

# Comparing Methodologies for the Allocation of Overhead and Capital Costs to Hospital Services

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## ABSTRACT

**Background:** Typically, little consideration is given to the allocation of indirect costs (overheads and capital) to hospital services, compared to the allocation of direct costs. Weighted service allocation is believed to provide the most accurate indirect cost estimation, but the method is time consuming.

**Objective:** To determine whether hourly rate, inpatient day, and marginal mark-up allocation are reliable alternatives for weighted service allocation.

**Methods:** The cost approaches were compared independently for appendectomy, hip replacement, cataract, and stroke in representative general hospitals in The Netherlands for 2005.

**Results:** Hourly rate allocation and inpatient day allocation produce estimates that are not significantly different from weighted service allocation. **Conclusions:** Hourly rate allocation may be a strong alternative to weighted service allocation for hospital services with a relatively short inpatient stay. The use of inpatient day allocation would likely most closely reflect the indirect cost estimates obtained by the weighted service method.

**Keywords:** cost comparison, hospital service, indirect cost allocation, methodology, overheads.

## Introduction

Economic evaluations are a prerequisite for the reimbursement and implementation of hospital services in many countries because they can provide health-care decision-makers with valuable information on the relative efficiency of different services [1,2]. To be able to support management decisions, direct and indirect cost estimations should therefore be associated as closely as possible with the patients who cause them to be incurred [3]. Nevertheless, the assessment of *actual* resource use is lengthy and expensive, especially when hospital information systems are absent or inadequate [1,4].

Indirect cost components generally concern overheads (general expenses, administration and registration, energy, maintenance, insurance, and the personnel costs of nonpatient services, like management and administration) and capital (depreciation of buildings and inventory and interest). They often comprise a large proportion of the overall costs of hospital services [3,4]. In a study of St-Hilaire et al. (2000) carried out in Canada, indirect costs were estimated to represent between 35% and 40% of the total costs of hospital services [5]. More recently, Oostenbrink et al. (2002) have estimated the proportion of indirect costs to be 24% in The Netherlands [6]. Nevertheless, compared to the allocation of direct cost components, usually, little consideration is given to the allocation of indirect cost components to hospital services [4,5]. St-Hilaire et al. (2000) have suggested that the lack of interest and theoretical support for the estimation of indirect costs is mainly due to their arbitrary nature [5]. An invalid estimation of indirect costs may completely wipe out the time and effort spent on the cost determination of the direct costs. To generate valuable information for decision-making, it is therefore recommended to gain a better understanding of the distribution of indirect cost components [3].

There are two types of indirect cost allocation [4]. First, the allocation of indirect costs from the supporting departments to the medical departments within the hospital should be considered using e.g., cost center allocation or activity-based costing [1,4,5]. Nevertheless, the present article will focus on the second type of allocation, which allocates indirect costs within the medical department to specific patient (-group)s. Cost center allocation and activity-based costing are not applicable to this type of allocation, because these methods assume that the indirect costs have a cause-and-effect relationship with the department rather than with patients. Therefore, no allocation base or cost driver can trace indirect costs to the *actual* resource utilization of patients in an economically feasible way [4,6].

Finkler et al. (2007) have described four basic methods for the distribution of indirect costs within the medical department to specific patient (-group)s [4]. The first method is weighted service allocation, which establishes the relative costs of each patient by assigning relative value units. The method is believed to most closely reflect *actual* resource consumption. Nevertheless, it is very time consuming to observe the *actual* resource use of each patient and to convert the various resource use components into units suitable for assessing relative value units [4]. Therefore, most economic evaluations apply hourly rate allocation, inpatient day allocation, or marginal mark-up allocation. The hourly rate method employs service time of the primary treatment as a proxy for resource consumption, yielding a cost per treatment minute. In inpatient day allocation, all patients are assumed to have the same indirect costs per inpatient day regardless of their *actual* resource use. Marginal mark-up allocation distributes indirect costs to direct costs by raising the direct costs with a mark-up percentage.

Cost estimates based on *actual* resource use are relevant for both economic evaluations as well as price setting for hospital management and health insurance purposes [2]. Decision-makers must consider whether the benefits of more reliable cost information justify the additional costs incurred in obtaining accurate and detailed information [4,5]. Nevertheless, even though indirect costs often represent a large share of the total cost of hospital services, no studies have quantified the cost differences that result

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from the application of the different methods for the allocation of indirect costs within the medical department to patient (-group)s. Hence, the aim of the present study was to determine whether hourly rate, inpatient day, and marginal mark-up allocation are reliable alternatives for weighted service allocation. We report the results of a costing exercise designed to collect and compare the indirect cost allocation approaches independently for appendectomy, hip replacement, cataract, and stroke in representative general hospitals in The Netherlands for 2005. These hospital services represent large burden of disease measured as number of people affected or costs related in many developed and developing countries [7,8]. The hospital services serve as illustrations, on the basis of which we attempt to formulate general methodological recommendations.

## Methods

The costing exercise was conducted as part of the European Union (EU) funded research project HealthBASKET (full title: Health Benefits and Service Costs in Europe, contract no. FP6 501588). Retrospective cost analyses were conducted at 18 general hospitals in The Netherlands for appendectomy (n = 100), hip replacement (n = 70), cataract (n = 70), and stroke (n = 70) from the hospital perspective. The study included 100 males between 14 and 25 years of age who presented at the hospital with acute abdominal pain, 70 females between 65 and 75 years of age with hip osteoarthritis requiring hip replacement because of considerable impairment, 70 males between 70 and 75 years of age who received diagnosis of Cataracta Senilis, and 70 otherwise healthy females between 60 and 70 years of age with severe hemiparesis, aphasia, and dependency.

Direct cost estimates were determined using the microcosting methodology, in which all relevant cost components from hospital admission to discharge of the patient were defined at the most detailed level. Direct costs included diagnostics (imaging, laboratory, and other diagnostics), drugs, labor (direct patient time of medical specialists, fellows, nurses, and other staff), inpatient stay (hotel and nutrition and the indirect patient time of nurses), and devices. Details of the direct cost analyses are described in detail elsewhere [9–12].

Indirect cost components included overheads and capital and were appointed to hospital services using weighted service allocation, hourly rate allocation, inpatient day allocation, and marginal mark-up allocation. *Annual* direct and indirect costs were taken from the annual accounts of the participating hospital departments. All costs were based on the 2005 cost data. Where necessary, costs were adjusted using the general price index of the Dutch Central Bureau of Statistics [13].

### Weighted Service Allocation

The weighted service method establishes the relative cost of each patient by assigning a base value to the elementary resource use of the hospital service and adding relative values to this base value when the patient incurred additional resource use [4]. For each hospital service, all participating hospitals were included in an ordinary least squares (OLS) regression analysis. OLS regression was chosen because the technique means to disentangle the relationship between an outcome variable (also called dependent variable) and predictor variables (also called independent variables). Direct costs were taken as the dependent variable and department and treatment characteristics as explanatory variables. Department characteristics consisted of the number of beds per department, bed occupation, and the number of surgeons per department. Treatment characteristics comprised in-

patient stay, drug costs, treatment time, and use of additional interventions (cemented hip [yes/no] for hip replacement; thrombolysis [yes/no] for stroke). Data on treatment characteristics were analyzed at the hospital level because individual patient data were not available. A full model was assembled using backward regression. The  $\beta_0$ -coefficient of the model was considered the elementary resource use of each hospital service. Subsequently, the corresponding  $\beta$ -coefficients of the explanatory variables that were significantly associated with the direct costs were assumed to add a relative value. Based on the weighted service method, the predicted indirect costs per patient were estimated by dividing *annual* direct costs by the product of the predicted direct costs and *annual* indirect costs.

### Hourly Rate Allocation

The hourly rate method employs service time of the primary treatment as a proxy for resource consumption, yielding a cost per treatment minute. The unit costs per treatment minute were determined by dividing the *annual* indirect costs by the total number of workable minutes of the medical specialists of the corresponding hospital departments in 2005.

### Inpatient Day Allocation

In inpatient day allocation, all patients are assumed to have the same indirect costs per day regardless of their *actual* resource use. The *annual* indirect costs were divided by the total number of inpatient days in 2005 to calculate the unit costs per inpatient day.

### Marginal Mark-up Allocation

In marginal mark-up allocation, indirect costs are distributed to direct costs by raising the direct costs with a mark-up percentage. The mark-up percentage was determined by dividing *annual* indirect costs by *annual* direct costs.

### Comparison of Methodologies

In addition to descriptive statistics, the Friedman test was performed to detect cost differences between the four methods for each of the hospital services. Indirect cost estimates of hourly rate, inpatient day, and marginal mark-up allocation were compared with those of weighted service allocation by means of cost differences and the Wilcoxon signed ranks Z-test. Statistical analyses were conducted with the statistical software program SPSS for Windows version 13.0 (SPSS Inc., Chicago, IL).

## Results

### Appendectomy

The weighted service method resulted in overhead costs of €647 (SD 201) and capital costs of €237 (SD 100; Table 1). The indirect costs contributed to 39% of the total costs. Treatment time and drug costs were considered to add relative value to the base value (Table 2). The overhead estimate based on hourly rate allocation was somewhat higher compared to weighted service allocation (€738; SD 615), whereas the estimate obtained using marginal mark-up allocation was somewhat lower (€397; SD 32; Table 1). The indirect cost estimates obtained using the inpatient day method were virtually equal to those using the weighted service method.

### Hip Replacement

The weighted service method resulted in overhead costs of €1733 (SD 658) and capital costs of €618 (SD 256; Table 1). The bed

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