospitalisation who acquired VRE infection was 4 (7%) during the gown period versus 6 (9%) during the no-gown period.

Clinical conclusions
The percentage of patients who were already VRE positive on admission and the percentage of patients who acquired the infection during hospitalisation were higher during the no-gown period than the gown period.

Modelling
A decision tree model, showing the events pathways of the study, was developed to assess the costs and effectiveness of each intervention. The time horizon corresponded to the period during which the effectiveness data were collected (i.e. 30 months), but the results were annualised.

Measure of benefits used in the economic analysis
The summary measures of health benefit used were the number of VRE cases averted and the number of VRE cases
Averted per 1,000 MICU-days.

**Direct costs**
The costs considered in the economic study were those of the hospital. These included the costs of the gown, gloves, hand hygiene, nursing time to don and doff gowns, isolation cart set up, VRE-negative tests, VRE-positive tests, and MICU and hospitalisation costs. The authors reported that they performed a retrospective case-control study to identify the attributable cost of VRE by matching patients without VRE from the same MICU population with patients with VRE, according to the diagnostic-related groups (DRG) code, Acute Physiology and Chronic Health Evaluation (APACHE) II severity of illness score (+/− 2 points), and age (+/− 5 years). MICU costs were estimated from the hospital's step-down cost allocation system. The cost for each isolation cart included all initial supplies. In addition, the authors made assumptions to estimate the cost of gowns. Observational time trials and direct observation were used to estimate the time required for healthcare workers to retrieve, don, doff, and properly dispose of gowns. To estimate the cost associated with excess workload per VRE patient contact, the average time was multiplied by the average registered nurse salary. Microbiology costs were inclusive of all related testing costs. Therefore, the cost estimate was derived from actual data, a review of some literature and several authors' assumptions. No discounting was performed. The price year was not stated. The costs reported were the annualised costs associated with each of the strategies (i.e. gown use versus no gown use).

**Statistical analysis of costs**
Some results of statistical analyses of the costs were reported. Such analyses compared differences between patients with different types of infection (i.e. VRE colonised and VRE bacteraemia patients). However, no statistical comparisons between costs associated with the gown versus the no-gown periods were reported.

**Indirect Costs**
No calculation of the indirect costs was included in the analysis.

**Currency**
US dollars ($).

**Sensitivity analysis**
Parameter uncertainty was investigated using a one-way sensitivity analysis. The variables explored were the number of gowns used, the time required to don and doff gowns, VRE transmission rates and the cost of material.

**Estimated benefits used in the economic analysis**
The number of cases of VRE colonisation averted during the gown period was 58 (39 if annualised), or 5.96 cases per 1,000 MICU-days.

The number of cases of VRE bacteraemia averted during the gown period was 6 (4 if annualised), or 0.61 cases per 1,000 MICU-days.

**Cost results**
The annualised costs were $179,816 for the gown period and $105,821 for the no-gown period.

**Synthesis of costs and benefits**
The incremental annual cost between the gown and no-gown interventions was $73,995.

Incremental cost-effectiveness ratios (ICERs) were estimated as the incremental cost per case of VRE averted with...
gown use versus no-gown use. The ICER was $1,897.

The annual net benefit of the gown policy (defined as the difference between the averted costs derived from the use of gowns minus the incremental costs incurred) was $419,346.

The results were most sensitive to the probability of acquiring VRE. With a no-gown transmission rate of 40%, the incremental cost per case of VRE colonisation averted was $3,217 and the net benefit was $546,182. The use of gowns became a cost-saving strategy when the no-gown transmission probability was approximately 88% (corresponding to the prevention of 7 cases of VRE colonisation).

Authors’ conclusions
The use of gowns adds costs to the delivery of health services in a medical intensive care unit (MICU) setting, but the benefits from averting enteric vancomycin-resistant Enterococcus (VRE) transmission outweigh those costs.

CRD COMMENTARY - Selection of comparators
The authors did not explicitly state the reasons for the choice of the comparator, but it appears to have represented current practice before the wearing of gowns was required. The authors mentioned the ongoing debate in their setting over the cost versus benefits of requiring gown use to prevent VRE transmission. You should decide if the comparator represents current practice in your own setting.

Validity of estimate of measure of effectiveness
The analysis was based on a comparative study design with non-concurrent controls. This was not the most appropriate study design for the study question given its high potential for bias. Moreover, reporting on the clinical study was sparse. The study sample was not shown to be representative of the study population. The patient groups (gown versus no gown use) were not shown to be comparable at analysis. Appropriate statistical analyses of the effectiveness results were not reported in the study. Given the latter, and the non-randomised nature of the study design, the internal validity of the study might have been compromised as selection bias could be important. No power calculations were reported. The authors investigated the robustness of the study results when different transmission rates for the intervention group were considered in the sensitivity analysis.

Validity of estimate of measure of benefit
The authors derived a measure of health benefit specific to the health intervention considered at analysis. However, they did not derive a general summary measure of benefits, such as the number of quality-adjusted life-years, which would have allowed the study results to be compared with those obtained in studies analysing different interventions.

Validity of estimate of costs
The cost analysis was performed from the perspective of the hospital. All the relevant categories of costs related to this perspective seem to have been included in the analysis. Moreover, all the relevant costs for each category seem to have been included in the cost calculations. The authors used a double approach for their cost calculations. More specifically, they used a step-down cost allocation system to estimate MICU costs, and specific calculations for other resource use (i.e. cost associated with excess workload per VRE patient contact or microbiology costs). The costs and the resource use quantities were not presented separately for every item, which would hinder reflation exercises in other settings.

Other issues
The authors compared the results of their analysis with those of other studies but despite some agreement, the evidence would seem contradictory. They mentioned that the results may not be generalisable to other settings given the differences in costs across different settings. The authors’ conclusions seem to have reflected the scope of the analysis. The authors reported a number of limitations of their study. First, the costs of implementing the use of gowns were not
included in the economic study. Thus, if the costs of training personnel are substantial, then the cost-savings of the intervention would be reduced. Second, the costs attributed to excess workload due to management of gowns might have been overestimated, as staff payroll is unaffected by whether or not the MICU has a gown policy in place. Third, the magnitude of the benefit would have been greater if a societal perspective had been adopted, as the impact of these nosocomial infections on patients and family members could have been included in the analysis.

Implications of the study
Given the caveats reported, the results of this study should be interpreted with caution.

Source of funding
None stated.

Bibliographic details

PubMedID
15188849

DOI
10.1086/502416

Indexing Status
Subject indexing assigned by NLM

MeSH
Cohort Studies; Cost-Benefit Analysis; Cross Infection /prevention & control /transmission; Enterococcus /drug effects /isolation & purification; Gram-Positive Bacterial Infections /prevention & control /transmission; Humans; Missouri; Protective Clothing; Sensitivity and Specificity; Vancomycin Resistance

AccessionNumber
22004000753

Date bibliographic record published
31/03/2006

Date abstract record published
31/03/2006