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Activity-based costing evaluation of a [^{18}F]-fludeoxyglucose positron emission tomography study

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ABSTRACT

Objective: The aim of the study is to use the activity-based costing approach to give a better insight in the actual cost structure of a positron emission tomography procedure (FDG-PET) by defining the constituting components and by simulating the impact of possible resource or practice changes.
Methods: The cost data were obtained from the hospital administration, personnel and vendor interviews as well as from structured questionnaires. A process map separates the process in 16 patient- and non-patient-related activities, to which the detailed cost data are related. One-way sensitivity analyses shows to which degree of uncertainty the different parameters affect the individual cost and evaluate the impact of possible resource or practice changes like the acquisition of a hybrid PET/CT device, the patient throughput or the sales price of a 370 MBq ^{18}F-FDG patient dose.
Results: The PET centre spends 73% of time in clinical activities and the resting time after injection of the tracer (42%) is the single largest departmental cost element. The tracer cost and the operational time have the most influence on cost per procedure. The analysis shows a total cost per FDG-PET ranging from 859 Euro for a BGO PET camera to 1142 Euro for a 16 slices PET-CT system, with a distribution of the resource costs in decreasing order: materials (44%), equipment (24%), wage (16%), space (6%) and hospital overhead (10%).
Conclusions: The cost of FDG-PET is mainly influenced by the cost of the radiopharmaceutical. Therefore, the latter rather than the operational time should be reduced in order to improve its cost-effectiveness.

1. Introduction

Positron emission tomography (PET) plays an increasing role in the management of patients with cancer, but also in neurology and cardiology [1–4].

Despite its wide clinical diagnostic applicability, operating a PET center remains extremely complex and is widely perceived as expensive. In order to estimate the economic impact of FDG-PET incorporation into the clinical work-up, many payers are now using cost-effectiveness as a criterion for health care coverage [5–9]. However, before doing an accurate cost-analysis or cost-effectiveness analysis of ^{18}F-FDG PET procedures, the true cost of those procedures must be determined [10]. Such cost information is useful for policy making (for cost-effectiveness studies and for hospital financing and reimbursement purposes) as well as for internal cost management purposes [11,12].

Although the importance of accurate cost data has become recognized by the policymakers, the third party payers and even by the nuclear medicine profession, liter-

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ature data are scarce and often contradictory, as they are mainly based on traditional accounting methods.

The problems are that the mostly used costing methods fail in providing an accurate estimate of the cost structure. These cost analyses use: (a) hospital charges to estimate hospital costs and physician fees to estimate the cost of professional services; (b) average multiple hospital and physician charges; (c) adjust charges by cost–charge ratios; (d) use third party payments as proxies for resource costs [13]. Because they are easy to obtain these indirect methods are used to estimate the costs. Although it is theoretically possible that charges or reimbursement for a given procedure are an accurate measure of its actual resource cost, this is rarely the case in reality because of historical and political factors, regulatory compliance, budget constraints, and market forces. Allocating cost based on revenues then becomes arbitrary, when charges are determined independently of costs.

Focusing on average cost per procedure extrapolated from a global cost, these methods do not take into account differences in complexity of some procedures or changes in practice, because they assume implicitly a stable relationship between the different activities of ^{18}F-FDG-PET procedures and their related costs. Ideally, the cost of each steps of the procedure should as much as possible be calculated separately [14–16]. Because of differences in methods used, cost components included and healthcare systems, comparisons based on these traditional accounting methods are unreliable, as these methods provide very little information about factors that cause costs and where the costs are really incurred.

In response to these shortcomings, the activity-based costing (ABC) method was introduced in the late-1980s as an accounting method in manufacturing. ABC defines costs in terms of an organization's processes or activities and determines their relative costs. The basic ABC assumption, represented in Fig. 1, is that cost objects consume activities, which in turn consume resources. The strength of such a detailed cost accounting program lies not only in the analysis of the actual situation, but also in the possibility to run simulations on variations in resources [17].

The aim of the current study was to conduct a comprehensive ABC estimation of a ^{18}F-FDG-PET procedure in a dedicated stand-alone PET facility of the Mont-Godinne University Hospital to calculate an accurate cost estimate as well as to identify the critical cost components, the distribution of costs across the different types of resources used and the impact of changes in cost patterns of major innovations (like the acquisition of a PET/CT) or effect of ^{18}F-FDG price fluctuations or changes in practice patterns.

While a variety of positron-emitting radiopharmaceuticals can be used to perform PET procedures, [^{18}F]-fludeoxyglucose (^{18}F-FDG) is the most commonly used tracer in Europe [18]. The majority of the clinical research done with PET in oncology available for economical analyses is therefore based on this radiopharmaceutical. Although some authors used ABC to evaluate the cost structure of a nuclear medicine department [19–21] to the best of our knowledge, a comprehensive ABC analysis of a ^{18}F-FDG-PET procedure has not yet been performed.

2. Methods and materials

2.1. Study design

A multidisciplinary team (i.e. one physician, one technologist, one assistant and the department accountant) was assembled to design the ABC data-gathering process, monitor the program's implementation and interpret the results.

The method was based on a four steps process. First, the different activities were recorded in a flowchart. The process of a ^{18}F-FDG-PET procedure could be described by listing activities in time sequence. It must reflect the natural activities within the department and group the activities in a way that makes logical and meaningful analysis possible. With ABC, the process is subdivided into discrete, quantifiable activities or phases.

Then for each activity, the required material as well as the labor time were determined on the basis of structured interviews with involved persons. The structured interviews were based on the following principles: all steps in which the respondent was involved were identified and for each step the respondent was requested to list the material required, to estimate the time involved, and to estimate the frequency of performing such a step. It was an iterative process during 6 months to identify incompleteness and correct some errors or misinterpretations recorded during the interviews.

Thirdly, information on unit resources costs was collected from the financial and administrative databases of Mont-Godinne University Hospital and expressed in Euro. The costs of each part of the activity are summed to form the cost of the activity: activity cost = cost of space + cost of materials + staff costs + cost of capital equipment + costs of hospital infrastructure. Thus, if the activities of care delivered to the patient are known, an accurate cost per patient can be calculated.

Finally, based on these interviews best and worst-case generic scenarios within realistic boundaries were build. The reliability of these different scenarios was confirmed by interviews of other PET centre managers and some hardware vendors.

2.2. Methodological ABC aspects

The PET center is a stand-alone imaging facility of the Mont-Godinne University Hospital, equipped with a HRT PET camera (Siemens Medical Solutions, Erlangen, Germany). The study mix was based on the 1889 ^{18}F-FDG-PET procedures performed between 1 January and 31 December 2004.

The ABC methodology is based on a stepwise process: (1) identification of the different activities in the production process, (2) the link between the different activities through cost drivers, and (3) how these activities are linked to the consumption of resources, which contains typically wages, materials, equipment, space and overhead costs. The addition of the activity cost estimates produces an overall cost estimate for the entire process.