Cost-effectiveness analysis of an antimicrobial transparent dressing for protecting central vascular access in critically ill patients versus standard transparent dressings in France

A comparison of two modelling approaches: Decision-Tree versus Non-Homogeneous Markov Model

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OBJECTIVE To compare the results of cost-effectiveness analysis (CEA) for the transparent CHG dressing versus standard transparent dressings, obtained with a classical decision tree model and with a Non-Homogeneous Markov Model (NHMM) previously developed.

METHODS Clinical data was extracted from a multicentre randomised controlled trial (RCT) with 1,879 patients and economical data obtained from micro and macro-costing published studies1-4 (Table 1). The comparator method is a 30-day ICU-time NHMM model developed in Microsoft Excel® with Visual Basic App. (VBA) and comprising eight states: four combining either occurrence or no occurrence of CRBSI and the need of a new catheter (CT); one for contact dermatitis; one for changing alternative dressing (gauze and tape) in case of dermatitis and two absorbing states (death and discharge of the ICU (Fig. 1).

RESULTS CEA with the Decision Tree: The antimicrobial dressing strategy is dominant compared to standard transparent dressings. The intervention prevents 0.0135 CRBSI (13.5/1,000) and saves €157 per patient (Fig. 3A). These results are robust across a range of values for several parameters in DSA (Fig. 3B).

CEA with the NHMM: The simulation of 1,000 patients per group shows 12 infections avoided with the use of the antimicrobial dressing. The mean cost difference of €141 for the CHG-dressing group is not statistically significant. DSA shows that this difference is more sensitive to the additional ICU LOS due to CRBSI (Fig. 3C).

The PSA from 1,000 simulations of 1,000 patients each, confirms the results of the first simulation. The CHG-dressing prevents 11.75 infections/1,000 patients (95%CI: [-19.64; -3.85]) and a mean extra cost of €141 per patient (95%CI: [€-975; €1,258]) when using antimicrobial dressing.

Table 2. Comparison between modeling approaches

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<thead>
<tr>
<th>Models</th>
<th>Decision Tree</th>
<th>NHMM/Markov Model</th>
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<tbody>
<tr>
<td>Main drivers</td>
<td>CRBSI-attributable additional LOS, number of CHG-dressings, daily ICU costs</td>
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<tr>
<td>Possibility of cohort simulations</td>
<td>No</td>
<td>Yes</td>
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<td>Possibility of sensitivity analysis</td>
<td>No</td>
<td>Yes</td>
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<td>Probabilistic sensitivity analysis</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Outcomes</td>
<td>Mean cost difference per patient</td>
<td>Mean cost difference per patient, CRBSI-attributable additional LOS and ICU LOS</td>
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<td>Mean values for effectiveness and costs without CI</td>
<td>Mean values for effectiveness and costs with CI</td>
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<td>Mean values for effectiveness and costs without CI</td>
<td>Mean values for effectiveness and costs with CI</td>
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DISCUSSION AND CONCLUSIONS

- Although the Decision-tree and the NHMM are structurally different their outcomes are coherent (Table 2). However, the antimicrobial dressing strategy appears DOMINANT with the Decision tree and COST-EFFECTIVE with the NHMM Model.
- The mean effect difference in cost per patient with CHG-dressings is negative with the decision-tree, indicating savings, and positive with the NHMM, indicating extra cost even not statistically significant.
- Possible interpretations for the differences between the two modelling approaches are:
  1) The decision-tree is a linear simplification, with less health states and disregarding possible state’s change or recurrence, can overestimate the real savings.
  2) NHMM is prone to overestimate the real costs in the CHG-dressing group by integrating the cost impact of a substantial number of patients being discharged or dying sooner than assumed in the time horizon chosen (because of competing risks).

REFERENCES