Development of a Practical Costing Method for Hospitals

PENGYU CAO, SHIN-ICHI TOYABE and KOUHEI AKAZAWA

Division of Information Science and Biostatistics, Department of Medical Informatics and Pharmaceutics, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan

CAO, P., TOYABE, S. and AKAZAWA, K. Development of a Practical Costing Method for Hospitals. Tohoku J. Exp. Med., 2006, 208 (3), 213-224 — To realize an effective cost control, a practical and accurate cost accounting system is indispensable in hospitals. In traditional cost accounting systems, the volume-based costing (VBC) is the most popular cost accounting method. In this method, the indirect costs are allocated to each cost object (services or units of a hospital) using a single indicator named a cost driver (e.g., Labor hours, revenues or the number of patients). However, this method often results in rough and inaccurate results. The activity based costing (ABC) method introduced in the mid 1990s can prove more accurate results. With the ABC method, all events or transactions that cause costs are recognized as “activities”, and a specific cost driver is prepared for each activity. Finally, the costs of activities are allocated to cost objects by the corresponding cost driver. However, it is much more complex and costly than other traditional cost accounting methods because the data collection for cost drivers is not always easy. In this study, we developed a simplified ABC (S-ABC) costing method to reduce the workload of ABC costing by reducing the number of cost drivers used in the ABC method. Using the S-ABC method, we estimated the cost of the laboratory tests, and as a result, similarly accurate results were obtained with the ABC method (largest difference was 2.64%). Simultaneously, this new method reduces the seven cost drivers used in the ABC method to four. Moreover, we performed an evaluation using other sample data from physiological laboratory department to certify the effectiveness of this new method. In conclusion, the S-ABC method provides two advantages in comparison to the VBC and ABC methods: (1) it can obtain accurate results, and (2) it is simpler to perform. Once we reduce the number of cost drivers by applying the proposed S-ABC method to the data for the ABC method, we can easily perform the cost accounting using few cost drivers after the second round of costing.

© 2006 Tohoku University Medical Press

Cost-savings is an important factor in hospitals management (Munoz et al. 1989; Scott and Thomas 1997; Shinohara et al. 1998; Wakai et al. 2005). Especially, the prospective payment system which fixes the amount of reimbursement for hospitals has been introduced in health care.
Therefore, hospital managers have to reduce hospital costs while still maintaining the quality of care. Starting in April 2003 a Japanese prospective payment system (PPS) was introduced to a number of acute care hospitals in Japan. This Japanese payment system has a fixed daily reimbursement scheme based on a modified version of the case mix classification called the “diagnosis procedure combination (DPC)”. The plan is to adopt the DPC/PPS system in all hospitals in the near future in Japan.

In traditional cost accounting systems, the volume-based costing (VBC) method is the most popular cost accounting method. In this method, the indirect costs are allocated to each cost object (services or units of a hospital [Chan 1993; Greger 2000; Klose and Bottcher 2002]) using a single indicator named a cost driver (e.g., Labor hours, revenues or the number of patients). Although the VBC method has advantages regarding its simplicity, it often gives rough and inaccurate results (Partovi 1991; Suneel 2001). In the mid 1990s, a new costing method was introduced to the healthcare fields which is named the activity-based costing (ABC) method (Ralph and Ramsey 1994; Baker and Boyd 1997; Lisa et al. 2002). With the ABC method, all events or transactions that cause costs are recognized as “activities”, and a specific cost driver is prepared, whereby indirect costs are allocated to each activity. ABC can provide more accurate results. However, since the number of activities performed in hospitals is vast, data collection for these cost drivers is both time consuming and costly. In addition to its accuracy, the ABC method is much more complex than other traditional cost accounting methods (Robin 1988; Suneel 1996; Noah et al. 2000).

We herein propose a substitute method which provides a more convenient cost accounting method in comparison to the ABC. By this method, the data collection for cost drivers will become easier to perform by reducing the number of cost drivers. Simultaneously, this method avoids the inaccurate results that sometimes occur in cost accounting using the VBC method.

We further demonstrate the superiority of the proposed method in indirect cost accounting by comparing the costing results of three kinds of clinical examinations using ABC, VBC and the newly proposed method. Moreover, we evaluated the effectiveness of this new method using sample data from a physiological laboratory department.

**Methods**

**ABC cost calculation**

The total costs for each cost object are divided into direct and indirect costs; the direct costs mainly include direct labor costs, direct material costs and direct equipment costs, which can be accurately obtained from hospital information systems. The ABC method is a method that calculates the costs of indirect activities to each cost object. We assume that there are \( n \) indirect activities \( A_i \) (\( i = 1, ..., n \)), the corresponding total cost \( X_i \) of \( A_i \), and \( m \) cost objects \( O_j \) (\( j = 1, ..., m \)). Under the ABC method, indirect costs \( C_{ij} \), a component of the \( X_i \) is allocated to \( O_j \) based on the cost driver \( D_i \). Herein, each activity corresponds to a cost driver. The total volume of the cost driver, \( D_i \), is divided into the sub-volume for each cost object, \( d_{ij} \). For example, assume that we want to calculate the indirect cost of the chemical test unit \( O_j \) in the clinical examination department. We can then assign the activity “receive test order” and the “number of order receptions” to \( A_1 \) and \( D_1 \), respectively. Consequently, \( d_{1j} \), which is a part of \( D_1 \), is the number of order receptions for chemical tests. Fig. 1 shows the procedure for allocating the cost \( X_i \) of \( A_i \) to the cost objects \( O_j \).

The indirect cost to be allocated to \( O_j \) from \( X_i \), \( C_{ij} \) is obtained by the following equation:

\[
C_{ij} = X_i \times d_{ij}/D_i .
\]  

(1)

Finally, the total indirect cost, \( C_{ij} \), allocated to \( O_j \) is expressed as:

\[
C_{ij} = \sum_{i=1}^{n} C_{ij} .
\]  

(2)

**VBC cost calculation**

Table 2 shows the VBC cost accounting method. The traditional VBC method is applied when all cost drivers are common to \( A_i \). This method allocates indirect costs to \( O_j \) using the following formula:

\[
C_{ij} = \sum_{i=1}^{n} X_i \times d_i /D,
\]

where \( C_{ij} \) is the total indirect cost allocated to \( O_j \), and \( D \) is the volumes of the only cost driver for all the indirect activities (Fig. 2).
In the processes of cost accounting, the data collection for the cost drivers is most time consuming and costly step, especially, when many activities and corresponding cost drivers exist. The obvious disadvantage of ABC is that the method is associated with the collection of a vast amount of data because it has more cost drivers. Moreover, the thorough collection of data used in ABC is almost impossible in some cases. A convenient cost accounting method to reduce the number of cost drivers without a loss in accuracy for estimations of the indirect costs in the ABC is thus needed. We herein propose a
method for objectively selecting a representative cost driver from several cost drivers which have a high correlation. The detailed explanation for the calculation process of the cost driver selection is given below:

(a) For \( O_j \), the rate of cost driver \( R_{ij} \) of \( d_{ij} \) to \( D_i \) with \( A_i \) is calculated by

\[
R_{ij} = \frac{d_{ij}}{D_i} \times 100\%.
\]

(b) With \( k \)-th \( A_i \), the residual, \( \mu_{ij}^{(k)} \), between \( R_{ij} \) for \( A_k \) is computed by

\[
\mu_{ij}^{(k)} = R_{ij} - R_{kj}.
\]

(c) We then define \( p \) as the critical value (can be adjusted by user). We select the cost drivers \( D_i \) and \( d_{ij} \) for \( A_k \) such that \( \mu_{ij}^{(k)} \) ≤ \( p \). If there have not selected \( D_i \) and \( d_{ij} \), the \( D_k \) and \( d_{kj} \) for \( A_k \) used in ABC are selected.

(d) In succession, we find the \( D_i \) that was simultaneously selected in each \( O_j \). If there are several such \( D_i \), then we define the best cost driver that obtained the least \( \mu_i^{(k)} \) as the \( D_i^* \). \( \mu_i^{(k)} \) is the sum of \( \mu_i^{(k)} \), ..., \( \mu_{im}^{(k)} \) with \( D_i \) shown as:

\[
\mu_i^{(k)} = \sum_{j=1}^{m} \mu_{ij}^{(k)}.
\]

(e) If the cost driver \( D_i \) of activity \( A_i \) is mutually selected for activity \( A_i \), and the cost driver \( D_j \) of activity \( A_j \), is also selected for activity \( A_j \), respectively, then the two cost drivers can be unified into one with a larger \( X_i \).

This proposition is easily proven as follows:

\[
\sum_{j=1}^{n} | C_{yj}^{(x)} - C_{xj}^{(x)} | = X_i \sum_{j=1}^{n} | R_{yj} - R_{xj} |
\]

\[
\sum_{j=1}^{n} | C_{yj}^{(y)} - C_{xj}^{(y)} | = X_i / X_j \sum_{j=1}^{n} | C_{yj}^{(y)} - C_{xj}^{(y)} |
\]

\[
\sum_{j=1}^{n} | C_{yj}^{(x)} - C_{xj}^{(y)} | = \frac{X_i}{X_j} \sum_{j=1}^{n} | C_{yj}^{(y)} - C_{xj}^{(y)} |
\]

If \( X_i > X_j \), then the total deviation of costing using \( D_i \) in \( A_i \) is smaller than using \( D_j \) in \( A_j \). Therefore, the cost driver \( D_i \) with a smaller costing deviation is a new cost driver common to the two activities.

(f) This new combination of cost drivers \( D_g \) (\( g = 1, \ldots, f < n \)) are the selected cost drivers obtained by the cost driver selection method.

Once we reduce the number of cost drivers by applying the cost driver selection method to the data for the ABC, from the second time of costing, we will then be able to use a simplified ABC (S-ABC) method that can easily perform both data collection and cost accounting.

Fig. 3 shows the procedure for allocating costs \( X_i \) of \( A_i \) to the cost objects \( O_j \) using the selected cost drivers.

**Practicality of the S-ABC method**

To exemplify the practicality of the S-ABC method,
we performed the actual cost accounting of three kinds of laboratory tests namely biochemical, hematological and immunochemical tests, using the ABC, VBC and the S-ABC methods.

The activities necessary for test implementation in the laboratories of our hospital comprise eight factors: (1) Receiving test orders; (2) Taking blood samples; (3) Transferring reports; (4) Claiming remuneration; (5) Supplying materials; (6) Supplying reagents; (7) Maintaining SLAX (PREP-LAX system, Hitachi Medical Co., Tokyo); and (8) Maintaining STS (Sample transportation system, Hitachi Medical Co.). According to these activities, seven cost drivers (two activities, “Taking blood samples” and “Maintaining SLAX”, use the same cost driver) and three cost objects (three tests) were thus constructed. Table 1 presents the total costs of each activity, the cost drivers, total volume of each cost driver and sub-volume of these cost drivers for each cost object with the ABC method. For simplification purposes, the hospital overhead costs such as building, water and light were excluded from this analysis.

Evaluation of the effectiveness of the S-ABC

We described an example from a physiological laboratory department to certify the effectiveness of the S-ABC. Table 4 shows the data list contained the values of activities \( A_i \) \((i = 1, \ldots, 10)\), sum costs of each activity \( X_i \), cost drivers \( D_j(d_j) \) \((j = 1, \ldots, 7)\) and cost objects \( O_j \). There are ten activities and seven cost objects in the physiological laboratory department of our hospital. The information on labor time consumed by each activity was obtained by a time study. There are two aims of the evaluation containing (1) whether the new method is effective in the cost driver reduction, and (2) to show the relationship among the critical value \( p \), the number of cost drivers and accuracy of costing.

**Results**

The indirect costs of the three laboratory tests with the ABC method

Indirect costs were allocated to each test using equation (1), and the total indirect costs for each of the three tests were calculated using equation (2). The results are shown in Table 1. The total indirect costs for the biochemical, hematological and immunochemical tests were $396,963, $27,868 and $16,393, respectively.

Cost estimation using VBC

We accounted the indirect costs of the three cost objects with the VBC method using the annual total number of order reception as the cost driver. The allocated indirect costs were estimated to be $419,363 for the biochemical tests, $15,248 for the hematological tests and $6,613 for the immunochemical tests (Table 2).

Cost driver selection using S-ABC

Fig. 4 illustrates the procedures and result of the cost driver selection with the raw data and using \( A_1 \) as an example. The critical values \( p \) described in procedure (d) of the Methods section was set as 0.02. As a result, the cost driver \( D_2 \) and \( D_7 \) was selected for activity \( A_1 \) and \( A_2 \), \( D_3 \) and \( D_5 \) for \( A_3 \) and \( A_8 \), respectively. In accordance with procedure (f), with \( D_2 \) a larger “\( X_i \)” exists between \( D_1 \) and \( D_2 \), therefore, cost driver \( D_2 \) was used for both \( A_3 \) and \( A_8 \). In the same way, cost driver \( D_8 \) was used for \( A_5 \) and \( A_8 \). Because no other cost drivers were accepted, except \( D_3 \) and \( D_6 \) for \( A_3 \) and \( A_6 \), the \( D_3 \) and \( D_6 \) used in the ABC method were still used for \( A_4 \) and \( A_7 \). In \( A_4 \) and \( A_7 \), the \( D_2 \) was selected (\( D_1 \) was same with \( D_2 \)).

Finally, the seven cost drivers used in the ABC method were reduced to four, \( D_2, D_3, D_6 \) and \( D_8 \), with the cost driver selection method.

Comparison of costing results between the S-ABC, ABC and VBC methods

We used the S-ABC method to perform cost estimations of three laboratory tests using the four cost drivers, \( D_2, D_3, D_6 \) and \( D_8 \). Table 3 shows the cost estimation results. The total indirect cost for the biochemical, hematological and immunochemical tests were $397,411, $27,133 and $16,680, respectively. The differences among the results of cost accounting by the ABC, VBC and S-ABC methods were assessed and are shown in Tables 2 and 3. The greatest difference of the S-ABC was less than 2.7% according to the hematological test. On the other hand, the differences between ABC and VBC showed significant discrepancies ranging from 6-60%.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Total cost ($)</th>
<th>Cost driver</th>
<th>Total volume of cost drivers ($X_i$)</th>
<th>Sub-volume for each $O_i$ ($d_{ji}$)</th>
<th>Indirect costs ($C_{ij}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B-test</td>
<td>H-test</td>
<td>I-test</td>
</tr>
<tr>
<td>(1) Receiving test orders</td>
<td>44,608</td>
<td>Number of order receptions</td>
<td>2,143,412</td>
<td>2,037,214</td>
<td>74,071</td>
</tr>
<tr>
<td>(2) Taking blood samples</td>
<td>203,032</td>
<td>Number of tests requiring vacuum tubes</td>
<td>2,128,262</td>
<td>2,023,073</td>
<td>73,366</td>
</tr>
<tr>
<td>(3) Transferring reports</td>
<td>25,100</td>
<td>Number of HIS terminals</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>(4) Claiming remuneration</td>
<td>8,200</td>
<td>Time required</td>
<td>241</td>
<td>230</td>
<td>8</td>
</tr>
<tr>
<td>(5) Supplying materials</td>
<td>50,096</td>
<td>Number of bills</td>
<td>1,081</td>
<td>1,054</td>
<td>16</td>
</tr>
<tr>
<td>(6) Supplying reagents</td>
<td>45,659</td>
<td>Number of bills</td>
<td>133</td>
<td>85</td>
<td>34</td>
</tr>
<tr>
<td>(7) Maintaining SLAX</td>
<td>10,632</td>
<td>Number of tests requiring vacuum tubes</td>
<td>2,128,262</td>
<td>2,023,073</td>
<td>73,366</td>
</tr>
<tr>
<td>(8) Maintaining STS</td>
<td>53,897</td>
<td>Number of tests by transfer</td>
<td>2,069,341</td>
<td>2,037,214</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>441,225</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 The number of tests in which a vacuum tube was required. $D_i = D_j$
2 Hospital information system.
3 Biochemical test.
4 Hematological test.
5 Immunochemical test.
6 SLAX, the equipment system required for the vacuum tube preparation.
7 STS, the equipment system required for the sample transfer.
TABLE 2. The indirect cost accounting with the VBC method

<table>
<thead>
<tr>
<th>Total indirect costs</th>
<th>Cost driver</th>
<th>Total volume of cost drivers</th>
<th>Sub-volume for each ( O_j ) ((d_j))</th>
<th>Indirect costs ((C_j))</th>
</tr>
</thead>
<tbody>
<tr>
<td>441,225</td>
<td>Number of order receptions</td>
<td>2,143,412 2,037,214 74,071 32,127</td>
<td>(B)-test (H)-test (I)-test</td>
<td>(B)-test (H)-test (I)-test</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(419,363) (15,248) (6,613)</td>
<td>(5.64) (45.29) (59.66)</td>
</tr>
</tbody>
</table>

Difference with the ABC results (%)

Fig. 4. The cost driver selection and result for \(A_1\) to \(A_8\) using \(A_1\) as the sample.
<table>
<thead>
<tr>
<th>Activity (A_i)</th>
<th>Total cost ($) (X_i)</th>
<th>Simplified cost driver</th>
<th>Total volume of cost drivers (D_g)</th>
<th>Sub-volume for each O_j (d_{gj})</th>
<th>Indirect costs (C_{ij})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B-test</td>
<td>H-test</td>
<td>I-test</td>
</tr>
<tr>
<td>(1) Receiving test orders</td>
<td>44,608</td>
<td>Number of tests with vacuum tubes</td>
<td>2,128,262</td>
<td>2,023,073</td>
<td>73,366</td>
</tr>
<tr>
<td>(2) Taking blood samples</td>
<td>203,032</td>
<td></td>
<td>192,998</td>
<td>6,999</td>
<td>3,036</td>
</tr>
<tr>
<td>(4) Claiming remuneration</td>
<td>8,200</td>
<td></td>
<td>7,795</td>
<td>283</td>
<td>123</td>
</tr>
<tr>
<td>(7) Maintaining SLAX¹</td>
<td>10,632</td>
<td></td>
<td>10,106</td>
<td>366</td>
<td>159</td>
</tr>
<tr>
<td>(3) Transferring reports</td>
<td>25,100</td>
<td>Number of HIS³ terminals</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>(6) Supplying reagents</td>
<td>45,659</td>
<td>Number of bills for reagents</td>
<td>133</td>
<td>85</td>
<td>34</td>
</tr>
<tr>
<td>(5) Supplying materials</td>
<td>50,096</td>
<td>Number of tests by transfer</td>
<td>2,069,341</td>
<td>2,037,214</td>
<td>0</td>
</tr>
<tr>
<td>(8) Maintaining STS²</td>
<td>53,897</td>
<td></td>
<td>53,060</td>
<td>0</td>
<td>837</td>
</tr>
<tr>
<td>Total</td>
<td>441,225</td>
<td></td>
<td>397,411</td>
<td>27,133</td>
<td>16,680</td>
</tr>
</tbody>
</table>

¹ SLAX, the equipment system required for the vacuum tube preparation.
² STS, the equipment system required for the sample transfer.
³ Hospital information system.

Note: According to the S-ABC method, the costs of the activities (1) Receiving test orders, (2) Taking blood samples, (4) Claiming remuneration and (7) Maintaining SLAX were allocated to the tests using the unified cost driver “Number of tests with vacuum tubes”. The costs of activities (5) Supplying materials and (8) Maintaining STS were allocated to the tests using the unified cost driver “Number of tests by transfer”.
### TABLE 4. The real data from the physiological laboratory department

<table>
<thead>
<tr>
<th>Activities ((A_i))</th>
<th>Total cost for each (A_i(X_i))</th>
<th>Cost driver</th>
<th>(D_{ij})</th>
<th>(d_{i1})</th>
<th>(d_{i2})</th>
<th>(d_{i3})</th>
<th>(d_{i4})</th>
<th>(d_{i5})</th>
<th>(d_{i6})</th>
<th>(d_{i7})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule appointments</td>
<td>11,346</td>
<td>Time required (1)</td>
<td>2,800</td>
<td>235</td>
<td>235</td>
<td>235</td>
<td>482</td>
<td>553</td>
<td>478</td>
<td>582</td>
</tr>
<tr>
<td>Patient check in</td>
<td>7,092</td>
<td>Time required (2)</td>
<td>1,715</td>
<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
</tr>
<tr>
<td>Patient education</td>
<td>8,036</td>
<td>Time required (3)</td>
<td>8,507</td>
<td>1,758</td>
<td>535</td>
<td>1,453</td>
<td>878</td>
<td>1,585</td>
<td>1,253</td>
<td>1,045</td>
</tr>
<tr>
<td>Provision of testing</td>
<td>8,509</td>
<td>Time required (4)</td>
<td>7,584</td>
<td>1,857</td>
<td>725</td>
<td>993</td>
<td>785</td>
<td>1,204</td>
<td>885</td>
<td>1,135</td>
</tr>
<tr>
<td>Handling of equipments</td>
<td>4,727</td>
<td>Time required (5)</td>
<td>7,520</td>
<td>1,534</td>
<td>558</td>
<td>782</td>
<td>1,123</td>
<td>2,140</td>
<td>658</td>
<td>725</td>
</tr>
<tr>
<td>Patient check out</td>
<td>3,782</td>
<td>Time required (6)</td>
<td>2,585</td>
<td>635</td>
<td>325</td>
<td>325</td>
<td>325</td>
<td>325</td>
<td>325</td>
<td>325</td>
</tr>
<tr>
<td>Handling of reports</td>
<td>14,182</td>
<td>Number of tests</td>
<td>20,313</td>
<td>791</td>
<td>12,791</td>
<td>3,966</td>
<td>1,300</td>
<td>934</td>
<td>114</td>
<td>417</td>
</tr>
<tr>
<td>Billing and administration</td>
<td>7,563</td>
<td>Time required (7)</td>
<td>4,109</td>
<td>587</td>
<td>587</td>
<td>587</td>
<td>587</td>
<td>587</td>
<td>587</td>
<td>587</td>
</tr>
<tr>
<td>Handling of materials</td>
<td>5,673</td>
<td>Time required (8)</td>
<td>6,691</td>
<td>1,477</td>
<td>358</td>
<td>559</td>
<td>575</td>
<td>1,875</td>
<td>1,089</td>
<td>758</td>
</tr>
<tr>
<td>Others</td>
<td>5,200</td>
<td>Time required (9)</td>
<td>2,605</td>
<td>552</td>
<td>320</td>
<td>320</td>
<td>320</td>
<td>453</td>
<td>320</td>
<td>320</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost objects ((O_j))</th>
<th>Total costs allocated from activities with ABC (C_{ij})</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1 Electroencephalogram (EEG)</td>
<td>11,590</td>
</tr>
<tr>
<td>O2 Electrocardiogram (ECG)</td>
<td>15,064</td>
</tr>
<tr>
<td>O3 Respiratory function tests</td>
<td>10,381</td>
</tr>
<tr>
<td>O4 Holter ECG</td>
<td>8,972</td>
</tr>
<tr>
<td>O5 Electromyogram (EMG)</td>
<td>12,149</td>
</tr>
<tr>
<td>O6 Test for peripheral circulation</td>
<td>8,738</td>
</tr>
<tr>
<td>O7 Treadmill test</td>
<td>9,216</td>
</tr>
</tbody>
</table>
Application of S-ABC to physiological laboratory data

We evaluated the effect of $p$ value on cost driver selection. The $p$ value was changed from 0.0 to 0.1 (Table 4). The changes in the number of selected cost drivers and the deviation of costing results from original values calculated by the ABC method are shown in Fig. 5. The cost drivers were the most efficiently reduced from ten drivers to six without losing the accuracy of costing (the deviation of costing results from the ABC values were showed as $-1.44$, $4.83$ and $-3.57$ percent at median, max and min) when $p$ value was 0.04-0.05.

DISCUSSION

There are two major advantages with the S-ABC method in comparison to the VBC and the ABC methods when used in routine cost accounting at hospitals. First, the S-ABC method provides accurate costing results, and the accuracy of costing is achieved by the appropriate usage of cost drivers. The second advantage is that the data collection and costing procedures in S-ABC are simpler than those in the ABC method. The simplicity of costing with our method is achieved by the reduced number of cost drivers compared with the ABC method. The pertinent reduction in the cost driver numbers does not significantly influence the accuracy of costing as shown by the laboratory examinations. The results of cost driver selection using S-ABC was similar to those using the cost driver reduction method, which is an alternative method to reduce cost driver and simplify the cost estimation (Cao et al., in press).

The data collection for cost drivers is not always easy. For example, supposing that an indirect labor cost is allocated to each cost object using labor hours as the cost driver, we have to perform a time study to determine how long each member of staff has spent on each cost object. However, labor hours are difficult and troublesome to measure, especially in healthcare practices, because staff are often simultaneously engaged in several activities (e.g., performing a treatment, involved in a meeting of inquiry, data recording or taking reports) or working for several different cost objects. These procedures are not only difficult and troublesome to compute but also costly. Moreover, thorough data collection is almost
Development of a Practical Costing Method for Hospitals

impossible in some cases. For example, supposing that the costs for a surgical operation are estimated using the ABC method, the number of activities and thus cost drivers would be enormous. The enormity of data and complexity of data collection for surgical operations is beyond comparison with that required for laboratory examinations, which was used as an example in our study. The strict application of such ABC method in usual cost estimation is therefore difficult to realize. Therefore, we have to simplify the procedure of data collection for the cost estimation that may be required at anytime in hospitals.

On the other hand, the number of cost drivers can be adjusted using the S-ABC method. This adjustment can be performed by adjusting the $p$ value. If we want to obtain accurate cost data while not taking into account the labor required for data collection, we will decrease the $p$ value. On the other hand, the $p$ value increases when we want to obtain the cost data quickly. However, there is a drawback in that the accuracy of costing may be lost when the number of cost drivers is reduced too much. The great advantage of the S-ABC method is the ability to adjust the balance between the accuracy and simplicity depending on the purpose of specific cost accounting. For three laboratory tests, Fig. 6 showed the simulation results of the change in the number of cost drivers and costing deviation with the ABC results by change the $p$ value from 0.0 to 0.1. The cost drivers were the most efficiently reduced from seven drivers to four without losing the accuracy of costing (the deviation of costing results from the ABC values were showed as 0.11, 1.75 and $-2.64$ percent at median, max and min) when the $p$ value was 0.02-0.03. We therefore selected 0.02 as the $p$ value in this study.

Once we reduce the number of cost drivers by applying the proposed S-ABC method to the data for the ABC method, we can easily perform the cost accounting using few cost drivers after the second round of costing. The proposed S-ABC method can be generally used throughout all hospitals.

A patent on this S-ABC method is currently under review at the Japan Patent Office (No. 3483705).

Fig. 6. The simulation results using the data shown in Table 1. Changes in the number of cost drivers and costing deviances with the ABC results based on the change in the $p$ value in cost calculations for three laboratory tests. The costing deviances between the simulated results and the ABC results are shown by a box-and-whisker plot, and the number of cost drivers are indicated by a cross mark.
Acknowledgments

The authors thank Mr. Brian Quinn for his help in editing the English in this paper.

This work was funded by a grant from the Japan-China Medical Association and Health Care Science Institute.

References


