ON THE FOLLY OF USING RCCs AND RVUs FOR INTERMEDIATE PRODUCT COSTING

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July 2006

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For decades, hospitals have used one of two methods to compute the cost of their intermediate products (such as a laboratory tests and radiological procedures): a ratio of costs to charges (RCC) or relative value units (RVUs). Both methods are highly flawed. CFOs who use either of these methods in an effort to ascertain the full cost of an intermediate product are making a mistake that can have serious financial consequences for their institutions. Indeed, CFOs who use one of these methods during negotiations with payers about capitation or sub-capitation rates, DRGs payments, or fees for individual services, may end up proposing prices that are too high to obtain the contract. Or, perhaps worse, the hospital might end up with a contract in which its service-delivery costs exceeded the associated revenue.

The Stage 2 Dilemma in Full Cost Accounting

A full cost accounting effort goes through two stages. In Stage 1, the hospital's accounting staff (a) defines cost centers, distinguishing between production (or revenue) centers and service centers, (b) assigns all costs to one or more of those cost centers, (c) determines appropriate bases of allocation for service centers, and (d) allocates the service center costs to the production centers. The end result is that all costs reside in production centers. While it has some flaws, the Stage 1 effort is well developed in many hospitals, and, when done well, results in reasonably accurate production center costs.

It is in Stage 2, when a production center's costs are attached to its products, that problems arise. During this stage, the production center's costs are divided into direct and indirect. The direct costs are those that can be attached to a product unambiguously; they typically comprise direct labor and direct materials. There is no big problem here.

With indirect production center costs, however, there are some tricky accounting problems, in part because these costs fall into three categories, which typically are grouped under the label of "manufacturing overhead," or MOH: (a) indirect labor, such as supervisory time, (b) indirect materials, i.e., materials that cannot be directly associated with a unit of output, such as cleaning solvents for machines, and (c) the service center costs that were allocated to the production center during Stage 1.

In a typical manufacturing context, MOH ordinarily is "attached" to products through the use of one or more "overhead rates." The *absorption process*, as this effort sometimes is called, can be a little tricky, and, can easily give misleading results. For example, when only one overhead rate is used, as frequently happens, the implicit assumption is that the unit used in that rate (e.g., machine hours or direct labor hours), drives the use of all manufacturing overhead. However, MOH generally results from a more complex array of forces, such that an absorption process using a single overhead rate can give management incorrect information about the actual

consumption of MOH, and hence about the full cost of a product. This can lead to poorly informed pricing decisions and profitability analyses.

Enter Activity-Based Costing

Activity-based costing, or ABC, is now used in many manufacturing settings as a way to correct for this deficiency. Designers of ABC systems use multiple "overhead cost pools," and try to make the resources in each pool as homogeneous as possible. They then identify an activity that drives the use of each pool's resources, and use it to compute the pool's overhead rate. For example, one MOH cost pool in a factory might be the labor and supervisory time needed to set up the machines for manufacturing a batch of products. In this case, the appropriate cost pool would be everything associated with setting up the machines (such as cleaning and adjusting tolerances), and the appropriate unit of activity for the pool would be a setup. As a result, a unit of output in a small batch of products would get a higher share of the setup cost than a unit in a large batch.

Unfortunately, although many hospitals have developed intermediate-product costing systems in an attempt to determine the full cost of a DRG (the final product), few have developed an ABC system. Yet, intermediate products in a hospital—such as laboratory tests, radiological procedures, and surgical interventions—are, from a cost accounting perspective, conceptually identical to products in a manufacturing setting. Instead of developing an ABC system to cost out the products, however, many of these hospitals have relied on either RCCs or RVUs as a means to compute the full cost of their intermediate products. The abbreviated full cost report for Owen Hospital, shown in Exhibit 1, can be useful for illustrating the errors associated with each of these approaches.

Cost centers that produce a single product do not need an ABC system. An example is the renal dialysis department, which, at Owen Hospital, had direct costs of $1,250,000 and allocated service center costs of $423,930, resulting in a full cost total of $1,673,930. If, during the year that it incurred these costs, the department performed 6,000 dialysis procedures, the full cost of a single procedure (the intermediate product) would be $278.99. In this situation, since the department's only product is a dialysis procedure, and since all dialysis procedures are (more or less) identical, the average cost per procedure is a meaningful number.

By contrast, the radiology department (direct costs of $1,750,000, allocated service center costs of $688,321, and total costs of $2,438,321) conducts a wide variety of procedures: chest x-rays, limb x-rays, CT scans, magnetic resonance imaging, and so forth. Each procedure requires some technician time, and some procedures require supplies, such as a contrast medium. These are all direct costs of the department and are contained in the $1,750,000 figure. They are also direct costs of the procedures. That is, it is relatively easy to use time and motion studies to determine the portion of the cost for any given procedure that results from technician time, films, contrast-media, and other supplies.

But what about the supervisor in the department who doesn't work on procedures? Or the department's scheduling personnel? Or any of a variety of other people in the department who don't work directly on procedures? These are all direct costs of the radiology department—they can be unambiguously associated with the *department*—but they are *indirect* with regard to any given procedure. And yet, if we are to know the full cost of a particular procedure, we must find a way to attach some portion of these costs to it.

And then there are the $423,930 in service center costs that were allocated to the department during Stage 1. They are *indirect* with regard to *both* the department *and* any given procedure, but we also must find a way to attach a portion of these costs to each procedure. Historically, this is where RCCs and RVUs came into play, and, unfortunately, their use has led to potentially serious inaccuracies.

The Flaws in RCCs

To compute a ratio of costs to charges for, say the radiology department, the accounting staff divides the sum, of the department's full costs for a year, as determined in Stage 1, by the department's total charges for that year. The resulting ratio then can be multiplied by the charge for any given product, such as an MRI, to determine the product's cost.

Research has indicated that the RCC approach to determining a hospital's costs is about 95 percent accurate at the product line level and about 85 percent accurate for a DRG.[1] Below that level of aggregation, however, its accuracy declines, and it is extremely unreliable for any single product provided by a production center.

To illustrate this inaccuracy, assume we wish to compare the costs of four laboratory tests used in the treatment of a patient with a given DRG in a teaching hospital with costs of the same four tests for a patient with the same DRG in a community hospital. Assume the following conditions apply:

- Each hospital conducts four identical tests: three "Simple" tests and one "Esoteric" test.
- The laboratories in the two hospitals are equally efficient and pay the same factor prices (wage rates, etc.). Thus, there should be no *real* cost differences between the two hospitals. That is, the "true cost" of each test (in terms of resources actually expended) is the same in the teaching hospital as the community hospital.
- For various strategic reasons, however, the two hospitals use different "markups," resulting in different charge structures, but these differences net out at the department level. That is, the average markup is the same in each hospital's laboratory, as shown below.

[1] For details, see Michael Shwartz. David W. Young, and Richard Seigrist" The Ratio of Costs to Charges: How Good a Basis for Estimating Costs," *Inquiry,* Fall 1995.

Hospital/Test	True Cost	Average Markup	Strategic Markup/Discount	Total Markup	Charge	RCC(1)
Teaching Hospital						
Simple Test	$10.00	108.3%	+291.7%	400.0%	$50.00	
Esoteric Test	50.00	108.3%	-58.3%	50.0%	75.00	
Department Total	$60.00				$125.00	.48
Community Hospital						
Simple Test	$10.00	108.3%	-8.3%	100.0%	$20.00	
Esoteric Test	50.00	108.3%	+1.7%	110.0%	105.00	
Department Total	$60.00				$125.00	.48

1. True Cost ÷ Charge. Computed at the overall departmental level only.

Thus, although the *true* cost of each test is the same in both the teaching hospital and the community hospital, the *reported* costs (using the average RCC of .48 multiplied by the charge) are quite different, as follows:

	Simple Test	Esoteric Test
Teaching Hospital	($50 x .48) = $24	($75 x .48) = $36
Community Hospital	($20 x .48) = $9.60	($105 x .48) = $50.40

As a result, total costs for the four lab tests in question would appear to differ considerably:

Teaching Hospital:

3 Simple Tests @ $24	=	$72.00
1 Esoteric Test @ $36	=	36.00
Total Cost		$108.00

Community Hospital:

3 Simple Tests @ $9.60	=	$28.80
1 Esoteric Test @ $50.40	=	50.40
Total Cost		$79.20

Over a large volume of tests, these cost differences would net out. But, in a department that provides a heterogeneous mix of outputs, the use of RCCs usually will produce similarly misleading results for any aggregation of patients below the DRG level, and certainly for any single test or procedure.

It often is argued that teaching hospitals are more expensive than community hospitals because of their greater case complexity, research agendas, residency programs, location, and a variety of other matters, all of which quite likely are true. It also seems likely, however, that a least some portion of their so-called higher costs arises from the flaws in an RCC approach to costing. Indeed, imagine the difficulty the teaching hospital in the above example would have in obtaining a managed care contract in which the population to be served was expected to use a large number of "simple tests," and it thought that its cost for a simple test was $24 instead of $10.

The Flaws in RVUs

Many hospital departments perform a variety of different kinds of procedures. In radiology, these range from a simple chest x-ray to a rather sophisticated CT scan that requires injecting a contrast medium into the patient's

blood and taking several images of the patient's brain as the contrast medium flows through it in the bloodstream. Assume that during the period covered by the cost report for Owen Hospital, the radiology department performed 30,000 procedures. With total costs of $2,438,321, the average cost per procedure is $81.28

Assume further that we wish to know the radiology cost for two patients, each of whom received two procedures. If we use the average cost per procedure, the cost for each patient would be $162.56. However, if Patient A received two chest x-rays and Patient B received two CT scans, these totals would be very misleading.

To address this problem, the radiology department might decide, as many have, to use relative value units. An RVU approach uses information from a national data base to assign a weight to each procedure based on its complexity. For illustrative purposes, assume a chest x-ray is worth one RVU and a CT scan is worth 10, and that the radiology department did 25,000 chest x-rays and 5,000 CT scans during the period covered by the cost report. We can compute the total RVUs delivered during the period as follows: 5,000 CT scans * 10 = 50,000 RVUs; 25,000 chest x-rays * 1 = 25,000 RVUs; Total RVUs = 75,000. Cost per RVU = $2,438,321÷75,000 = $32.51.

Since Patient A had two chest x-rays and Patient B had two CT scans, the new per-patient costs are as follows.

	Patient A (Two Chest X-Rays)			**Patient B (Two CT Scans)**		
	Old	New	Difference	Old	New	Difference
Number of units	2	2	--	2	20	--
Cost per unit	$81.28	$32.51	--	$81.28	$32.51	--
Total cost	$162.55	$65.02	($97.53)	$162.55	$650.22	$487.67

Intuitively, this makes sense, since we know that a CT scan is a more complex procedure than a chest x-ray. Thus, given that a CT scan is 10 times more complex than a chest x-ray, based on its RVUs, it makes intuitive sense that its cost should be 10 times that of the x-ray.

In terms of accuracy, however, the important cost accounting question is not procedure complexity, since much of this is picked up in the material and labor costs that are attached to the product directly, but whether all MOH should be a function of RVUs. If we conclude that MOH is driven by something other than procedure complexity, then we must undertake an ABC effort. To do so, we need to divide our overhead costs into several pools, and determine the appropriate cost driver for each. Exhibit 2, illustrates how costs might be computed if drivers other than RVUs were used for attaching the department's MOH to its products. There are several important points to note about this exhibit.

- Labor and material costs are direct costs and therefore are not an issue. (Because the CT scan has 10 RVUs, its unit costs under the RVU approach are 1/10 of what they are under the procedure approach. In total, they are the same under both approaches.)
- There are five overhead cost pools. Four (hospital administration, plantwide depreciation, housekeeping, and maintenance) are the same as the ones used in Exhibit 1; that is, they are hospital service centers whose

costs were allocated to radiology, and the total amount shown is the amount of the allocation. The fifth is the department's administrative costs, which are direct costs of the department but indirect with respect to any given procedure performed in the department. (In practice, we might use more overhead cost pools in an effort to improve the cost homogeneity in each.)

- To attach the costs in these pools to the department's products, this example uses the same cost drivers that were used to allocate the costs to the department in Stage 1 (such as square feet for depreciation and housekeeping). It then computes the amount of space, maintenance hours, and salary dollars associated with each of the procedures, and uses the resulting percentages to distribute the costs between the two procedures.
- The specific results would change depending on the overhead pools we select, the cost drivers we use for them, the mix of procedures, and the number of cost driver units used by each. With the assumptions in Exhibit 2, however, the per-patient cost comparisons between RVUs and ABC look as follows.

	Patient A (Two Chest X-Rays)			**Patient B (Two CT Scans)**		
	RVUs	ABC	Difference	RVUs	ABC	Difference
Number of units	2	2	--	20	2	--
Cost per unit	$32.51	$65.07	--	$32.51	$162.33	--
Total cost	$65.02	$130.14	$65.12	$650.22	$324.66	($325.56)

With the ABC approach, we have relaxed the implicit assumption under the RVU approach that all overhead is driven by procedure complexity. In its place, we have attached overhead to each product by means of several homogeneous overhead cost pools and an appropriate cost driver for each. The result is that the chest x-ray now costs about twice as much as under the RVU approach, and the CT scan costs about half as much.

More generally, hospitals that substitute RVUs for a serious cost accounting effort can come to highly misleading conclusions about the cost of an intermediate product. This is because, although RVUs address the complexity issue, they do not deal with the fact that much of MOH is unrelated to procedure complexity.

When to Use ABC

Hospitals and other healthcare providers that wish to measure their costs more accurately, both for competitive bidding purposes and so that they can manage them more effectively, can benefit considerably from activity-based costing. Clearly, there are situations where a single overhead rate is adequate (such as in the dialysis unit), and, therefore, there is no need for ABC. But there are many other situations where the presence of one of three factors calls for an ABC system: product diversity, relative costs, and volume diversity.

Product diversity exists when different products use overhead-related services in different proportions. For example, if one product requires considerably more supervisory time than another, there is product diversity. However, product diversity is important only if the costs of the different activities are significantly different, which

is the *relative cost* factor. Finally, some overhead activities are batch-related, and, if products are manufactured in batches of different sizes, there is *volume diversity*.

Developing an ABC System

The details of the process for developing an ABC system are discussed in many cost accounting textbooks. In general, the process entails classifying a production center's costs into four activity-related categories:

- *Facility-Sustaining*. This is the highest order activity, and includes work such as plant (or departmental) management, repair and maintenance, security, and other activities unrelated to the department's products, per se.
- *Product-Sustaining*. These are the activities needed to assure that products are produced according to specifications. They include process engineering, product specifications, engineering changes, and product enhancements.
- *Batch-Related*. These are activities that are performed each time a batch of products is manufactured, such as set up time for machines, material movements, and inspections.
- *Unit-Level*. These are activities that are tied directly to the number of units produced, such as utility usage, machine hours, and the like. (Unit level activities also include direct manufacturing costs; the three other categories include only manufacturing overhead.)

These four categories are the building blocks of an ABC system. Once costs have been classified into a category, and the categories have perhaps been further subdivided into more homogeneous cost pools, the accounting staff needs to determine the activity that causes a product to incur the costs in each pool. Conceptually, the search is for a *cost driver* that reflects a product's demand for the costs in the pool. For some pools this is relatively easy; for others, it can be tricky. Nevertheless, even if considerable effort is required to put an ABC system in place, that effort is one-time. Once developed, an ABC system can be sustained at minimal ongoing expense.

In summary, a hospital department can use a single rate to assign its MOH to products if it has little product diversity and production batches that are all about the same size, or if it has high product and/or volume diversity, but similar activities regardless of the type of product or the batch size in a production run. A dialysis unit, with little product diversity and equal batch sizes (one dialysis in a "batch") falls into this category.

By contrast, when there is high product or volume diversity, or differences in activities associated with different products or batch sizes—as there are in pathology, radiology, the operating suites, and many other departments where a hospital's intermediate products are delivered—there quite likely is a need for an ABC system with multiple overhead cost pools and a separate cost driver for each. Once such a system is in place, it can produce

more accurate cost information, which, in turn can better inform pricing decisions and profitability analyses, especially in hospitals that are engaged in managed care contracting.

Outside of health care, the use of ABC has led managers in many organizations to reverse their thinking on which of their products are the most profitable. It is likely that similar conclusions would be reached in a hospital that undertook an ABC effort. Indeed, in an era of shrinking resources for health care, and intense negotiations between payers and providers, a hospital that does not have an ABC system could be putting its financial viability at considerable risk.

Side Bar

Much has been written about Activity-Based Costing. One of the earliest articles to identify the idea—and an article that, in some sense, set the stage for much of the work in ABC—is Robert Kaplan, "Yesterday's Accounting Undermines Production," Harvard Business Review, July-August, 1984. See also Robin Cooper, "Does Your Company Need a New Cost System," Journal of Cost Management, Spring 1987, pp. 45-49.

For a discussion of the characteristics of a system where a single overhead rate is inappropriate, see Robin Cooper, "You Need a New Cost System When. . . . ," *Harvard Business Review,* January-February 1989, pp. 77-82.

Beyond this, a particularly good sources for additional information is Robin Cooper and Robert S. Kaplan, *The Design of Cost Management Systems,* Englewood Cliffs, New Jersey, Prentice Hall, 1991. Two readings in that book that apply directly to the topic of implementing activity-based cost systems are Robin Cooper, "Implementing an Activity Based Cost System,"from *Journal of Cost Management,* Spring 1990, pp. 33-42; and Michael D. Shields and S. Mark Young, "A Behavioral Model for Implementing Cost Management Systems," from *Journal of Cost Management,* Winter 1989, pp. 17-27.

Exhibit 1. Abbreviated Cost Report for Owen Hospital

	Direct Costs	Allocated Costs	Costs to be Allocated	Allocations: Depreciation (Sq Ft)	Allocations: Maintenance (Hours)	Allocations: Housekeeping (Sq Ft)	Allocations: Administration (Salary $)	Full Cost
	1	2=4+5+6+7	3=1+2	4	5	6	7	8=1+2
Service Centers								
Building depreciation	1,200,000	0	1,200,000					
Building maintenance	950,000	105,000	1,055,000	105,000				
Housekeeping services	300,000	154,555	454,555	95,000	59,555			
Admin & General	1,300,000	381,605	1,681,605	156,000	158,250	67,355		
Mission Center								
Radiology	1,750,000	688,321		140,000	147,700	64,300	336,321	2,438,321
Laboratory	2,000,000	788,814		160,000	172,545	69,500	386,769	2,788,814
Dialysis Unit	1,250,000	423,930		50,000	116,050	22,455	235,425	1,673,930
Inpatient Care	7,000,000	959,723		350,000	158,250	165,600	285,873	7,959,723
Outpatient Department	2,250,000	889,212		144,000	242,650	65,345	437,217	3,139,212
Total cost	18,000,000			1,200,000	1,055,000	454,555	1,681,605	18,000,000

Exhibit 2. Computing Full Cost Per Unit Using an ABC Approach

Notes	Labor & Material Cost/Unit 1	Number of Units	Directly Attachable Direct Cost 2	% of Salary Dollars 3	Department Admin. Cost 4	Hospital Admin. Cost 4	% of Square Feet 3	Depreciation Cost 5	Housekeeping Cost 5	% of Maint. Hours 3	Maintenance Cost 6	Total Cost	Cost per Unit	Cost per Procedure 8
Using Procedures														
Chest x-ray	40.00	25,000	$1,000,000	0.70	$280,000	$235,425	0.40	$56,000	$25,720	0.20	$29,540	$1,626,685	$65.07	$65.07
CT Scan	70.00	5,000	350,000	0.30	120,000	100,896	0.60	84,000	38,580	0.80	118,160	811,636	$162.33	$162.33
Total		30,000	$1,350,000		$400,000	$336,321		$140,000	$64,300		$147,700	$2,438,321		
Using RVUs														
Chest x-ray	40.00	25,000	$1,000,000	0.70	$280,000	$235,425	0.40	$56,000	$25,720	0.20	$29,540	$1,626,685	$65.07	$65.07
CT Scan	7.00	50,000	350,000	0.30	120,000	100,896	0.60	84,000	38,580	0.80	118,160	811,636	$16.23	$162.33
Total		75,000	$1,350,000		$400,000	$336,321		$140,000	$64,300		$147,700	$2,438,321		

Notes:
1 Computed based on time and motion study for a procedure. Divided by RVUs for RVU analysis.
2 Equals column 1 * column 2.
3 Obtained from hospital and department records.
4 Assigned based on percent of salary dollars.
5 Assigned based on percent of square feet occupied.
6 Assigned based on percent of maintenance hours.
8 Cost per unit multiplied by units per procedure