In Reply.—We thank Green and Beger for their observations on the Combitube. We concur with their assessment that the possibility of excessive insertion may result in the inability to ventilate a patient’s lungs. As with all airway devices, vigilance is the operative word. Sheridan Catheter will review the package insert for clarification of the depth of insertion and auscultation of breath sounds.

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A Simple Spreadsheet Tool for Cost Accounting Anesthesia Care

To the Editor.—Health-care providers, including anesthesiologists, are under increasing pressure to review the importance that cost factors play in their practices. As an initial step, an accurate accounting of the cost of anesthetic agents is needed. We developed a cost accounting tool, using computer spreadsheets, that simply and rapidly quantifies nonpersonnel costs of anesthesia care.

Methods. A list of intravenous and inhalational anesthetic agents and several disposable anesthesia equipment items was compiled and entered into a computerized spreadsheet format using Microsoft’s Excel for Windows, Version 5 program (fig. 1). The spreadsheet incorporated unit costs (cost paid to supplier), enabling the agents and items to be tracked and their costs tallied per anesthetic encounter. The cost estimates of volatile anesthetics were obtained from repetitive calculations of vaporizer settings and fresh gas flow rates at specific times using the formula

\[
\text{Cost} = \left( \frac{P \times F \times T \times M \times C}{24 \times 12 \times 100} \right),
\]

where \( P \) = percent inspired anesthetic (volume %), \( F \) = fresh gas flow (l/min), \( T \) = time (min) anesthetic was being delivered at the

Table 1. Anesthetic Drug Waste (Drawn Up, but Unused) before and after an Educational Intervention Using the Spreadsheet Tool

<table>
<thead>
<tr>
<th>Drug</th>
<th>mg/ml</th>
<th>Cost per ml</th>
<th>Waste in ml per Week</th>
<th>Waste Cost per Week ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>9/92</td>
<td>5/93</td>
</tr>
<tr>
<td>Midazolam</td>
<td>1.0</td>
<td>1.59</td>
<td>85</td>
<td>72</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.05</td>
<td>0.12</td>
<td>114</td>
<td>144</td>
</tr>
<tr>
<td>Sufentanil*</td>
<td>0.01</td>
<td>8.65</td>
<td>59</td>
<td>14</td>
</tr>
<tr>
<td>Succinylcholine</td>
<td>20</td>
<td>0.04</td>
<td>443</td>
<td>43.5</td>
</tr>
<tr>
<td>Atracurium</td>
<td>10</td>
<td>4.21</td>
<td>117</td>
<td>6.5</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>1</td>
<td>1.73</td>
<td>244</td>
<td>39.5</td>
</tr>
<tr>
<td>Propofol</td>
<td>12</td>
<td>0.525</td>
<td>418</td>
<td>257</td>
</tr>
<tr>
<td>Thiopental</td>
<td>20</td>
<td>0.10</td>
<td>844</td>
<td>1039</td>
</tr>
<tr>
<td>Ephedrine*</td>
<td>5</td>
<td>0.325</td>
<td>519</td>
<td>108</td>
</tr>
<tr>
<td>Phentylephrine*</td>
<td>0.1</td>
<td>1.78</td>
<td>327</td>
<td>45</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.5</td>
<td>0.615</td>
<td>91</td>
<td>7.5</td>
</tr>
<tr>
<td>Glycopyrrolate</td>
<td>0.2</td>
<td>0.28</td>
<td>65</td>
<td>8.5</td>
</tr>
<tr>
<td>Total waste per week</td>
<td></td>
<td></td>
<td>1,583.87</td>
<td>503.55</td>
</tr>
</tbody>
</table>

* Diluted concentrations: sufentanil 10 μg/ml, ephedrine 5 mg/ml, phentylephrine 100 μg/ml.
above P and F parameters, M = molecular weight of the anesthetic, C = cost of the liquid anesthetic in dollars/ml, D = density of the anesthetic, and 24:12 = liter volume of 1 mole of gas at 24°C. The formula was entered into the spreadsheet and then replicated to account for incremental time periods of different length, each with possibly differing fresh gas flows and vaporizer settings. The spreadsheet summed costs of the incremental time periods and transferred the subtotal to appropriate locations as shown in the example in figure 1.

The spreadsheet tool was used for two separate 1-week periods to determine the cost of drug waste (defined as opened but unused drugs left on the anesthesia carts at the close of the day). Educational efforts emphasizing awareness of waste were made during the interim separating the two periods.

The spreadsheet was also used to compare the costs of various anesthetic agents including muscle relaxants, propofol, opioids, and volatile anesthetics.

Results. The use of the spreadsheet tool allowed accurate and rapid determinations of the costs of the volatile agents as well as the in-vivo agents given to each patient during anesthesia. The use of the tool in concert with educational efforts reduced drug waste by $1,000 per week, which was about 10% of our total weekly drug costs (table 1).

Discussion. The spreadsheet format was readily adaptable to additional changes encountered in anesthesiology. New agents or equipment could be added to the sheet, others could be deleted, and the prices could be modified with a few strokes on the keyboard. In addition, drug or equipment substitutions could be made to sim-

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ulate "what-if" scenarios for different conceivable anesthetic plans. The spreadsheet tool was useful in identifying relative costs of groups of anesthetics and techniques (e.g., regional vs. general).

Conclusions. Accounting of anesthesia institutional and drug costs can be simplified with the use of a computer spreadsheet program. The use of a computer spreadsheet allows non-computer programmers to quickly set up a customized tool to identify anesthesia costs at their individual hospital institutions. Application of the spreadsheet tool permits accurate cost accounting for drugs given to the patient, as well as drugs that are drawn up but not used (i.e., wasted at the close of each case). The tool allows comparative cost analysis between anesthetic techniques and agents and between individual anesthesia care providers. The tool also can be used to identify costly practices and monitor savings that result from educational efforts, as well as uncover or enhance the value of published clinical trials involving different anesthetic regimens.

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References


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Insensitivity of Implicit Memory to Anesthesia Methods

To the Editor:—Schwender et al.1 are to be commended for their pioneering exploration of relationships among midlatency auditory evoked potentials, implicit memory, and methods of general anesthesia. A note of caution concerning their results seems warranted, however. They state that "implicit recall was statistically significant more often in group 1 than in the control group (group 4) or group 2 or group 3 (P < 0.01)." Readers should not interpret this statement to mean that flunitrazepam/fentanyl anesthesia (group 1) significantly increased the incidence of implicit memory relative to isoflurane/fentanyl (group 2) or propofol/fentanyl (group 3) anesthesia. The significance level of P < 0.01 in the statement apparently refers to a test comparing all four treatments and indicating that they were not all equivalent. Schwender et al. did not report additional analyses indicating whether groups 2, 3, and 4 individually differed from group 1. Such analyses, either with the chi-squared tests used by Schwender et al. or Fisher's exact tests, which are more appropriate because 50% of the cells have expected counts fewer than 5, indicate that group 1 differed significantly from group 4, but not groups 2 or 3 (P = 0.051 by chi-squared test and P = 0.14 by Fisher's exact test). Although the trend toward a greater incidence of implicit memory with the combination of the benzodiazepine and the opioid than with the combinations of isoflurane or propofol with the opioid warrants further investigation, anesthesiologists' judgments about the choice of anesthetic regimens should not be influenced by these equivocal differences.

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