Database

- This database consisted in part of cost data from patients admitted to 138 acute care hospitals throughout Japan in 2004 .
  - Including 20 national university hospitals, 29 private university hospitals and 89 non-university hospitals.
- The data obtained included financial data, number of beds, staff assignments, floor space and number of patients.

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Database

- The data also included claims data and discharge summary data on all patients discharged between July 2004 and October 2004 from 139 hospitals.
  - Including 21 national university hospitals, 29 private university hospitals, and 89 non-university hospitals

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Database

- The claims data used refers to the hospital reimbursement claims based on the nationally uniform fee-for-service system (the Diagnosis Procedure Combination [DPC] system).
- Details of algorithms used in the database development have been previously reported.

Hayashida et al. (2009)

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New Patient-Oriented Costing System Using Function Tracing

- Using this database, we developed a patient-oriented costing method, and also utilized a traditional hierarchical cost system to quantify patient-level costs.
- The patient-oriented costing method required the following information: Claims data, the number of staff, the allocation of costs for individual services by activity indicators or substitute, floor space, profit and loss statements, material costs, rental costs, and depreciation.

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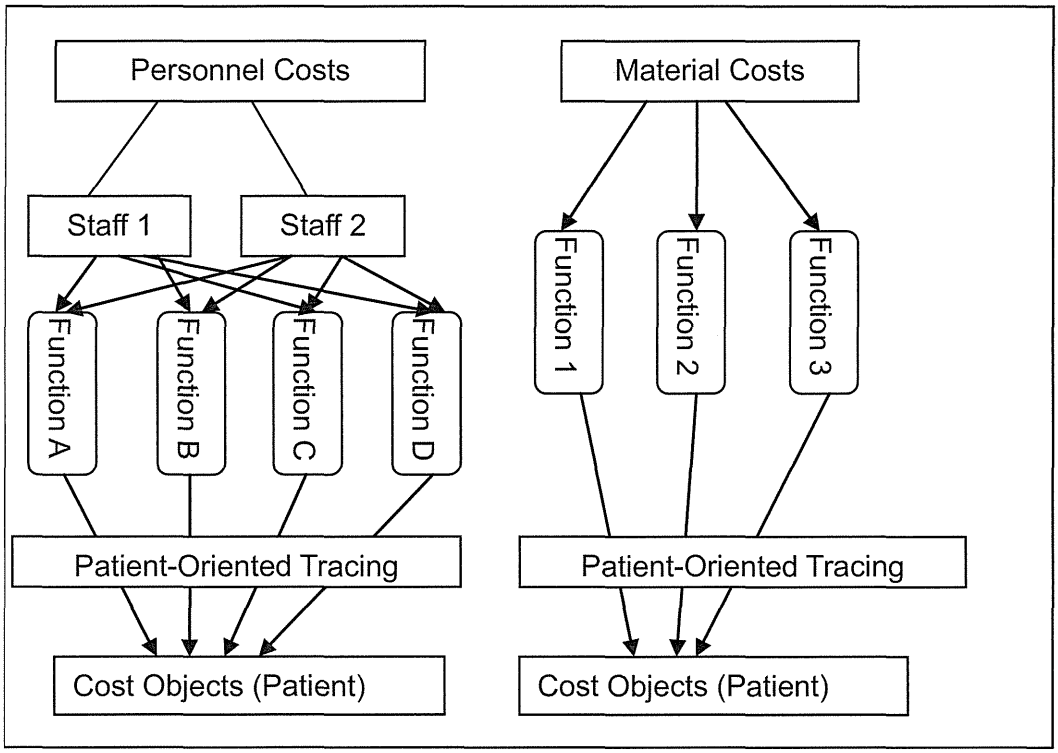
Calculation method of the new patient-oriented costing system using function tracing



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Practical Application of the New Costing System

- We then applied this new costing system to the calculation of patient-level costs in two voluntary participant acute care hospitals.
- Patient-level costs per day were calculated with the cooperation of the staff from these hospitals, and feedback was obtained from the staff with regard to the usability and practical application of the system.

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RESULTS
Database

- Our database comprised of data from 284 730 patients and individual patient case-level costs with components. For the model, we used an exchange rate of 110 Japanese yen (JPY) = US$1.
- A wide range of average costs per hospitalization, from $820 to $65 737 ($Q_1$: $4 373; Q_2: $7 163; Q_3: $12 712) was observed. Average costs per diem varied from $300 to $2 475 ($Q_1$: $437; Q_2: $491; Q_3: $565) .

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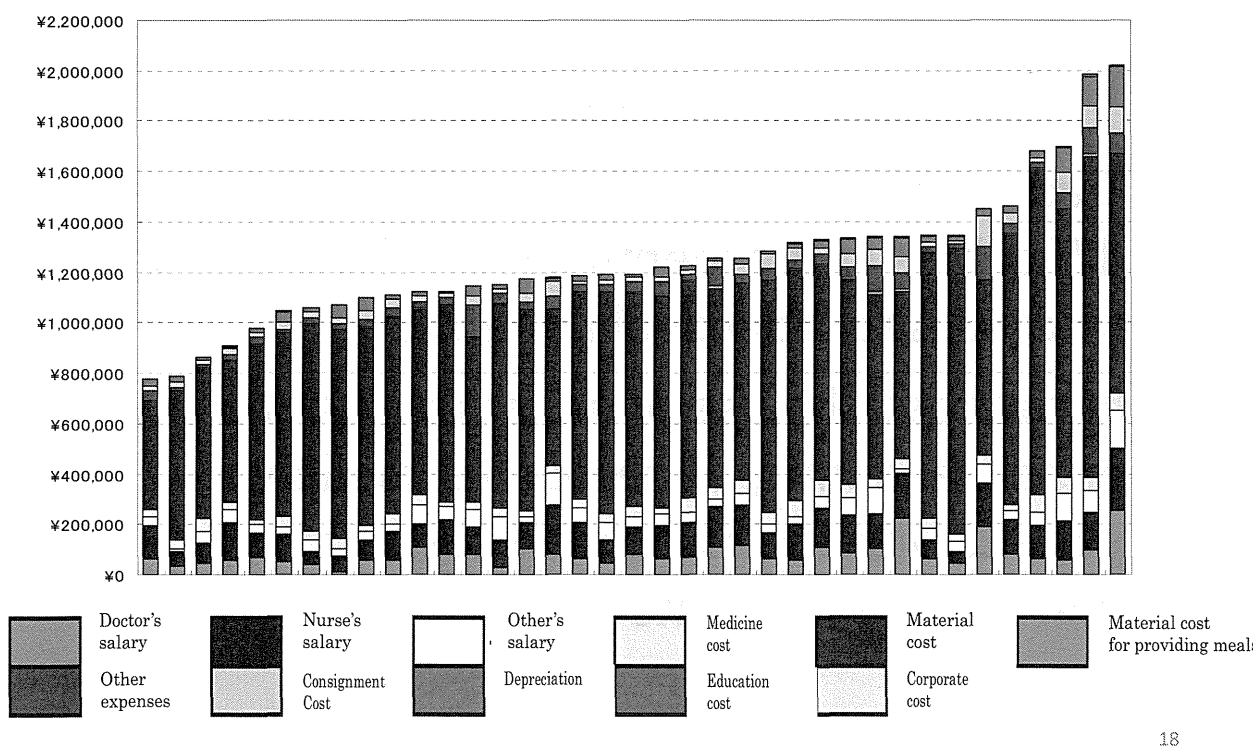
Multi-institutional comparisons of hospital costs and cost components in patients with angina



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Results
New Patient-Oriented Costing System Using Function Tracing I

- The new costing system utilizes two methods of assignment costs to each cost object: direct tracing and tracing by function drivers. Of the two methods, direct tracing is the most precise because it relies on physically-observable causal relationships.
- Driver tracing, which is ostensibly less accurate than direct tracing, relies on causal factors known as drivers to assign costs to cost objects (for each patient).

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Results
New Patient-Oriented Costing System Using Function Tracing II

- Traditional methods of cost calculation have difficulties in the identification and tracking of resources to individual patients.
- In contrast, the use of driver tracing can in principle identify all resources used by a patient, and the associated costs can therefore be calculated.

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Results
New Patient-Oriented Costing System Using Function Tracing III

- Based on this principle, all costs of resources of hospitals are apportioned according to the Mutually Exclusive and Collectively Exhaustive (MECE) principle into patient-oriented functions.
- A function definition database was prepared, and measurements for utilization were calculated for each function according to this list. This function definition database was then used to assign costs of each function to cost objects for individual patients.

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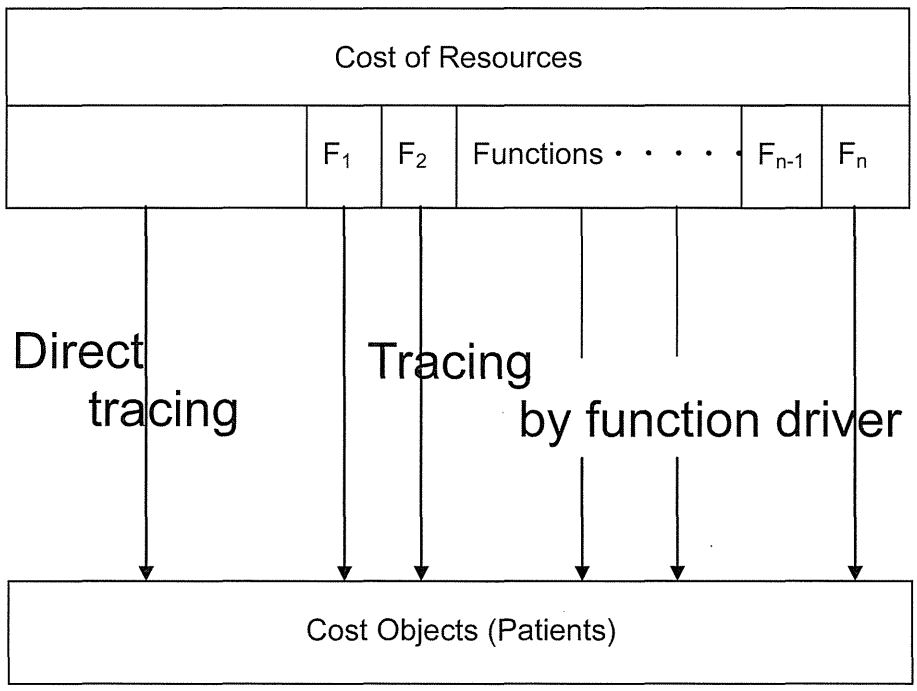
Model of patient-oriented costing using function tracing



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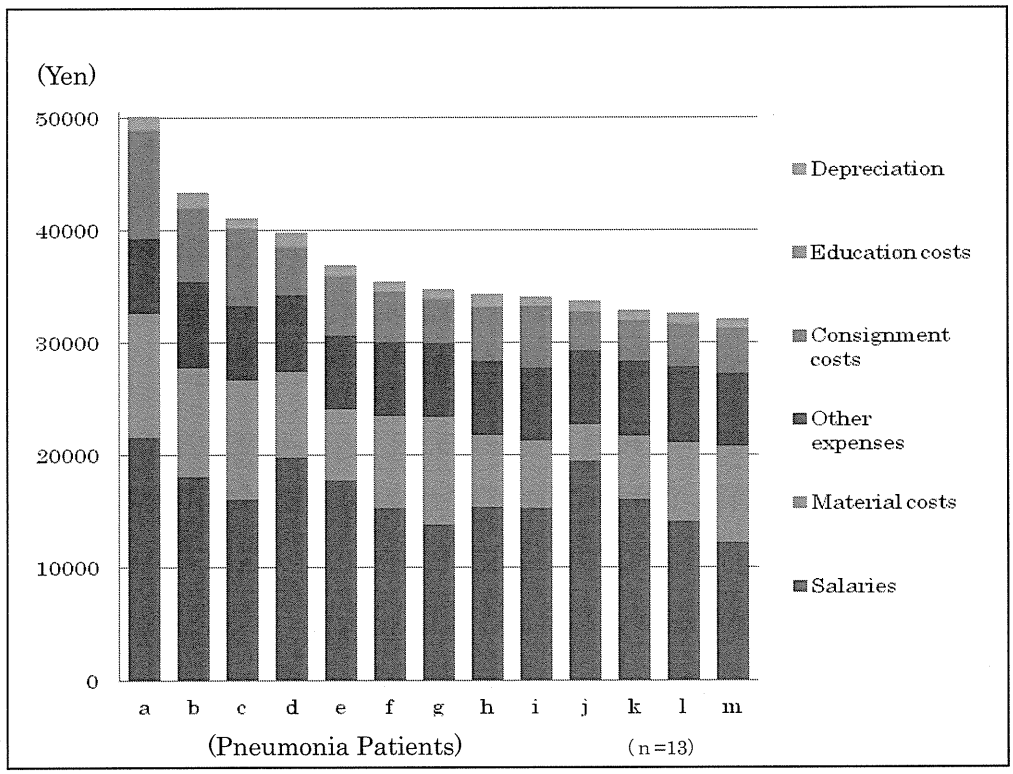
Patent number: 5076095

Mean daily health care costs and cost components of patients with pneumonia



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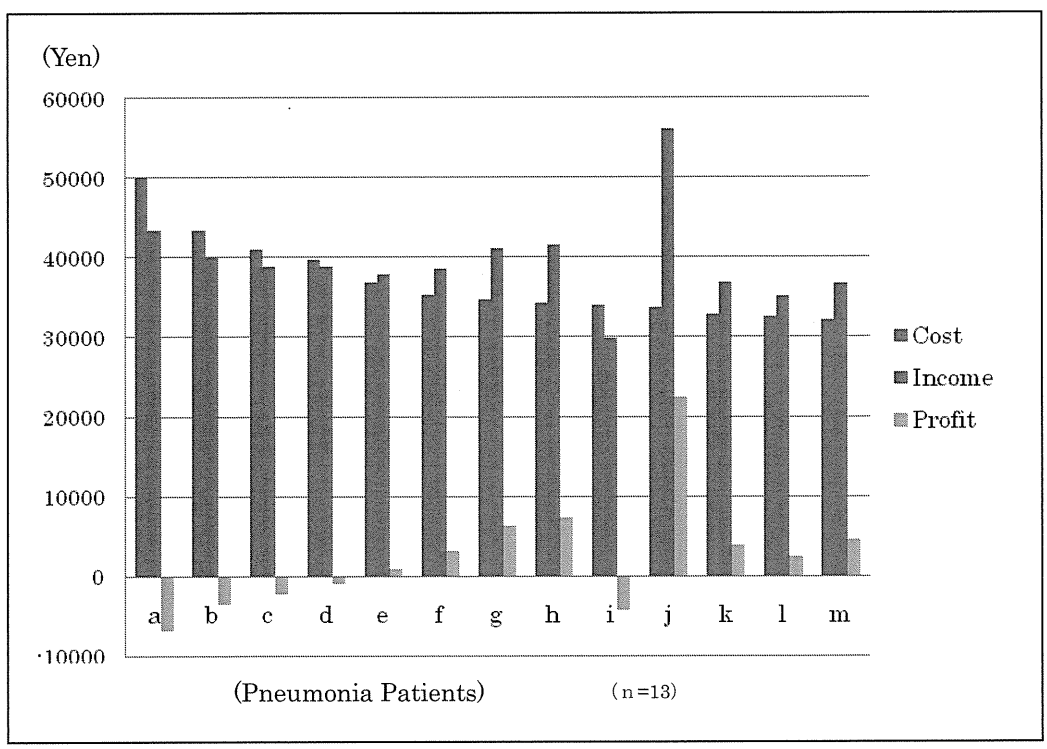
Mean daily hospital cost, income, and profit of patients with pneumonia



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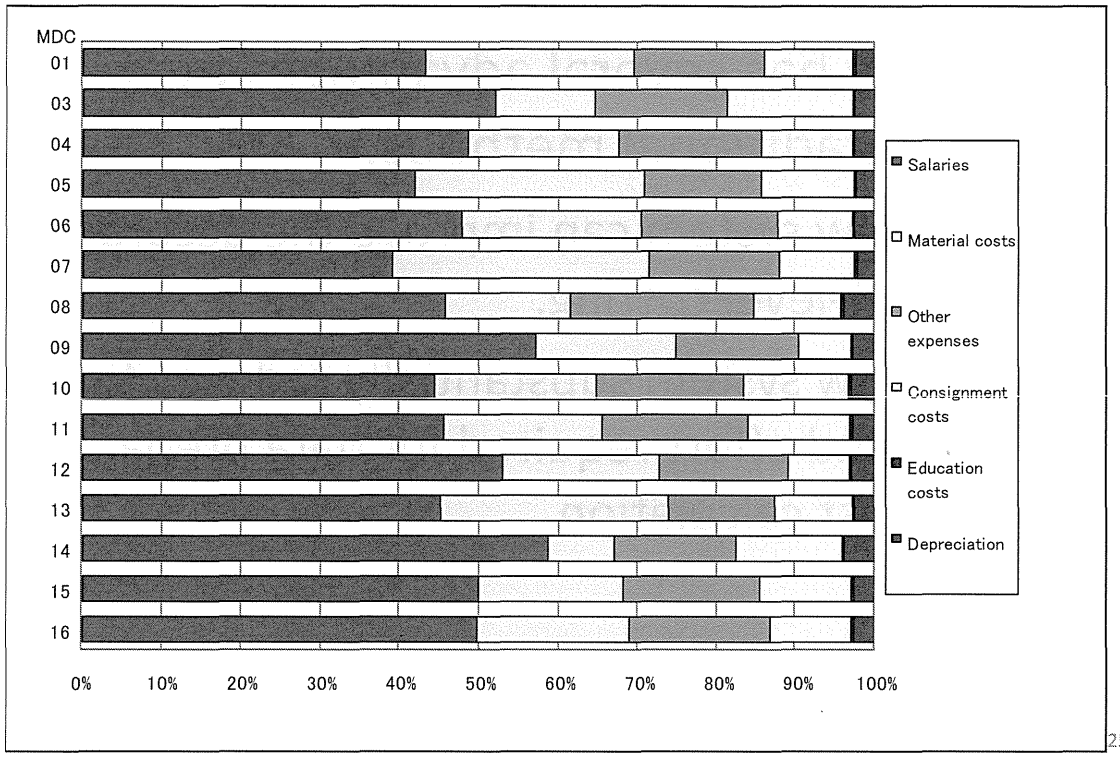
Mean hospital cost components by Major Diagnostic Category (MDC) in a hospital



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DISCUSSION

- In this study, we have developed a multi-institutional costing database comprising of data from 284 730 patients.
- Using this database, we developed a new patient-level costing system based on function tracing using this database.
- Finally, we applied the new costing system into calculating health care costs for patients in two hospitals.

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Advantages of the New Costing System

- Our study has several advantages over existing traditional methods.
  1. The new system can improve the accuracy of patient-level costing.
  2. The new system substantially reduces the time and effort required for data preparation and cost calculation.

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Driver tracing techniques

- Traditional methods are limited in the identification of specific resources used by individual patients.
- Our use of driver tracing techniques has allowed all resources used to be apportioned into patient-oriented functions according to the MECE principle.
- The function definition database allows quick identification of the resources used and costs incurred by individual patient.

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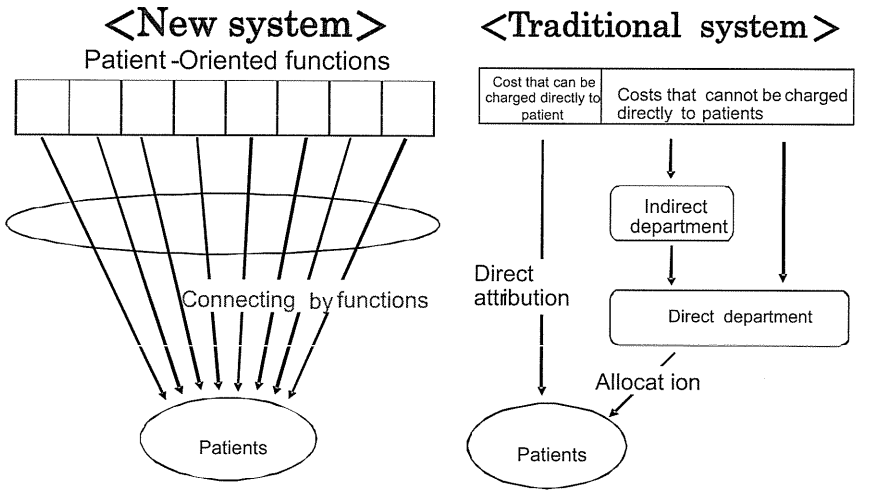
Differences between the new costing system and the traditional costing system



Data required by the new system include:
Claims data (Eand Ffiles) ,number of staff, allocation of each service cost by activity indicators or substitutesfloor space, profit and loss statement, material costs, rental,costs depreciation

The new system substantially improves the accuracy of patient-level costing and reduces the time and effort required for data preparation and calculation

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Conclusions

- Despite the difficulties in calculating patient-oriented costs, advances in the performance of costing have been achieved by the new "function tracing" methodology.
- Patient-level costs are more accurate than those calculated using traditional costing, and are better suited to support decision-making at the hospital and governmental levels.
- Our system of costing was also shown in practice to have improved efficiency over the traditional method, and this new methodology can be advantageous to hospital management, third-party payers and government policymakers.

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Development of Patient-Oriented Costing System by Function Tracing

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Development of Patient-Oriented Costing System by Function Tracing

ABSTRACT

[Background]

Understanding patient-oriented costing is extremely important to developing an efficient system for providing high quality health care. However, patients receive treatment and care from various professionals in different settings at different times, and this makes the accurate calculation of patient-level costs extremely difficult. Also, traditional costing methods are highly time- and labor-intensive.

[Objectives]

The aim of this study was to develop a patient-oriented health care costing system that, when compared with traditional costing systems, is able to quantify costs with a greater accuracy using patient-oriented functions, as well as to produce these costs more efficiently with regard to data preparation and calculation.

[Method]

We developed a standard method and a nation-wide, multi-institutional database by traditional hierarchical costing framework utilizing the data sets underlying administrative claims, as the Project of the Ministry of Health, Labour and Welfare, Japan. Based upon this achievement and reviewing the processes, we then created and developed a new patient-oriented costing system using "function tracing", in which all the resources used by a patient were linked to functions of health services before cost calculation. Finally, this new costing method was applied in practice to actual hospitals in order to quantify patient-level health care costs.

[Results]

The database comprised of data from 284,730 hospital patients and individual patient case-level costs. Although traditional costing methods frequently fail to include costs that are not directly associated with an individual patient's care, our new system utilizes a principle of apportioning all resources used into patient-oriented functions. A function definition database was prepared, and resources used by each patient was measured and the ensuing costs calculated. The application of the new costing method showed that the method was able to provide detailed and accurate cost calculations at the patient level, with much less time and labor required in the costing process. The method received favorable feedback from the participating hospitals.

[Conclusion]

We have developed a new patient-oriented costing system with improved accuracy and efficiency using "function tracing" method. This new methodology may be advantageous to hospital management, third-party payers and government policymakers.

BACKGROUND

Understanding patient-oriented costing is extremely important to developing an efficient system for providing high quality health care. The use of patient-oriented costing can also support the improvement of current levels of management efficiency and quality of health care. However, health care is an aggregate service in which patients receive treatment and care from various professionals in different settings and at different times, and it is this myriad of services that makes the accurate calculation of patient-level costs extremely difficult. Despite these difficulties, there has been increasing interest in the development of a standardized patient-oriented costing system from both individual hospitals and the government [1, 2].

At the hospital level, standardized patient-oriented cost calculations are necessary for various aspects of business management, such as budget preparation and control, evaluation of cost and performance, establishment of management master plans. Cost calculations can also be used to support informed negotiations of fund procurement and as reference data for benchmarking. Furthermore, accurate patient-oriented cost calculations may also improve certain attributes of care management, such as the planning and control of care, assessment of cost performance in care, patient safety and infection control [10], Because hospital managers need to properly assess costs that can be potentially controlled in the context of rising medical expenditures, the importance of the management ability of each hospital is also increasing, [3-5].

From a governmental perspective, standardized hospital cost calculations represent essential information used in the process of health care policy making, such as the development of reimbursement systems, estimation of financial resources required for health care services, and decision making based on economic evaluations. Previous studies have emphasized the need for payments to reflect the necessary costs [6-9].

Although there have been previous studies that have addressed cost calculation for health care in Japan, it is difficult to apply their findings to hospital management and government policy making. A major caveat to the interpretation of the majority of these studies is the limitation of scope: these included limited cost coverage (e.g., personnel costs, which frequently account for the largest portion of the total cost, were not included), limited diagnoses, and limited hospital departments. Furthermore, the traditional cost calculation systems used to quantify hospital costs are extremely time- and labor-intensive.

The aim of this study was to develop a patient-oriented health care costing system that, when compared with traditional costing systems, is able to quantify costs with a greater accuracy using patient-oriented functions, as well as to produce these costs more efficiently with regard to data preparation and calculation.

METHODS

Database

We developed a multi-institutional database in collaboration with the Ministry of Health, Labour and Welfare, Japan for a costing project based on traditional costing methods. . This database consisted in part of cost data from patients admitted to138 acute care hospitals throughout Japan in 2004 (including 20 national university hospitals, 29 private university hospitals and 89 non-university hospitals). The data obtained included, but were not limited to, financial data, number of beds, staff assignments, floor space and number of patients. The database also included claims data and discharge summary data on patients included information on all patients discharged between July 2004 and October 2004 from 139 hospitals (21 national university hospitals, 29 private university hospitals and 89 non-university hospitals). The claims data used refers to the hospital reimbursement claims based on the nationally uniform fee-for-service system (the Diagnosis Procedure Combination [DPC] system). Details of algorithms used in the database development have been previously reported [9].

New Patient-Oriented Costing System Using Function Tracing

Using this database, we developed a patient-oriented costing method, and also utilized a traditional hierarchical cost system to quantify patient-level costs. The patient-oriented costing method required the following information: Claims data, the number of staff, the allocation of costs for individual services by activity indicators or substitute, floor space, profit and loss

statements, material costs, rental costs, and depreciation. Figure 1 shows an example of the calculation method of this new costing system. In the case of personnel costs or salary, total salaries were subdivided first by individual staff, then by the various services provided, before linking the services to patients via patient-oriented tracing. Finally, these costs were then calculated at the individual patient level. Similarly, in the case of material goods provided, the costs of these materials were categorized by health services function, and these functions linked to individual patient costs via patient-oriented tracing.

Practical Application of the New Costing System

We then applied this new costing system to the calculation of patient-level costs in two voluntary participant acute care hospitals. Patient-level costs per day were calculated with the cooperation of the staff from these hospitals, and feedback was obtained from the staff with regard to the usability and practical application of the system.

RESULTS

Database

Our database comprised of data from 284 730 patients and individual patient case-level costs with components. For the model, we used an exchange rate of 110 Japanese yen (JPY) = US$1. A wide range of average costs per hospitalization, from $820 to $65 737 ($Q_1$: $4 373;

Q_2: $7 163; Q_3: $12 712) was observed. Average costs per diem varied from $300 to $2 475 ($Q_1$: $437; Q_2: $491; Q_3: $565) .

The costs of materials for inpatients within the Major Diagnostic Category (MDC) of MDC05 (diseases/disorders of the circulatory system) and MDC13 (diseases/disorders of the blood and blood-forming organs and immunological disorders) comprised a large portion of the total cost, when compared with costs of materials for inpatients with other MDCs. Inpatients who had undergone surgery had a higher cost per diem than that of non-surgical inpatients within any MDC. Moreover, the cost of materials in hospitalizations involving surgery and the percentage of the cost of materials as a component of total cost were higher than for non-surgical inpatients in almost all MDCs. In contrast, the cost of materials was higher, and the cost of materials represented a higher proportion of total cost in non-surgical inpatients in the following MDCs: MDC08, MDC09 (diseases/disorders of the breast), MDC11 (diseases/disorders of the kidney, urinary tract and male reproductive system) and MDC12 (diseases/disorders of the female reproductive system) compared with the cost of materials in surgical inpatients with the same MDCs. A high correlation (correlation coefficient = 0.94) between costs and charges was observed. Figure 2 shows a graph sample of the total and component costs of angina patients of selected hospitals for a multi-institutional comparison. The results show that there was considerable variation in costs even in the treatment of an identical disease.

New Patient-Oriented Costing System Using Function Tracing

The new costing system utilizes two methods of assignment costs to cost object: direct tracing and tracing by function drivers. Of the two methods, direct tracing is the most precise because it relies on physically-observable causal relationships. Driver tracing, which is ostensibly less accurate than direct tracing, relies on causal factors known as drivers to assign costs to cost objects (for each patient). Traditional methods of cost calculation have difficulties in the identification and tracking of resources to individual patients. In contrast, the use of driver tracing can in principle identify all resources used by a patient, and the associated costs can therefore be calculated. Based on this principle, all costs of resources of hospitals are apportioned according to the Mutually Exclusive and Collectively Exhaustive (MECE) principle into patient-oriented functions. A function definition database was prepared, and measurements for utilization were calculated for each function according to this list. This function definition database was then used to assign costs of each function to cost objects for individual patients.

Figure 3 shows the model of the patient-oriented costing system using function tracing.

The patent of this New Patient-Oriented Costing System was applied in March, 2006 and patented by Japan Patent Office [11].

Practical Application of the New Costing System

The new costing system was applied to calculating patient-level costs in two hospitals. Figure 4 shows an example of the differences in mean patient-level costs and cost components per day for several patients with pneumonia using this new system. It was observed that even among patients with an identical disease, there was a large degree of variation in these costs. Figure 5 shows the details of patient-level mean costs and hospital income. Again, the results show a large degree of variations in patients with an identical condition (pneumonia), with regard to costs and hospital income, as well as the ensuing profit from each patient.

By using the costing data from all patients, we are able to calculate the total hospital costs and cost components by the various MDCs, as shown in Figure 6. (Note: MDC2 was excluded from this Figure as the participating hospital that provided the data for this calculation did not have any patients within this category).

Discussions with the study hospitals after the calculation analysis showed that the hospital staff were appreciative of the increase in accuracy in patient-level costing, as well as the decrease in labor-intensiveness in the calculation process.

DISCUSSION

In this study, we have developed a multi-institutional costing database comprising of data from 284 730 patients. We then developed a new patient-level costing system based on function

tracing using this database. Finally, we applied the new costing system into calculating health care costs for patients in two hospitals.

Advantages of the New Costing System

Our study has several advantages over existing traditional methods. First, the new system can improve the accuracy of patient-level costing. Second, the new system substantially reduces the time and effort required for data preparation and cost calculation. Although traditional methods are limited in the identification of specific resources used by individual patients, our use of driver tracing techniques has allowed all resources used to be apportioned into patient-oriented functions according to the MECE principle. The function definition database allows quick identification of the resources used and costs incurred by individual patient.

Difference between new costing system and traditional costing system

Figure 5 shows the main differences between our new costing system and the traditional costing system. The traditional system involves establishing cost items (such as salary cost, material cost, overhead and depreciation) based on cost items included in profit-and-loss statements. Calculation is dependent on whether a cost item could be directly charged to a patient: If a cost item could be directly charged to patients, the system then assesses only the