NHS Innovation Accelerator

Economic Impact Evaluation Case Study: PneuX™

1. BACKGROUND

The PneuX™ Pneumonia Prevention System is an endotracheal/tracheostomy tube system for airway management, designed to prevent ventilator-associated pneumonia (VAP) in patients having ventilation for 24 hours or more. VAP can occur in critically ill patients who are having mechanical ventilation. The endotracheal or tracheostomy tube, which is inserted to help or control respiratory function, interferes with the normal protective reflexes of the upper airway, such as coughing. As a result of this, micro-organisms are not cleared and bacteria can colonise the oropharyngeal secretions. These can leak down into the airway, contaminating the respiratory tract (micro-aspiration).

Current tracheal tubes used for ventilation have cuffs to prevent the passage of contaminated secretions. However, an imperfect seal can permit the slow passage of material, whilst excessive pressure can lead to tracheal mucosa injury. The PneuX™ Pneumonia Prevention System is a cuffed ventilation tube with an electronic, automatic pressure controller which controls and maintains the safe inflation volume and pressure of the cuff during use. It is intended for use with patients who are having long-term mechanical ventilation, which is expected to be for more than 24 hours, but no more than 30 days.

The PneuX™ system is manufactured by Venner Medical (Singapore) Pte and is supplied by Qualitech Healthcare Limited in the UK. The system has had a successful trial with New Cross Hospital in Wolverhampton and a utilisation study has been conducted at Blackpool Victoria Hospital, leading to adoption of the technology.1 PneuX™ is the subject of a NICE Medtech Innovation Briefing Document (MIB45) from which most of the data for this case study has been taken.2

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1 Young P. NIA Analysis Framework. March 2017
This case study provides a cost-effectiveness analysis (CEA) of the PneuX™ system and a simple return on investment (ROI) analysis based on the information provided.

2. INPUT COSTS

The PneuX™ system consists of three component parts:

- PneuX™ endotracheal/tracheostomy tube – a flexible silicone tube with a cuff, a flange, a drain tube, an inflation tube, a reservoir and a connector. The endotracheal tubes (of various sizes) cost £150 each exclusive of VAT. The tracheostomy tubes (of various sizes) cost £175 exclusive of VAT;
- The PneuX™ tracheal seal monitor – an electronic automatic pressure controller for the inflation volume and pressure within the tube cuff during use. This is provided on a loan basis to the hospital;
- An extension tube – a 2-metre extension tube for the monitor, which connects the air outlet on the seal monitor and the pilot valve of the endotracheal/tracheostomy tube. Extension sets are non-sterile and are for single patient use. These are provided at no charge to the hospital.

The endotracheal/tracheostomy tubes and the extension tubes are sterile and for single patient use. The manufacturer provides training at no cost to the hospital/trust. There are no maintenance or calibration requirements for the system and the monitor is serviced at two-year intervals by the manufacturer at no additional cost. The PneuX™ system can be placed by anaesthetists and maintained by critical care nurses.

The PneuX™ is fully developed and available for adoption. The costs of development and project management are unknown. There are no anticipated further development costs associated with this technology.

The costs for a hospital adopting the PneuX™ technology would be the purchase of the endotracheal/tracheostomy tubes, which are single use. The tubes are packed as single units and supplied as a box of 10 units of a single size. The extension tubes are also single use and are provided free of charge. The tracheal seal monitor is provided on loan at no cost to the hospital. Training is provided at no cost and two-yearly servicing of the monitor is carried out by the manufacturer at no cost. The example costs used in this case study are shown in Table 2.1.

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endotracheal / tracheostomy</td>
<td>Flexible, one-use silicone tubes with a cuff, a flange, a drain tube, an inflation tube, a reservoir and a connector. Weighted average cost based on 76% use of endotracheal tubes &amp; 24% use of tracheostomy tube</td>
<td>£156</td>
</tr>
<tr>
<td>Tracheal seal monitor</td>
<td>Electronic automatic pressure controller for the inflation volume and pressure within the tube cuff</td>
<td>£0</td>
</tr>
<tr>
<td>Extension tube</td>
<td>2-metre extension tube which connects the seal monitor and the endotracheal/ tracheostomy tube</td>
<td>£0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>£156</td>
</tr>
</tbody>
</table>
There will be some costs relating to staff time for training in the use of the PneuX™ system when an organisation adopts it. No indication has been given as to how much time this would be.

3. **OUTCOMES**

The key outcome of interest relating to PneuX™ use is a reduction in the cases of VAP in an Intensive Care Unit (ICU). A UK-based, single-centre randomised (RCT) controlled trial of the PneuX™ system indicated incidence of VAP under standard care of 21%. This is compared to incidence of VAP using the PneuX™ system of 10.8%. The patients included in this study were at high risk of VAP. Critically ill patients who develop VAP appear to be twice as likely to die compared with similar patients without VAP.

Standard intubation in the NHS is carried out using a variety of tubes, whose prices range from £1.12 to £1.35 without subglottic suction and from £3.25 to £11.60 with subglottic suction. In addition, there are several alternative devices known to the National Institute for Health and Care Excellence (NICE) that appear to fulfil a similar function to the PneuX™ system. The costs of these devices are not known, nor is their impact on the incidence of VAP.

The cost of treating a case of VAP is given as £10,000 per patient episode. Evidence provided from published papers gives a range of costs of treating VAP between £6,490 and £25,900 per patient. As these figures are from previous studies carried out in the US, the costs have been converted from dollars to pounds and adjusted for inflation.

**Table 3.1: Impacts, metrics and proxy values for PneuX™**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Metric</th>
<th>Proxy value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced incidence rates of colonisation and pneumonia prevention</td>
<td>Cost of treating an episode of VAP £10,000 per episode</td>
<td>£10,000 per patient episode</td>
</tr>
</tbody>
</table>

4. **ECONOMIC ANALYSIS**

The information available on the costs of the treatment and the costs of standard care, plus the incidence of VAP in an ICU allows a cost-benefit analysis to be undertaken, comparing the costs and outcomes of these two options. This is presented here based on a District General Hospital with 10 intensive care beds over a one year time horizon. The return on investment has also been calculated using the same data.

In a District General Hospital with 10 intensive care beds, it is estimated that 300 patients would be intubated per year. Table 4.1 shows the cost comparison of PneuX™ and Standard Care.

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5 NIA Fellow May 2017.

Table 4.1: Cost comparison of PneuX™ versus Standard Care in a District General Hospital over one year

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubation under standard care (average of standard intubation using tubes with &amp; without subglottic suction = £6.36) x 300 episodes of intubation</td>
<td>£1,908</td>
</tr>
<tr>
<td>Intubation using PneuX™ (average of endotracheal &amp; tracheostomy tubes = £156) x 300 episodes</td>
<td>£46,800</td>
</tr>
<tr>
<td><strong>Net cost/saving of intubation using PneuX™</strong></td>
<td>-£44,892</td>
</tr>
<tr>
<td>Costs of treating VAP under standard care with incidence of 21% at £10,000 per episode</td>
<td>£630,000</td>
</tr>
<tr>
<td>Cost of treating VAP using PneuX™ with incidence of 11% at £10,000 per episode</td>
<td>£330,000</td>
</tr>
<tr>
<td><strong>Net cost/saving of treating VAP using PneuX™</strong></td>
<td>£300,000</td>
</tr>
<tr>
<td><strong>Total net cost/saving with PneuX™</strong></td>
<td>£255,108</td>
</tr>
</tbody>
</table>

This shows a substantive annual saving from using PneuX™ compared to standard care. The saving is the result of reduced incidence of VAP, which outweighs the higher cost of PneuX™ endotracheal and tracheostomy tubes.

An ROI has been calculated using the formula:

\[
\frac{\sum \text{Total discounted benefits}}{\sum \text{Total discounted costs}}
\]

Using the cost data from table 4.1, this gives values of:

300,000
44,892

This gives an ROI of: 668%

Nationally there are estimated to be 83,500 cases of intubation per year. This would give a saving of £71,005,060 per year nationally.

5. IMPACT ON EMPLOYMENT

To ensure adequate training and support within the Trusts, the Distributor (Qualitech Healthcare Limited) has recruited two full-time members of staff (Clinical Specialists), at a cost of £120,000 per annum (including running costs). There are no further impacts on employment envisaged by this innovation.

Reduced incidence of VAP would enable patients to return home and, in some cases, resume other activities sooner than with standard care.

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6. CONCLUSION

The results of cost-benefit analysis indicate that the PneuX™ system would be strongly cost-saving compared with standard care and gives a strongly positive return on investment from an NHS perspective.

The quality of evidence of effectiveness is good, in relation to the key RCT study (Gopal et al. 2015). This is supported by two smaller studies, of lesser quality having no control group, but which also reveal low rates of VAP using PneuX™.

The data provided have allowed calculations to be performed on both a District General Hospital level and the national level. Some trusts will already be using this or similar technologies (as of November 2015, three NHS hospitals were using the PneuX™ system according to the manufacturer). This suggests that some benefits from the adoption of PneuX™ have already been accrued.

York Health Economics Consortium
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