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Cost of Positron Emission Tomography: Method for Determining Indirect Cost

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This paper describes methods of determining the indirect cost associated with Positron Emission Tomography (PET) scans and the manufacture of 18-F-Fluorodeoxyglucose (FDG), the radioactive isotope used in PET scans.

We surveyed sites participating in the Veteran's Administration (VA) Cooperative Study 27, "FDG- PET Imaging in Patients with Solitary Pulmonary Nodules." Site managers were asked for information about the direct costs of operating their department, including the acquisition cost and expected lifetime of capital equipment, the amount of space occupied, the cost of supplies and repairs, and the number and type of staff involved in operating the PET scanner and FDG lab.

We did not ask site managers to report the indirect costs associated with their department. Such costs include administrative support, utilities, engineering, housekeeping, and supply services. We estimated the indirect costs by analyzing VA and Medicare financial data to calculate an indirect cost ratio. We multiplied the direct cost estimate obtained from the survey times this ratio, to find the indirect costs associated with PET scanner operation and FDG synthesis.

In our analysis, we used the VA Decision Support System (DSS) and Medicare hospital cost reports. These sources characterize hospital costs, including costs of direct patient care departments and indirect cost departments. Definitions of direct and indirect costs used in the DSS and Medicare reports differed from what we considered to be direct and indirect costs in our survey. We therefore had to make several adjustments to the indirect and direct cost totals obtained from DSS and Medicare before calculating the indirect cost ratio.

First, capital costs, including the cost of buildings and equipment, are treated as an indirect cost by both DSS and Medicare. Since we had a more accurate measure of capital cost from our survey, we wished to exclude capital cost from our indirect cost ratio. Secondly, both Medicare and DSS reports include the cost of medical education as an indirect cost. We did not want to include education in our estimate of the indirect costs of FDG synthesis and PET scans. Finally, DSS includes additional indirect costs, such as research, national and regional administration, and administration of veterans benefits programs. Research is defined by DSS as any activity not related to patient care. We wanted to exclude these costs from our indirect cost estimates as well.

We calculated four different indirect cost ratios, two based on the VA DSS, and two based on the Medicare cost report. The first DSS-based ratio was based on all hospital departments in the VA; the second used information on the indirect cost of outpatient PET scans at the VA, adjusted with hospital-wide information. The first Medicare-based ratio was based on the cost of all departments in Medicare hospitals. The second Medicare ratio was based on diagnostic radiology departments in Medicare hospitals; it was also adjusted with hospital-wide information

We made the following assumptions in estimating the indirect cost ratios:

- Indirect costs are proportionate to direct costs.
- The cost of research and education, and their associated overhead, should not be included.
- The cost of VA benefits, and national and regional administration should not be included.
- The indirect cost ratio for PET scans and FDG synthesis is the same it is for other hospital services.

There were four different variations of the last assumption, resulting in four different estimates. We assumed that the indirect cost ratio for PET/FDG is the same as (1) all hospital departments in VA, (2) outpatient PET scans at VA hospitals, (3) all departments among Medicare hospitals, or (4) diagnostic radiology departments in Medicare hospitals.

1. VA Hospital-Wide Indirect Cost Ratio

We obtained information on direct and indirect costs from the national VA DSS department-level cost data set, called the Account Level Budget Cost Center (ALBCC) DSS national extract. This extract provides the total cost incurred by each production unit at each VA medical center. Production units include both direct patient care departments, as well as indirect cost departments.

We tabulated VA costs using DSS department data from all hospitals for the 1999-2000 federal fiscal year, and found the following totals:

Table 1
 Total DSS Cost of VA Medical Centers
 by Type of Production Unit
 1999-2000 Fiscal Year

Cost Type	Cost (\$)	Description and definition
Research (R)	151,661,473	National total expenditures for research production units (production unit variable=01)
Education (E)	172,978,714	National total expenditures for education production units (production unit variable=02)
National and Regional Administration and Veteran Benefits (N)	1,116,671,278	National total expenditures for administration (production unit variable=00) in the following cost centers: depreciation of buildings (682) and equipment (0), patient travel (602), care for the dead (603), VA headquarters (614), VISN Director costs (652)
Local (hospital level) Administration (A)	6,624,661,923	All other administrative costs (production unit variable=00 in cost centers not listed above)
Patient Care (P)	11,841,221,295	National total expenditures for patient care production units (All other costs)

We found the following indirect cost ratio:

$$\frac{A}{(P + R + E)} = 0.5445$$

This is the overall ratio of indirect costs to direct costs at the hospital level. The indirect costs (A) in this ratio exclude national and regional administration of VA, the cost of capital depreciation, and veterans' benefits. The direct costs (P, R, E) include patient care, research and education. Inclusion of education and research in the denominator assigns them a proportionate share of indirect costs.

This ratio is algebraically equivalent to:

$$\frac{A - A \frac{(R + E)}{(P + R + E)}}{P}$$

Where

- A All administrative costs in the administration production unit except costs in the national and regional administration, the cost of capital depreciation, and veteran benefits cost centers
- P Total expenditures for patient care production units
- R Total expenditures for research production units
- E Total expenditures for education production units

In this version of the formula, the indirect costs of research and education are explicitly deducted in the numerator, and the ratio consists of the remaining indirect cost to direct patient care cost.

2. Adjusted Indirect Cost of PET Scans in the DSS Encounter-Level Database

We identified 2,056 outpatient PET scans provided by VA in the 1999-2000 fiscal year by searching the VA outpatient events file for all encounters assigned a Current Procedures Terminology (CPT) code for a PET scan. We were not able to include inpatient scans, as the cost of PET scans are not identified separately in the VA DSS national data extracts, the national DSS database of hospital costs. We found the cost of 1,984 of these encounters in the DSS outpatient encounter-level extract. We used data from only those facilities that matched the 1,984 records we found in the outpatient events file. All of those hospitals had PET centers. We calculated the mean cost per PET scan at each medical center, and then found the mean of these means. We took the mean of facility means because we did not want our estimate to be overly influenced by a few facilities that accounted for most of the scans in our data set.

These mean costs were as follows:

Table 2
Mean DSS Cost of VA Outpatient PET Scans
1999-2000 Fiscal Year

Cost Type	Amount (\$) Mean Cost per Scan
Indirect Cost (I)	616
Direct Cost (D)	764

This indirect cost contains costs that we wished to exclude, including national and regional administration, benefits, depreciation of buildings and equipment, research, and education. To estimate how much of these need to be excluded, we used hospital-wide information from the ALBCC DSS extract.

Our ratio was:

$$\frac{I}{D} \left(\frac{A \left(\frac{P}{P + R + E} \right)}{A + N + R + E} \right) = 0.6446$$

Where:

- I Indirect cost of outpatient PET scans
- D Direct cost of outpatient PET scans
- A All administrative costs in the administration production unit except costs in the national and regional administration, the cost of capital depreciation, and veteran benefits cost centers
- P Total expenditures for patient care production units
- R Total expenditures for research production units
- E Total expenditures for education production units
- N Total costs from national and regional administration and veteran benefits cost centers in the administration production unit

The term $\frac{I}{D}$ represents the indirect and direct costs from the DSS encounter-level extract. These costs were obtained by summing indirect and direct costs of PET scans at VA hospitals that performed PET scans. The term in the large bracket represents costs from the DSS ALBCC extract. This includes costs from all VA hospitals. In the largest brackets the right term in the numerator, $\frac{P}{P + R + E}$, is the percentage of direct cost that is patient care cost. This was multiplied by the total hospital level indirect cost (A), to determine the amount of hospital level indirect costs that should be assigned to patient care. By dividing the hospital level indirect costs which are assigned to patient care by total indirect costs (A, N, R, and E), we obtained the percentage of indirect costs which were both hospital level and related to patient care. We then multiplied this percentage by the total encounter level DSS indirect cost (I). The quantity “I” includes all indirect costs including national administration, research and education. By multiplying I by the percentage in the brackets we determined the amount of indirect costs obtained from the encounter level DSS data that are related to patient care and should be included in our indirect cost ratio.

3. Hospital-Wide Medicare Indirect Cost Ratio

The Medicare and DSS cost reports differ in several ways. The Medicare cost report includes capital but not depreciation costs; however, depreciation but not capital costs are included in the DSS report. The Medicare cost report represents short-term, acute care hospitals; VA cost reports on the other hand, represent both acute and long-term care facilities. Additionally, the Medicare cost report includes costs related to malpractice expenses; these expenses are not part of the VA budget. Finally, the

encounter-level DSS data represents costs from only outpatient PET scans; Medicare cost reports represent both inpatient and outpatient cost data. Despite these differences, a calculation of an indirect cost ratio from Medicare cost reports provides a valuable comparison to DSS ratios. We tabulated costs in Medicare hospital cost reports of all U.S. hospitals for the fiscal year that ended in 1999. We tabulated costs in Worksheet B, Part I, grouping all departments into four mutually exclusive categories: capital expenditures, education, other indirect costs, and direct costs. The total costs reported in the Medicare cost reports were as follows:

Table 3
Capital, Education, Other Indirect, and Direct Costs
in Medicare Cost Reports
1999 Reporting Year

Cost Type	Amount (\$)	
Capital Expenditure (C)	26,336,065,745	National total in capital expenditure accounts (before allocation)
Education (E)	6,862,297,749	National total in education expenditure accounts (before allocation)
Other Indirect Costs (O)	112,832,894,000	National total of all other indirect costs (before allocation)
Direct Costs (P)	178,228,220,600	National total in direct cost accounts (before allocation)

We found an indirect cost ratio of:

$$\frac{O}{P + E} = 0.6096$$

Here we calculated the ratio of the indirect cost (O), to direct cost (P and E), which includes patient care and education. Note that the indirect cost in the numerator, (O), excludes capital and education cost.

Some of the indirect costs of a hospital include the overhead of its medical education programs. Although the Medicare cost reports explicitly allocates indirect costs to education, we were unable to use this information, as it does not distinguish the indirect costs we are interested in from capital expenditures, which we wished to exclude. We put education cost in the denominator, assigning it a share of indirect cost. In this way, the resulting indirect cost ratio excludes the indirect costs associated with education. We assumed that the indirect costs of education are proportionate to expenditures.

The ratio is algebraically equivalent to:

$$\frac{O - (O)\left(\frac{E}{P + E}\right)}{P}$$

This is the ratio of indirect cost, exclusive of the share assigned to education, to direct patient care cost. The indirect cost of education is assumed to be proportionate to its share of direct cost $\frac{E}{P + E}$. This proportion was multiplied by the indirect cost (O), to determine the amount of indirect cost related to education that we needed to exclude.

4. Indirect Cost Ratio of Diagnostic Radiology Departments in the Medicare Cost Reports

The Medicare cost report includes a diagnostic radiology account. Costs in this account are reported before allocation (B) and after allocation (A). Before-allocation costs (found in Worksheet B, Part I) are direct costs. After-allocation costs (found in Worksheet B, Part II) include direct and indirect costs. We found indirect costs for this department by subtracting B from A.

Table 4
Cost of Diagnostic Radiology
Before and After Allocation of Indirect Cost
1999 Reporting Year

Cost Type	National Total Cost (\$)
Cost of diagnostic radiology department after cost allocation (A)	20,459,123,172
Cost of diagnostic radiology department before cost allocation (B)	11,745,282,739
Indirect Costs (A-B)	8,713,840,433

Once again the indirect cost (A-B) contains costs that we wish to exclude such as capital expenditures (C), and education (E); and the other indirect costs that we wished to include (O).

Our ratio is:

$$\frac{(A - B)}{B} \left(\frac{O \left(\frac{P}{(P + E)} \right)}{O + E + C} \right) = 0.5520$$

In the brackets, the right term in the numerator, $\frac{P}{P+E}$, is the percentage of direct cost that is patient care cost. This was multiplied by other indirect cost (O), to determine the amount of other indirect costs that was related to patient care. We divided this amount by total indirect costs (O, E, and C). This is the percentage of indirect costs that are related to patient care, excluding capital cost, education cost, and the indirect cost associated with education. We multiplied this percentage by the total diagnostic radiology account indirect cost (A-B) to find our indirect cost ratio.

Summary

The indirect cost ratio that we found ranged from .5520 to .6446. For ratios based on hospital-wide calculations, the ratio based on DSS data was lower than the Medicare ratio. For ratios based on department-level cost assignment, the ratio based on DSS data was higher than the Medicare ratio.

Table 5
 Indirect Cost Ratios
 by Alternate Methods
 (Excludes Education, Research, Capital,
 VA National and Regional Administration Costs, VA Benefits Cost)

Method	Ratio
VA hospital-wide	.5445
VA outpatient PET scans	.6446
Medicare hospital-wide	.6096
Medicare diagnostic radiology departments	.5520

Even when the cost of capital, medical education, research, and regional and national administration are excluded, indirect costs remain a significant part of the cost of hospital-based health care.