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August 2002

Micro-cost Methods for Determining VA Healthcare Costs

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Acknowledgments

We gratefully acknowledge support from the Health Services Research and Development Service (HSR&D) and the Cooperative Studies Program (CSP) for funding the development of this research handbook.

Recommended citation

Smith MW, Barnett PG, Phibbs CS, Wagner TH, Yu W. Micro-cost methods for determining VA healthcare costs. Menlo Park, CA: Health Economics Resource Center, Health Services Research and Development Service, U.S. Department of Veterans Affairs, 2002.

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Chapter 1. Overview

1.1 Introduction

The purpose of this handbook is to introduce researchers to micro-costing, a set of related methods for determining the cost of healthcare. It explains micro-cost methods and provides guidance on using them with data produced by the Department of Veterans Affairs (VA), but many of the principles that are described apply to other healthcare systems. Researchers new to the VA or new to cost analyses often have many questions about institutional matters, and it is these readers we have kept in mind when writing the handbook. We hope it will be a useful reference for more experienced researchers as well. To that end, it will be updated as needed to stay abreast of development in VA data systems and advances in research.

The handbook is organized as follows. Chapter 2 provides an overview of datasets that may be used to determine costs of VA care. Two important data sources, the Financial Management System (FMS) and the Cost Distribution Report (CDR), are explored at greater length in chapters 3 and 4, respectively. Chapters 5 through 8 describe three alternative methods of micro-costing: direct observation and measurement (chapter 5), creation of pseudo-bills (chapters 6-7), and statistical cost functions (chapter 8). Chapter 9 covers two topics that have received little attention heretofore: malpractice payments and the cost of capital.

This handbook is one of four produced by the Health Economics Resource Center (HERC). Two others deal with average cost methods. Average costing for inpatient stays is described in *HERC's Inpatient Average Cost Datasets for VA Care: Version 2: Fiscal Years 1998-2000* (Wagner et al., 2001). A similar handbook for outpatient visits is *HERC's National and Local Outpatient Average Cost Dataset for VA Care: Fiscal Years 1998-2000* (Phibbs et al., 2001). The handbook by Yu and Barnett (2002), *The Decision Support System National Data Extracts*, details the structure and contents of an encounter-level extract from the Decision Support System. Each of the handbooks is available on request from HERC (herc@med.va.gov).

There are additional sources of information on micro-cost methods as well. The HERC website (www.herc.research.med.va.gov) contains a number of short pieces under the "FAQ" heading, many of which pertain to micro-costing. HERC has also developed presentations on costing methods, available in both audio and visual formats. Many of these may be downloaded directly from the HERC website; others will be sent on request.

A good general resource on cost-effectiveness analyses is the 1996 report of a Public Health Task Force on cost-effectiveness (Gold et al., 1996). It recommends use of micro-costing and average-costing methods, discusses methodological issues in detail, and offers many specific recommendations on carrying out cost-effectiveness analyses. The micro-cost methods described in this handbook are consistent with the guidelines set forth in the Task Force report wherever possible.

1.2 When to Use Micro-costing

Cost-effectiveness, cost-utility and cost-outcome analyses are major components of health economics research. What they have in common is the need to measure the cost of healthcare activity. Three methods for doing so in the context of VA care are micro-costing, average costing, and using the Decision Support System (DSS). The methods differ in their level of detail. In micro-costing, a cost is derived for each element of an intervention: staff time, supplies and medications, out-of-pocket expenses, and so on. The DSS National Data Extracts (NDE) allow costs to be determined by patient, day, and bedsection, but costs are not broken down into units of staff time, medication cost, etc. The highest level of aggregation is found in the average-costing approach. Here, mathematical models are used to determine the mean cost of a day of inpatient care or an outpatient visit. With average costing, there is no detail available on the cost of any component of the stay or visit.

A common method for determining VA costs is average costing. In average costing a researcher combines VA utilization data, relative values for costs of care derived from non-VA cost datasets, and department costs obtained from the VA Cost Distribution Report (CDR). Every encounter with the same characteristics is assumed to cost the same. Relative values may be the Medicare relative weights associated with the Diagnosis Related Group of an inpatient stay, or the reimbursement associated with an outpatient procedure code. In many studies, and for some of the healthcare utilization in nearly every study, an average cost method can be used. HERC has prepared a comprehensive set of estimates of the cost of VA care using average cost methods (Wagner et al., 2001; Phibbs et al., 2001).

The Decision Support System (DSS), a computerized cost-allocation system, has significant potential as a second method for assigning costs. DSS staff allocate costs to VA healthcare products and to patient stays. Validity checks performed at HERC suggest that analysts should not rely exclusively on DSS cost estimates. Current results from the DSS validity analysis are found in a separate handbook (Yu and Barnett, 2002).

Analysts turn to micro-costing when average costing is unsatisfactory. For example, the average-cost files developed by HERC cannot distinguish the costs of two patients in the same bedsection on the same day, or two patients who have a visit characterized with the same procedure code.[1] Micro-costing is needed when an intervention changes patterns of resource use in a way that is not reflected by the Diagnosis Related Group, the bedsection, or the procedure code.

Micro-costing is also needed to capture costs borne by the patient, such as out-of-pocket expenses, that are unavailable in VA administrative data systems. Micro-costing is also one foundation of a broader method known as activity-based costing (ABC). In ABC, costs are organized by activity rather than by department or bedsection. Surveying staff members to learn their work patterns, an example of micro-costing, is the first step in an ABC analysis (Brinker et al. 2000; Waters et al. 2001).

[1] A bedsection is similar to, but not exactly equivalent to, a traditional hospital ward.

Micro-cost methods include three approaches: direct measurement, preparation of pseudo-bills, and estimation of a cost function. They are summarized below.

Direct measurement

In direct measurement, inputs such as staff time and supply costs are directly measured to develop a precise cost estimate. The time of each type of staff is estimated and its cost determined from accounting data. The analyst may directly observe staff time, have staff keep diaries of their activities, or survey managers. The cost of supplies, equipment, and other expenses must also be determined. Program volume is determined from administrative records, and the average cost is then estimated. When units of service are not homogenous, unit costs may be estimated by an accounting approach, by applying estimates of the relative cost of each service, or via an econometric approach. Chapter 5 of this Handbook contains a detailed discussion of direct measurement.

Pseudo-bill

A second method combines VA utilization data with unit costs from non-VA sources to estimate the cost of patient care. This is commonly referred to as the pseudo-bill method because the itemized list of costs is analogous to a fee-for-service hospital bill. The unit cost of each item may be estimated from Medicare reimbursement rates, the charge rates of an affiliated university medical center, or other non-VA sources. The application of pseudo-bills to inpatient data is described in Chapter 6 of this handbook, and to outpatient data in Chapter 7.

Cost function

The third micro-cost method is the cost function, which consists of regression analysis of a cost-related outcome. Cost functions have several uses. At the level of individual patients they are used to estimate the cost of VA services and to determine the marginal increase in cost from a new intervention. At an industry level they can address problems like the optimal size of healthcare organizations and the timing of entry into and exit from healthcare markets.
In our treatment of cost functions we will focus on patient-level applications.

A cost function is typically estimated with cost-adjusted charges as the dependent variable and information about the encounter as the independent variables. It requires detailed cost and utilization data for a specific, non-VA service. VA costs are then predicted using VA utilization data and the function's parameters. The chief advantage of this method is that it requires less data than is needed to prepare a pseudo-bill, making it more economical. The use of cost functions is explored in depth in Chapter 8 of this Handbook.

Distinguishing micro-costing from average costing

It is useful at this point to clarify the distinction between average costing and micro-costing. In average costing there is a predetermined, nonoverlapping set of events (outpatient visits or inpatient stays) characterized by procedures, diagnosis codes, length of stay (for inpatient stays), and so on. One may think of them as alternative bins. Each event/bin has been assigned an average cost based on some other dataset. The study analyst's job is to match each observed event in the study with one of these predetermined bins. Sometimes the match between actual event and bin will be close, and other times it will not. By contrast, micro-costing does

not involve matching actual events to predetermined events/bins. Rather, the analyst determines the total set of costly activities that occurred (procedures, inpatient days, nursing home stays, etc.) and then determines a cost for each. The sum of the component costs is the total cost for that event. Where the three methods of micro-costing (direct observation, pseudo-billing, and cost functions) differ is in the way they determine the set of component events and their costs.

1.3 Types of Cost

The type of cost information needed will determine whether a micro-costing approach is appropriate and will guide the choice between alternative micro-cost methods. In this section we start by distinguishing the concepts of cost, charge, and payment. We then address several issues that help to define the scope of cost data: study perspective, accounting versus economic costs, and long-run versus short-run time horizons.

Costs, charges, and payments

The concepts of costs, payments, and charges are sometimes used interchangeably in health services research. This is unfortunate, for they represent three distinct concepts. Moreover, understanding the differences among them will aid the researcher in preparing pseudo-bills for inpatient or outpatient utilization.

The three concepts are easily distinguished. The cost of a medical procedure is the sum total of all resources needed to carry it out. A charge for a medical procedure is the fee assigned by the provider for the service. The payment is the total reimbursement to the provider for the procedure by all payers.

The three concepts have differing uses in health services research. Costs are used to determine cost-outcome and cost-effectiveness ratios, typically from society's perspective. Charges are mostly useful for studies of the accounting practices of providers. Charges are not necessarily equal to any measure of cost, and usually charges exceed payments due to negotiated discounts between providers and payers. Payments are of greatest interest in cost-effectiveness studies done from the payers' perspective.

Accounting cost and economic cost

Definitions

Two concepts of cost are *accounting cost* and *economic cost*. Accounting cost refers to the purchase price of a good, including the cost of financing, minus depreciation. The accounting cost of a VA healthcare encounter is its cost as estimated by a cost allocation report. Accounting cost includes the direct cost of staff and supplies used, a share of the provider's overhead costs, such as administrative support, maintenance, utilities, and the amortized cost of equipment, buildings, and real estate. Costs are represented as the cash expended.

From a societal viewpoint, the full *economic cost* of a healthcare intervention is its *opportunity cost* (Garber et al., 1996). The opportunity cost of a good is the value of its next best alternative use. For example, a nursing home owned by VA could be rented out to a private

nursing home operator. The opportunity cost of using it as a VA facility is the revenue it would generate as a private facility. Likewise, a patient at a doctor appointment has foregone using the same time for work, hobbies, or other activities. The opportunity cost of the appointment is the value of the next-best alternative activity.

The distinction between accounting and economic costs can be important in cost-effectiveness analyses. Some items have economic value but no accounting value. A cost analysis from an accounting perspective would not count their value, whereas an analysis from a societal perspective would include their value.

Two healthcare items that have economic value but may not have accounting value are buildings and informally provided home healthcare. Because VA accounting rules fully depreciate all buildings over 40 years, buildings beyond that age have zero accounting value. They will continue to have economic value, however, as long as it has an alternative use that would generate revenue or that would save VA money it would otherwise have to spend. Healthcare provided by informal caregivers is similar. Although it has no accounting cost, it has a measurable economic value. In many instances, paid professionals must provide what is not available informally.

Measurement

Accounting cost at the level of department, services, or type of staff, is relatively straightforward to find using VA administrative databases. Chapter 3 of this handbook explains how one may calculate the accounting cost of VA staff using data from the Financial Management System (FMS). The average accounting cost of patient care by department can be found using the Cost Distribution Report, as described in chapter 4. Chapter 9 explains how to determine the accounting cost of VA buildings and equipment.

The opportunity cost (economic cost) of real estate is straightforward to calculate. The opportunity cost of commercial buildings may be measured by the rental cost of similar buildings in the local market. Commercial real estate agents can provide estimates.

Measuring the opportunity cost of personal time is more difficult. Garber et al. (1996) notes that the opportunity cost of time depends on its relation to other non-work ("leisure") activities. If a patient values the time spent obtaining care equal to time spent on other leisure activities, then obtaining care has no opportunity cost. If the patient values it similar to work, then the opportunity cost of obtaining care is the lost wage. If the patient considers it to be worse than work, then the opportunity cost is greater than the wage. In practice, there is rarely information on patients' relative utility in leisure, work, and healthcare, and so the average hourly wage is typically assumed to measure the opportunity cost of time.

Personal wage rates cannot be used with confidence to value the time of people out of the labor force, such as retirees and some individuals with disabilities. A similar difficulty concerns the opportunity cost of time offered by informal caregivers. The Public Health Task Force raises these issues but does not offer a recommendation for dealing with them. One approach is to consider the importance of each of these factors in the total cost of the interventions being

studied. If they are likely to constitute a significant fraction of costs, then the time value of such care should be directly obtained through survey questions. Another option is to value the care according to a national average wage for in-home caregivers, as calculated each year by the U.S. Bureau of Labor Statistics. If such costs are likely to constitute only a small fraction of total costs, however, then it will most likely suffice to make a plausible assumption, with sensitivity analyses to determine whether the result depends on the particular values chosen.

Time horizon: short-run vs. long-run costs

When thinking about time, economists distinguish between the short-run and the long-run. The *short run* is a timeframe over which most costs are fixed. Hospital buildings, vehicles, real estate, and contracts often cannot be procured, eliminated or renegotiated over short period of time. In the short run, fixed costs may be ignored as the cost of an intervention may be determined based on the variable elements. In the *long run* all economic elements may vary: buildings may be built, contracts negotiated, real estate bought and sold, and so forth. All costs are variable in the long run, and thus finding the total cost of the intervention requires assigning costs to every element.

The choice between short-run and long-run approaches should be guided in part by the scope of the intervention. If carrying out a new intervention as part of standard care would require building new facilities, then a long-run analysis should be done. A policy analysis of the federal end-stage renal disease payment program, for instance, would need to account for the outpatient dialysis clinics that sprang up due to the program and to the increased use of medical care by patients who have lived longer than they would have absent the program. Conversely, a short-run analysis (i.e., one that assumed that some costs are fixed) would be appropriate in managerial studies, where the analyst takes the perspective of the hospital and evaluates proposed changes that do not require capital improvements.

Perspective

The costs of healthcare are different from the viewpoint of patients and their families, employers, insurers, federal and state governments, and society as a whole. An example will illustrate. Suppose that it takes two hours for an employed person to obtain ambulatory care during a working day. To the patient, the time cost is the opportunity cost—the value of the next-best alternative use of that time. Employers will only value the patient's time if it is covered by sick leave or reduces the worker's productivity. Insurers would not value the patient's time under any circumstance, while society would always value it. A good discussion of alternative cost perspectives appears in Russell et al. (1996). Most authors have advocated the use of the societal perspective in cost-effectiveness and similar analyses, although not all (Garber, 2000).

1.4 Component Events of the Intervention

General considerations

Once an analyst has chosen a study perspective and time horizon, and whether to count the full economic costs of an intervention or simply the accounting cost, the next step is to determine which component costs of the intervention must be measured. There is a rule of thumb: to find the cost of an intervention, include the cost of all activities needed to replicate the

intervention in a typical healthcare setting. Costs incurred only to study the intervention should be excluded. When an activity involves both delivery of the intervention and research on its effect, the cost of any activity needed to deliver the intervention is included.

For example, consider the cost of a follow-up telephone call. The study participant is asked to return to a clinic to receive more intervention and to fill out a research assessment. The call is a cost of intervention. In order to replicate the intervention in the real world, the follow-up call will still be needed so that the patient will return to clinic to receive more intervention. A strict accounting of intervention cost would exclude any extra cost that was exclusively attributable to research—for example, any extra minutes spent describing the research assessment. This extra cost would not be needed to replicate the intervention in the real world.

Another example is a laboratory test conducted to identify patients who are eligible for the study. The test is a cost of the intervention because it would be needed to replicate the intervention elsewhere with same level of effectiveness.

Research and development (R&D) costs should be included if the study's purpose is to provide guidance on whether to produce the intervention at all. If the intervention already exists, then R&D costs should not be counted. For example, a study comparing the impacts of existing drugs would not take R&D costs into account. Once a drug is synthesized, the incremental cost to using it in a new setting is only its acquisition cost. If R&D costs are to be counted, they should be spread evenly over all future uses. A simple method is to divide R&D costs by the number of uses, based on reasonable forecasts of use and of the technology's expected lifetime.

There may be costs arising from subcontracts with outside firms. Contract costs should be included if they relate to the intervention. Beyond the stated value of a contract, there will also be indirect costs relating to the bidding process and contractor oversight. These indirect costs should also be included.

Clinical studies may involve a more intensive level of patient assessment than would occur under usual circumstances. For example, physicians may order more tests in a clinical study in order to detail patient outcomes as fully as possible in the final report. If the test is needed only to evaluate the intervention for research purposes, then it is a cost of research, not a cost of intervention. If test results affect subsequent care, then it becomes part of the cost of the intervention. By contrast, in general practice there is typically pressure to minimize costs by performing only those tests that are medically indicated. A knowledgeable clinician can determine whether the intervention is being carried out differently from how it would occur in typical practice settings. If so, a discussion of cost-effectiveness could present additional figures for the cost of the intervention under typical circumstances.

In some cases clinical staff members will perform tasks that relate both to an intervention and to normal patient care. Should time for these tasks be considered part of the cost of the intervention? From an economic theory standpoint, they should not. Only activities that would not have occurred absent the intervention should be counted as relating to the intervention. See the discussion of incremental costs in Chapter 5 for more detail.

Timing

The timing of data collection matters for several reasons. First, the average cost of the intervention may fall over time as clinicians become more practiced at performing it (Rosenheck, Neale and Frisman 1995). Second, clinicians differ in their efficiency. A study of care at a geriatric hospital, for example, should take into account that clinicians in other settings may not be as efficient in treating the elderly as those in a specialized facility. Finally, there may be returns to scale in providing an intervention as methods of care are adjusted within a facility. If this happens, long-run costs will fall below short-run costs measured during the study.

Staff time

Staff cost should be fully burdened with the cost of benefits, employer contributions to taxes, and non-productive time such as vacation and sick leave. This can be done in the calculation of the hourly cost of staff time. Total staff cost is divided by the number of applied (productive) hours, the time spent on activities that involve patient care. Hours on overhead activities such as vacations, sick leave, and professional training are excluded from the count of applied hours. Administrative duties and telephone calls that do not constitute patient care would also be excluded.

This method determines the hourly cost of a worker engaged in productive activities. Implicitly, the cost of vacation, sick leave and other "unproductive" activities is spread across the productive hours of the employee. For more details on measuring the cost of staff time, see Chapter 3 of this Handbook.

In addition to patient care and leave time, clinicians also engage in administrative duties, phone calls, and other activities. When determining the cost of an intervention, the researcher should consider whether any of these activities are taking place because of the intervention. If so, they may be excluded from applied hours and the cost would be distributed using this same method.

Double-counting Costs

Garber et al. (1996) caution against double-counting the patient's costs in a cost-effectiveness analysis. In particular, one should not count the same cost in the denominator (as a utility change) and in the numerator (as a loss in dollars). Consider a survey that measures patient utility following an intervention. If the survey refers to utility changes *holding income constant*, then the utility change may be assumed to refer only to pain and suffering. But if the survey does not instruct the patient to consider income (or productivity) fixed, then the analyst should assume that the utility change reflects those losses as well. In that case, the loss of income due to the intervention should not be counted separately in the numerator of the cost-effectiveness ratio.

1.5 Micro-cost versus Average Cost Methods

Micro-cost and average-cost methods are not mutually exclusive. In fact, it is often appropriate to use mixed methodologies in the same study. Typically a micro-cost method for estimating the cost of care associated with an intervention is combined with an average-cost

method for finding the cost of other, unrelated care. Of the three micro-cost methods, the most appropriate choice for a particular study will depend on the level of accuracy required and the levels of resources available. Micro-costing methods can be highly accurate but expensive to employ. Average cost methods require less effort but yield cost estimates that may not fully reflect how an intervention affects the resources used in providing care.

The average-cost method is limited by the set of assumptions used to create the averages. When deciding on the optimal method, analysts should consider whether the assumptions are appropriate to utilization data in the study. For example, will the intervention affect the cost of hospitals stays in a way that will not be captured by the DRG or length of stay? Will it affect the cost of ambulatory visits in a way that will not be captured by the relative value units associated with CPT codes? If either of these is true, then average costing may be inappropriate. HERC staff can offer assistance in determining the appropriateness of average cost methods for particular studies.

Micro-costing has limitations as well. The encounter-level claims in the Medical SAS files, the traditional VA source of national utilization data, do not include drug prescriptions. Prescription data must be obtained from other sources such as the proposed DSS Pharmacy Extract or from the Pharmacy Benefits Management database. It is uncertain if the Medical SAS files include all outpatient care, particularly laboratory tests and prosthetic supplies. If these are underreported, then researchers who need an estimate this type of utilization must turn to micro-costing. Some outpatient laboratory tests may be lacking from the Medical SAS files. Gaps may be filled from a review of patient records, from the proposed DSS national laboratory extract, or from the VISTA system. Similarly, data on prosthetics services are kept in the National Prosthetics Patient Database may not be reliably reported in the main inpatient and outpatient utilization datasets.

Chapter 2. VA Cost Datasets

2.1 Introduction

Chapter 1 reviewed the issues to consider when choosing between micro-costing and other costing methods. To perform micro-costing, the analyst must be able to assign costs to elements of the intervention. This chapter gives an overview of the primary databases used to determine the costs of VA care. These include the VA general ledger (FMS), the Cost Distribution Report (CDR), inpatient and outpatient utilization files (Medical SAS files), the Decision Support System National Data Extracts (DSS NDE), and the Pharmacy Benefits Management Version 3.0 (PBM V3.0) database. Brief mention is made of additional sources for assigning costs to physical assets and care provided at non-VA facilities.

Chapter 2 is intended to provide general direction in the choice of data sources. There are separate chapters in this handbook devoted to FMS (Chapter 3) and CDR (Chapter 4). The reader will find in them detailed descriptions of cost-related variables. At the end of each chapter is a sample SAS program for accessing the data files. Additional detail on the DSS National Data Extracts is available in a separate handbook (Yu and Barnett 2002), available from HERC on request. The VA Information Resource Center (VIREC) website also contains information on DSS; see http://www.virec.research.med.va.gov. Pharmacy data in DSS and in the Pharmacy Benefits Management (PBM) V3.0 database may be found in Smith and Joseph (2002), also available from HERC.

Table 2.1 provides a quick guide to the types of data available in four primary sources: FMS, CDR, DSS National Data Extracts, and the PBM V3.0 database. The cost elements are divided into three categories: all costs, staff costs, and pharmacy costs. *All costs* refers to total spending by VA for all aspects of care, including procedures, medications, staff time, and overhead. *Staff costs* covers the wages and benefits of employees. *Pharmacy costs* refers to VA spending for prescription medications.

Each data source identifies costs by time period and facility. Facilities are identified by a three-digit station identification number. In some cases, subdivisions of a facility may be identified through a five-digit code that consists of the three-digit station ID followed by two additional digits. For example, the VA Palo Alto Healthcare System has the station ID '640.' This number applies to all of its divisions, including Palo Alto, Menlo Park, and Livermore. VA could choose to distinguish between the divisions by using a five-digit ID, such as '640A0for Menlo Park, and '640A4' for Livermore. The parent station, Palo Alto, is designated by leaving the extra two digits blank. Five-digit IDs do not exist at every facility and may change over time. As a result, particular care must be exercised in relying on five-digit IDs to distinguish divisions of a single facility.

Table 2.1 Major Sources of VA Cost Data, by Type and Level

	FMS	CDR	HERC Average Cost	DSS NDE	PBM V3.0
ALL COSTS					
Total, by facility and month	Yes	Yes	No	Yes	No
Total, by facility and patient care department	No	Yes	No[8]	No[7]	No
Total, by encounter	No	No	Yes	Yes[1]	No
Encounter components (staff, procedures, prescriptions)	No	No	No	No[2]	No
Overhead costs	Yes	[3]	Yes[9]	Yes	No
STAFF COSTS					
Total, by facility and month	Yes	Yes	No	Yes	No
Total, by profession and month	Yes	No	No	No[4]	No
Overhead costs	Yes	[3]	No	No	No
PHARMACY COSTS					
Total, by facility and month	Yes[5]	Yes	No	Yes	Yes
Total, by facility and day	No	No	No	Yes	Yes
Total, by prescription	No	No	No	No[6]	Yes
Overhead costs	No	No	No	Yes	No
For further details, see:	*Chapter 3*	*Chapter 4*	*Wagner (2001) Phibbs (2002)*	*Yu and Barnett (2002)*	*Smith and Joseph (2002)*

[1] Outpatient visits are summed to include cost of all visits to the same clinic stop on a given day.
[2] Available in DSS production data only. Access to these data is limited and must be obtained separately for each VA facility. IRB approval may be necessary.
[3] Attributed to 11 cost distribution accounts rather than to patient-care departments.
[4] Costs reported in three categories: 'surgery,' 'radiology,' and 'all other.'
[5] See sub-account 2631 (drugs, medications, and chemical supplies)
[6] Available in DSS Pharmacy Extract only.
[7] NDE reports cost by groups of departments; at this writing, a DSS department level extract is being created.
[8] HERC costs are grouped by more than 20 types of cost, representing aggregations of departments
[9] HERC estimates distribute indirect costs reported in CDR in proportion to direct costs.

In the sections that follow, information on FMS, CDR, the utilization files, and DSS is presented by topic:

- Structure and contents
- Use in health research
- Guidelines and programs
- References

Structure and contents describes the structure of the dataset, the variables it contains, the population it covers, and its sources. How the dataset is typically used for economic research is covered in *Use in health research*. In *Guidelines and programs* we describe where to obtain documentation and example programs. We will also note whether instructional materials are available in printed or electronic format. The *References* section will note published studies that have used the respective data sources to estimate VA costs.

Access

CDR, FMS, and DSS datasets are stored at the VA Austin Automation Center. Access to them is gained through a time-share account. Currently these accounts are available only to employees of federal agencies. For VA employees, the request to establish an account is made through the local Information Security Officer (ISO). When establishing an account the user must request access to particular datasets, identified by name and functional task code (FTC). The list of available datasets and corresponding task codes is available from the ISO. Each use of the account accrues a charge. Quarterly billing statements are sent to the user's VA facility administration rather than directly to the user.

PBM V3.0 is created and stored by the PBM Strategic Healthcare Group at the Hines VA Medical Center (Hines, IL). Data extracts are created for users by the PBM staff; direct access to the data is not permitted. In general there is no charge for pilot studies by VA researchers. Some charges will apply to funded studies and to non-VA users. See Chapter 6 for details.

2.2 Financial Management System (FMS)

Structure and contents

The Financial Management System (FMS) is the electronic general ledger for the VA. Its purpose is to track obligations and expenditures by month, quarter and fiscal year. The data are organized according to the following characteristics:

- Month and fiscal year
- VA station
- Cost Center
- Budget Object Code

There is a separate file for each federal fiscal year, which runs from Oct 1st to the following Sept. 30th. Although FMS is updated monthly, researchers should use only the

September files. The September file contains all data for the previous fiscal year. Researchers may obtain a skewed view of costs by using data on partial fiscal years. This is because supply and equipment expenses are higher at the end of the fiscal year, and because partial year reports do not include end-of-year adjustments and reconciliations.

FMS data are reported at the station level, identified by the three-digit variable STA3N. The stations frequently include multiple facilities in a single geographic area. In some cases an additional two-digit code is available to identify data pertaining to the division, the individual location within a station.

Expenditures are further categorized into Cost Centers and Budget Object Codes.[2] A cost center is a VA service, such as the Psychiatry Service, the Nursing Service, and the Chaplain Service. Cost centers are not equivalent to patient care departments. A single service may include people who work in several patient care departments and administrative offices. The Budget Object Code, often called the *sub-account*, identifies the type of expense. Examples include personnel, medical supplies, and some capital. Large capital purchases are accounted for the in VA capital databases, described in Chapter 9.

VA plans to replace FMS with a new system, CoreFLS. Initial testing at two sites has begun. Data will be reported through FMS through the end of FY2004 (September, 2004) according to current plans, after which all stations will convert to CoreFLS.

Use in health research

FMS has several potential uses in cost analyses. It can provide average annual costs of employing personnel in more than 80 job categories, making it a necessary tool for determining costs in some VA clinical trials. (Chapter 3 of this Handbook describes how to use FMS data to determine personnel costs.) Selected supply and capital costs can be determined as well. Using files from multiple years, a researcher can track changes over time in expenditures across VA divisions, VISNs, or other administrative categories.

Guidelines and programs

The original guide to using FMS was volume IV, chapter III of the VA Database Resource Guide, also called the "Blue Books," available on the HERC website (www.herc.research.med.va.gov). While outdated in parts, the volume provides a good explanation of the relation of FMS to its predecessor, CALM.

Chapter 3 of this handbook on micro-cost methods represents a second source of guidelines for using FMS. The appendices include layouts and variable descriptions for the two files of most interest to VA researchers. The Health Economics Resource Center also provides guidance on using FMS data. Sample programs can be provided for common uses of the data.

References

Barnett and Swindle (1997) employed CALM, the predecessor of FMS, to estimate the staffing cost of inpatient substance abuse treatment programs in 1990. The authors used two

[2] Information on expenditures in this Handbook applies to obligations also.

methods of estimating total treatment costs: one that combined staff effort from a survey and CALM estimates of salary costs, and a second based on costs reported in the Cost Distribution Report (CDR), the VA cost allocation report described in the following section. Their results were not sensitive to the source of cost data.

2.3 Cost Distribution Report (CDR)

Structure and contents

The Cost Distribution Report (CDR), sometimes referred to as report RCS 10-0141, documents the use of the VA Medical Care appropriation. It contains estimates of the expenditures for patient care and support departments at each VA medical center.

The CDR contains estimates of expenditures in different patient care departments. It represents a reallocation of the expenditures reported in FMS. The Chief of each service estimates the proportion of staff time and expenditures that were spent in each Cost Distribution Account (CDA). There are CDAs for both patient care and support (overhead) departments.

A single VA medical center is represented by a large number of records in the CDR. Each record represents the cost from a cost center (CC) which has been assigned to a particular Cost Distribution Account (CDA). The CDR reports the total expenditures for each CDA, for personnel, and for all other items. It also reports the number of full-time-equivalent employees. The units of utilization and the cost of a unit of utilization are reported as well, although the workload data are sometimes unreliable.

Use in health research

CDR has two primary uses: to find VA expenditures and to determine the average cost of VA healthcare per visit or per time period (day, month, year). CDR is comprehensive, readily accessible, and may accurately represent VA expenditures on a broad scale. Accuracy at the facility level varies, however, due to inconsistent practices in recording data and to the use of service-chief estimates on funds allocations rather than objective data. Studying trends over time using CDR data is hampered by the addition of new cost distribution accounts which have been implemented at different times at different sites. In addition, prior to 1990 CDR cost estimates may have been biased due to a financial incentive within the VA to over-report costs in certain patient care units. In the absence of new service chief estimates, old estimates are carried forward into the future; biases in the CDR may have extended well into the 1990s as well.

References

CDR has been employed in many studies of VA care. As noted earlier, Barnett and Swindle (1997) used CDR to estimate the cost of inpatient substance abuse treatment. More recent studies include Kominski et al. (2001) for mental healthcare and Hughes et al. (2000) for home-based primary care. In a different vein, Carey (2000) uses 1997 CDR data to illustrate a multilevel technique for modeling patient costs.

2.4 Medical SAS Files

Structure and contents

VA researchers often need to know how patients use medical services and procedures. The national VA computer center, the Austin Automation Center (AAC) makes available two primary sets of files containing utilization data: the Medical SAS Inpatient Databases for hospital stays and the Medical SAS Outpatient Datasets for ambulatory services.[3] Tables 2.2 and 2.3 list the files within each of these and highlight some of their pertinent features.

Table 2.2 Characteristics of Medical SAS Outpatient Databases

File Name	First Year	Record Unit	Special Features
SF: Visit File	FY1980	one day	Demographic data
SC: Procedure File	FY1990	one encounter	CPT procedure codes[1]
SG: Diagnosis File	FY1997	one encounter	ICD-9 diagnosis codes
SE: Event File	FY1999	one encounter	Procedures, diagnosis code, and types of providers; will supplant SC and SG files in 2002.

[1]Covered only surgical clinics prior to FY1996.

Table 2.3 Characteristics of Medical SAS Inpatient Databases

	File Name Suffix			Record Unit	First Year
	Acute Care Data	Extended Care Data	Observation Data		
Main File	PM	XM	PMO	one discharge	FY1970
Bedsection File	PB	XB	PBO	one bedsection admission	FY1991
Procedure File	PP	XP	--	one discharge	FY1988
Surgery File	PS	XS	--	one discharge	FY1984

[3] Earlier names for these files include the Patient Treatment File (PTF) and the Outpatient Care File (OPC). The Medical SAS files are derived from the National Patient Care Database (NPCD), and that name is sometimes used as well.

Use in health research

The Veterans Health Administration exists to offer healthcare, and the utilization files are the records of VA's efforts. The files are used for many purposes. In the planning stage of a health services study or clinical trial, the data can reveal the number of potential patients meeting specific diagnosis and/or procedure criteria. Utilization records have been used to study standards of care within the VA system. They also reveal the impact of administrative efforts to reach subpopulations such as women, people with posttraumatic stress disorder, or veterans of the Vietnam era.

Guidelines and programs

The Veterans Affairs Information Resource Center (VIREC) has produced detailed guides to the utilization files. For each file the guides specify the variable names, file layouts, and file names. The guide for outpatient files is The Medical SAS Outpatient Databases – FY2000; for inpatient files it is The Medical SAS Inpatient Databases -- FY2000. They are available in portable document format (.pdf) on the VIREC website (www.virec.research.med.va.gov).

References

The Medical SAS files have long been the primary source of data on VA utilization. Recent publications that have made use of them include evaluations of mobile clinics (Menke and Wray 1999), drug therapy for HIV (Keiser et al. 2001), and a psychogeriatric intervention (Kominski et al. 2001). Other studies have employed utilization data to study cross-system service use (Desai et al. 2001), to determine how race and ethnicity affect VA healthcare (Collins et al. 2002; Dominitz et al. 2002), and to evaluate case-mix adjustment methods (Rosen et al. 2001).

2.5 Decision Support System National Data Extract

Structure and contents

The Decision Support System (DSS) is a set of software and hardware products designed to store and analyze healthcare utilization and cost. Each VA medical center implemented DSS separately, with system-wide implementation achieved in FY 1999. Researchers may use DSS data to investigate inpatient and outpatient care, including prescription-drug use.

The Bedford Technical Support Office (BTSO) has created a series of national-level extracts that combine data from each local DSS system. Table 4 lists the National Data Extracts that are currently available or are planned for delivery in 2002:

Table 2.4 DSS National Data Extract Files

Extract Name	Data Level	First Year*
Discharged inpatients	inpatient encounter (one per stay)	FY1999
Treating specialty	inpatient encounter (one per bedsection per stay)	FY1999
Outpatient	outpatient encounter	FY1999
Account-level budgeter	ALB cost center account (cost and staff hours only)	FY2002
Pharmacy extract	prescription	Proposed for FY2003
Lab test	test	Proposed for FY2003

* Some facilities have data for FY 1998 as well.

A few facilities reported unreliable data in FY 1999, and thus researchers should use extracts from that year with caution. The limited data available from FY 1998 is considered too unreliable for general use. Yu and Barnett (2002) discuss the reliability and coverage of the DSS inpatient and outpatient extracts.

Use in health research

Like the Medical SAS files, the DSS NDE extracts may be used to determine utilization of VA services. Unlike the Medical SAS files, the DSS NDE also includes cost data. Direct and indirect costs are presented separately, allowing users to choose based on their needs.

As documented in Yu and Barnett (2002), the correspondence between the Medical SAS files and the DSS NDE inpatient and outpatient files is not exact. DSS and the Medical SAS files report agree on the number and length of hospital stays, but there is discord with respect to the number of days spent in different wards (bedsections). About 5% of the visits reported in the Medical SAS outpatient files do not appear in the DSS files. DSS files have information on care that is not included in the Medical SAS files. This includes the total cost of all prescription drugs dispensed to outpatients on a given day. HERC staff are conducting research in this area, and researchers are invited to contact HERC for guidance on choosing the most appropriate data source.

Guidelines and programs

There are several sources of information on DSS data. HERC staff have prepared a separate handbook on the use of the DSS NDE (Yu and Barnett 2002). The handbook is available on the HERC website and by request. The VIREC website features a document that explains the goals of the DSS system and offers some explanation of the difference between the local and national extracts. There is no data dictionary for DSS, but users can consult the FY98

and FY99 Medical Records Books for similar information. The URLs for these documents are as follows:

FY1998: http://www.virec.research.med.va.gov/DATABASES/DSS/Fy98book.pdf
FY1999: http://www.virec.research.med.va.gov/DATABASES/DSS/Fy99book.pdf

Although detailed production data reside at the Austin Automation Center, at this writing access to DSS production data requires permission from each individual facility from which data are desired.

References

The use of DSS for cost-related studies is in its infancy. Two articles have been published to date: Hamby et al. (2000), a review of warfarin use at a VA medical center, and Barnett et al. (2002), a cost-effectiveness analysis of selective coronary angiography and revascularization after myocardial infarction. Additional studies using DSS are underway.

2.6 Pharmacy Benefits Management (PBM) V3.0 Database

Structure and contents

The Pharmacy Benefits Management Database Version 3.0 (PBM V3.0) contains information on each outpatient prescription filled by VA. Its primary sources are monthly data submissions from more than 140 VA pharmacies. The PBM Strategic Healthcare Group (SHG) cleans the submitted data and creates additional variables. The final data are stored in database format, rather than the SAS file format typical of data stored at AAC. Data are available for FY 2002 for all VA facilities, and for earlier years at select facilities.

The database includes many characteristics of the prescription, such as fill date, quantity dispensed, dispensing unit, days supplied, and direct cost. An unusual feature is the presence of dosing instructions. The medication is identified by National Drug Code (NDC), VA product name, and VA drug class. For generic agents there may be a single NDC assigned to identical formulations supplied by two or more manufacturers. This is unlikely to cause substantial trouble for researchers, however, because branded medications account for the lion's share of spending. For additional detail on the contents of PBM V3.0, see Smith and Joseph (2002) and the VIREC website (http://www.virec.research.med.va.gov/databases/pbm.htm).

Several expansions to the PBM database are also planned. Although currently only outpatient data are available, a database of inpatient prescriptions is under construction. PBM SHG also expects to release an updated Version 4.0 system during FY2004. The system will provide a wider range of data elements than does Version 3.0.

Use in health research

The PBM V3.0 database is suitable for determining the direct cost of medications dispensed by VA. It does not include any overhead charges or dispensing fees, and so total cost

cannot be determined. The data can be used to assess prescribing practices across facilities, conditions or time.

The method of assigning costs to prescriptions deserves a brief explanation. The primary mission of the PBM SHG is to administer the VA National Formulary process. One aspect of its work is the negotiation of prices for prescription medications. PBM SHG then creates a contract cost file listing the negotiated price of every medication for which a contract exists. In theory, local VA pharmacies consult the most recent price file when assigning a cost to dispensed medications. It is clear from the data they submit that not all pharmacies do so, however. As a result, two pharmacies may assign different costs to identical prescriptions on the same day. Moreover, local pharmacies are not bound to purchase drugs through the formulary system. They have the ability to procure them at market prices as well, and in a few cases this occurs.

One strategy for avoiding these price irregularities is to rely on the contract cost file rather than on the actual costs assigned. Although the contact cost file is updated daily, PBM SHG has maintained an historical file for several years that records each change of contract price for every medication in the National Formulary Process. The historical file is available from the PBM SHG on request.

Access to the PBM V3.0 database is unlike that of other VA databases. All requests to PBM SHG must be accompanied by a research protocol that explains the planned uses of the data. In order to avoid conflicts with its primary mission, PBM SHG does not permit use of PBM V3.0 data for studies whose design appears to favor one or another medication. There is also a fee for data extracts, except those for unfunded VA pilot studies or VA management projects. The fee will depend on the amount of effort needed to create the extract and the time needed, if any, to consult on study design. Potential users of PBM V3.0 should contact PBM SHG staff in advance to learn about current policies.

Guidelines and programs

There is no printed guidebook for using PBM data. The best source for information on the construction of the V3.0 database is the PBM Strategic Healthcare Group. Telephone and address information may be found on its internet site, *http://www.vapbm.org*. The VIREC website features a database dictionary and explanatory essay; see *http://www.virec.research.med.va.gov.databases/pbm.htm*. A comparison of data in the PBM V3.0 and the DSS Pharmacy Extract may be found in a HERC working paper (Smith and Joseph 2002), available on request.

References

The PBM data were only recently made available for public use, and so relatively few studies have been published that take advantage of them. Three related studies that have are Rosenheck et al. (2001) and Leslie and Rosenheck (2001a, 2001b), all of which analyze the use of antipsychotic medications.

2.7 Other Datasets

Allocation Resource Center files

The VA Allocation Resource Center has created files that estimate the cost of health incurred by individual patients. These data represent a measure of workload that is used in the VA budget allocation process. Prior to FY2002, these cost estimates were based on the CDR; cost estimates are now based on DSS data, but the methods used have not been documented. The Allocation Resource Center files stored at AAC do not report the cost of individual healthcare encounters.

Fee Basis Files

The Fee Basis Files report the cost of care provided under contract to VA. There are separate files for inpatient stays, inpatient ancillary services, outpatient care, pharmacy, and travel. While there is some information characterizing hospital stays (in the Non-VA PTF file) little information is available on other types of healthcare reported in these files. Care provided in state veterans' homes and under VA sharing agreements are not reported in these data. The Fee Basis files stored at AAC are listed in table 2.5. The names listed for these files are for FY01; other years' data can be found by substituting the appropriate year for the characters "01".

Table 2.5 VA Fee Basis Files

Type of Data	File name
Hospital stay	MDPPRD.MDP.SAS.FEN.FY01.INPT
Ancillary services provided to inpatients	MDPPRD.MDP.SAS.FEN.FY01.INPT.ANCIL
Outpatient services	MDPPRD.MDP.SAS.FEN.FY01.MED
Payments to pharmacies	MDPPRD.MDP.SAS.FEN.FY01.PHR
Travel expenses	MDPPRD.MDP.SAS.FEN.FY01.TVL
Pharmacy vendors	MDPPRD.MDP.SAS.FEN.FY01.PHARVEN
All other vendors	MDPPRD.MDP.SAS.FEN.FY01.VEN
Veterans receiving long-term fee basis care	MDPPRD.MDP.SAS.FEN.FY01.VET

Fixed Asset Package

The Fixed Asset Package tells the acquisition cost, useful life, depreciation, and undepreciated balance of all VA capital assets. The files are stored at AAC.

Database of VA facilities

The Veteran Administration Site Tracking system (VAST) providers the location and characteristics of VA facilities and contract providers. This file was created by VA Planning Systems Support Group (PSSG) in Gainesville, FL. PSSG's main telephone number is (352) 374-6080.

PAID

The PAID system contains information on VA payroll, with data on the salaries and benefits of individual employees. The information is highly confidential, and it is extremely difficult to gain access to these data.

Chapter 3. Using Data from the Financial Management System (FMS)

3.1 Introduction

The Financial Management System (FMS) contains financial accounting records. It represents a summary of the VA general ledger, similar to a bank checking account statement. FMS data provide a detailed breakdown of VA obligations and expenditures by category, location, and fiscal year.

FMS data are useful for determining total spending at the facility level month-by-month. They also report staffing costs (wages plus benefits), broken down into scores of categories corresponding to different professions. This enables estimation of a typical yearly employment cost (salary plus benefits) by profession and, if desired, by facility. Some typical questions that users might address using FMS data include the following:

- In FY 2000, what was the average compensation of nurses providing direct medical care at the Palo Alto facility?
- Is the ratio of medical care funding to medical research funding consistent across VISNs?
- What was the growth rate in obligations for engineering support over FY 1996-2000?

FMS has limitations as well. The data cannot be used to determine the cost of individual outpatient visits, inpatient stays, or prescription drugs. In many cases there are several facilities under a single VAMC, such as a hospital and outpatient clinics. FMS data do not distinguish facilities within a VAMC with 100% reliability. Finally, because intermediate monthly FMS reports are not reconciled with other VA sources, reliable data for a fiscal year is not available until 2-3 months after the close of the year.

Two FMS data files are of interest to health economic researchers. This chapter describes the contents of these data files and illustrates how to access them. The next section reviews the contents of the files. Section 3.3 provides specific instructions for writing a SAS program to access them, submitting it as a batch job, and retrieving the results. Section 3.4 describes additional resources available to researchers using FMS data. The exhibits provide detailed additional information and a sample program.

FMS replaced the Centralized Accounting for Local Management (CALM) system. The change from CALM to FMS began in FY 1994 and was completed in FY 1996. Although data in CALM have not been converted to FMS format, the two systems have similar structures and contain many of the same variables. Researchers interested in accessing CALM files should also consult Chapter 2 of the *VA Databases Resource Guide*, Vol. IV, Version 2.0 (Beattie *et al*., 1997). A copy may be obtained at the HERC website *www.herc.research.med.va.gov*.

In FY2005, FMS will be replaced by a new financial management system named CoreFLS. Details of its contents are not yet available.

3.2 OBOCE and OBLOE Files

The FMS system contains a host of data files for each month of the fiscal year. Information on obligations, expenditures, and employee hours appear in an easily accessible format in two files: OBOCE (Obligations by Budget Object Code Extract) and OBLOE (Obligations by Organization/Program Extract). The OBOCE file is an extract of the data contained on the F885 (RPEOOCV) Report, while the OBLOE file is an extract of the data contained on the F887 (RPEOOPV) Report. The data files used to create the extracts are shown in Table 3.1, where "yy" refers to the fiscal year.

Table 3.1 OBOCE and OBLOE Source Files in FMS

FMS File	Source File Explanation	Source File Name
OBOCE	Summarized Closed Month General Journal	FMSPRD.FMS.PROD.GDG.CMGJByy
OBOCE, OBLOE	Summarized Year-to-Date General Journal (most recent generation)	FMSPRD.FMS.PROD.GDG.YTDGJByy
OBLOE	Summarized Year-to-Date General Journal (2-3 previous generations)	FMSPRD.FMS.PROD.GDG.YTDGJByy

The contents of OBLOE and OBOCE have considerable overlap. OBLOE contains data on obligations, expenditures, and employee hours for three time periods: the current month, the current quarter, and the fiscal year to date (FYTD). OBOCE has similar FYTD data but lacks current-month expenditures and any current-quarter data.

File layouts for OBLOE and OBOCE appear in Exhibits 3.1 - 3.2 at the end of this chapter. These are followed by a description explanation of the data elements, Exhibit 3.3. The data are in ASCII format and so variable names must be assigned in the SAS INPUT statement. Two sets of variable names are presented. The 'Official Variable Names' appear on the file layout provided by the Austin Automation Center. The same variables often have different names in the two files, however, and so the 'Uniform Variable Names' were created by HERC as suggested alternative names that are consistent across files.

Although their contents overlap, the OBOCE and OBLOE files do not have the same number of observations nor, in many cases, the same mean value or even the same range of values. Discrepancies such as this are common in administrative data and most likely reflect slight differences in accounting procedures rather than errors in data collection.

Time Frame and Location

FMS data are organized by fiscal year, location, and spending category. Separate datasets are created for each fiscal year, and thus two datasets are needed to create a complete data file for a single calendar year. For example, to obtain calendar-year 1998 expenditures one must combine elements of the federal FY1998 and FY1999 FMS datasets.[4] Location is determined by the station number of the VA facility. Spending categories are tracked in FMS files primarily by *cost center*.

Cost Centers

In FMS, expenditures are characterized by cost centers. According to VA Directive 4671, cost center codes "capture cost information for specific offices and organizations" within the VA. They are represented by a four-digit numeric code. Many cost centers correspond to VA services, like "Nursing Service" and "Psychiatry Service." Note that cost centers called "services" are not limited to direct medical care. Cost center 8241 (Nursing Service) reports all costs of employing nurses, regardless of where they are employed in a medical center.

Cost centers are divided into general categories. The range of numbers of VA cost centers of greatest interest for health economics research are these:

8000-8099	Medical administration (central office)
8101-8199	Medical & prosthetics research
8201-8299	Direct medical care at VA facilities
8301-8399	Direct medical care at non-VA facilities

Medical administration includes cost centers for administrative offices and VA services, such as Resource Management Office (8002) and Chaplain Service (8031). Medical research contains about 15 cost centers, including Investigator Salaries (8104) and Cooperative Studies (8107). Examples of direct medical care cost centers at VA facilities are Medical (8201), Surgical (8202), Psychiatry (8203), and Blind Rehabilitation (8245). Cost centers at non-VA facilities represent facility types (Civil Hospitals – 8311), locations (Manila – 8315), military services (U.S. Army – 8321), or provider types (Alcohol and Drug Treatment and Rehabilitation Centers– 8361).

The range of cost centers must be limited when estimating the average compensation of clinical professionals. A health economist who wants to assign a value to VA nurses' time in a clinical trial, for example, should only include cost centers corresponding to direct care in VA facilities (8201-8286).

VA Handbook 4671.11 contains the current list of cost centers. HERC staff can provide instructions on obtaining a copy of that Handbook section.

Sub-accounts (Budget Object Codes)

Data in FMS are also classified by *budget object code* (BOC), often called the *sub-account*. Sub-accounts identify the type of expense, such as personnel, supplies, contract

[4] Federal fiscal years start Oct. 1st and end the following Sept. 30th. FY1998 began in 1997 and ended in 1998.

services, transportation, or capital acquisition. The sub-account ranges of greatest interest to health economics researchers are these:

1001-1099	Personal Services and Benefits
1101-1310	Payroll Analysis Accounts

Personal Services and Benefits divide payroll costs into 80 job categories, such as 'Registered Nurses' and 'Physicians—Full Time.' Payroll Analysis Accounts divide the same payroll costs by type: regular pay, overtime pay, etc. Other sub-account classes cover supplies like prescriptions, blood products, and prosthetics, as well as office machines, furnishings, and medical and scientific equipment.

Costs characterized by single sub-account can be assigned to many cost centers. For example, the sub-account for full-time physicians (1081) will appear under cost centers 8019 (Pathology Service), 8053 (Medical Research Service), 8107 (Cooperative Studies Program), and many others. Calculating a quantity of interest will frequently require summing values from the same sub-account in multiple cost centers. To determine the average annual cost of RNs providing direct care, for example, limit the data to sub-account 1061 (Registered Nurses) and to cost centers 8200-8399 (direct medical care at VA and non-VA facilities). Sum fiscal-year-to-date expenditures (ACREXPYY) and divide by the sum of fiscal-year-to-date hours (QUANTYY) to find the average hourly cost. To find the average annual cost, multiply the hourly cost by 2088.[5]

The current list of sub-accounts is published as VA Handbook 4671.2, available in electronic form on the VA intranet. Selected sub-accounts also appear in this chapter. The Personal Services and Benefits sub-accounts (nos. 1001-1099) are reprinted in the sample SAS program that forms Exhibit 3.4, while the Payroll Analysis Accounts (nos. 1101-1399) appear as Exhibit 3.5.

A small number of records (eight percent in FY2001) contain a *sub-object code*. These provide further detail on the use of funds. The sub-object codes correspond to the last two digits of the Personnel Services and Benefits subaccounts, nos. 1101-1199. For example, both subaccount 1108 and sub-object code 08 refer to wage rate employees. Although 33 different sub-object codes were used in FY2001, three codes constitute 70% of the cases: 01 (administrative personnel not otherwise classified), 02 (clerical personnel), and 11 (Fee Basis - medical and nursing).

Expenditure and Obligation Variables

Six variables are used to represent expenditures and obligations, broken down by time period (current month, current quarter, or fiscal-year-to-date) and by type (expenditures vs. obligation). The six variables all appear in OBLOE, while OBOCE contains only the year-to-date figures. The variables represent the amount of money spent (or obligated) for each

[5] Although 2000 hours/year is a common rule of thumb, 2088 is more accurate. It comes from multiplying the number of weekdays in a year [365 – 52(2) = 261] and multiplying by 8 hours/day: 261*8 = 2088.

combination of facility (STATION), administrative staff/office (XDIVISIO), cost center (COSTCTR), sub-account (BOC), and appropriation code (FUND).

Avoid Double-Counting Payroll

The same payroll data appear twice in the sub-accounts. The "Personal Services and Benefits" sub-accounts (nos. 1000-1099) divide payroll data by job category. The "Payroll Analysis Accounts" (nos. 1101-1310) divide the data by payroll type (regular, overtime, holiday, etc.). **Never combine data from the two ranges of sub-accounts!** For instance, it is tempting to calculate total obligations for one site by simply summing across all cost centers or all sub-accounts for that site. This would overstate obligations, however, by counting payroll twice.

3.3 Accessing FMS Data

FMS files are maintained by AAC and accessed through time-share computer accounts. At present, only Federal government employees are eligible to establish accounts. VA employees may obtain accounts by submitting a time-share application to the local Information Security Office (ISO). The application should request the functional task code relevant to FMS, "104FF10 FMS READ ONLY."

Once an account is established, a user prepares and submits programs that use FMS data. The programs use Job Control Language (JCL) for file handling and SAS to perform statistical procedures. Program outputs can be viewed, saved to the user's account and transferred to other machines via FTP. A sample program is given at the end of this chapter.

Availability

OBLOE and OBOCE files are created soon after the end of each month. Because September is the last month of the fiscal year, only the September files contain fiscal-year-to-date information covering a 12-month period. These files end with the suffix 'SEPyy'. For example, a file with suffix 'SEP00' has monthly figures for September 2000 and year-to-date figures for all of FY2000 (Oct. 1999-Sept. 2000).

The TSO (Time Sharing Option) system may be used to check the availability of OBOCE and OBLOE files. TSO is a computer application that allows users to create, update and store data and command files. TSO may also be used to submit SAS jobs. Users are given access to TSO through the accounts described above.

It is straightforward to use TSO to check the availability of OBOCE and OBLOE files. After logging into TSO, type 'SPF' to reach to the ISPF primary menu, then type '3.4' and press <enter> on the command line. At the next screen type 'FMSPRD.FMS. FMSTODOR. LINK' on the DSName Level field for OBOCE (or 'FMSPRD.FMS.PROD. OBLOE' for OBLOE) and then press <enter>. The list of available files will appear. To browse the raw data, put the letter 'B' to the left of the file name and press <enter>.

Questions about the contents and availability of the OBOCE and OBLOE files should be directed to the Austin Automation Center (AAC). The AAC help desk may be contacted at

(512) 326-6780. Contact information for AAC is available on its website, *www.aac.va.gov*. Questions should be directed to the contact person for FMS. Researchers with access to the AAC Customer Information Guide can find the name and telephone number of the appropriate contact person in section 3.1 (the catalog of applications) under "FMS."

3.4 Obtaining Help with FMS

The VA Health Economics Resource Center (HERC) can provide assistance in framing research questions, selecting appropriate statistical models, and identifying relevant FMS variables. HERC staff are available by telephone through a Help Line (650-617-2630) and by email (herc@med.va.gov). Many topics of research design are also addressed in the FAQs on the HERC website (*http://www.herc research.med.va.gov*).

The Austin Automation Center (AAC) can answer questions on the availability of FMS data files and on how to obtain and use a time-share account to run SAS programs. Contact information for AAC is available on its public website, *www.aac.va.gov*. AAC has also produced a Customer Information Guide. The Guide describes the datasets housed by AAC, lists contact people for each (Chapter 3.1), and includes a time-share request form (Appendix B). Researchers within the VA may access the Guide in electronic format. From the AAC public website, click on the link labeled "AAC Intranet (For Current VA Customers)" and then continue following links for the Customer Guide on successive screens.

Exhibit 3.1 Data Elements in OBOCE File

Variable Description[1]	Uniform Variable Name	Official Variable Name	SAS Variable Type	Length	Position in Raw File
Station	STATION	XORGANIZ	Numeric	5	1-5
Satellite station	SUBSTN	SUBSTN	Numeric	2	6-7
Calendar year[2]	FISCYR	BFYS	Numeric	4	8-11
Appropriation fund	FUND	FUND	Character	4	12-15
Administrative / staff office	XDIVISIO	XDIVISIO	Character[3]	4	16-19
Cost center	COSTCTR	COSTCTR	Character[3]	4	20-26
Sub-account (Budget Object Code)	SUBACCT	BOC	Character[3]	4	27-30
Sub-object code	SUBOC	SUBOC	Numeric	2	31-32
CM obligations ($) *	MTHOBL	DOLAMCM	Numeric[4]	15	33-47
CM employee hours	MTHHRS	QUANTCM	Numeric[5]	8	48-55
FYTD dollars obligated	FYTDOBL	DOLAMYY	Numeric[4]	15	56-70
FYTD employee hours	FYTDHRS	QUANTYY	Numeric[5]	8	71-78
FYTD expenditures	FYTDEXP	ACREXPYY	Numeric[4]	15	79-93

Key: CM = current month YTD=year-to-date FYTD = fiscal-year-to-date

* In the SEP00 dataset all values are zero.

[1] The data are in ASCII format and so variable names must be assigned. Official Variable Names are those that appear on the file layout provided by the Austin Automation Center. Uniform Variable Names are suggested alternative names that are consistent across files.

[2] Year 2000 is coded '00' and appears as '0' in SAS; watch for erroneous values (e.g., '9900')

[3] Use SAS informat ' ?? ' ; variable format is 'nnnn00'

[4] Use SAS informat ZD15.2

[5] Use SAS informat ZD9.2

Exhibit 3.2 Data Elements in OBLOE File

Variable Description[1]	Uniform Variable Name	Official Variable Name	SAS Variable Type	Length	Position in Raw File
Station Code	STATION	STA3N	Numeric	7	1-7
Calendar year [2]	FISCYR	BFYS	Numeric	4	8-11
Appropriation fund	FUND	FUNDCODE	Character	6	12-17
*	XPGMT	XPGMT	Character	9	18-26
Admin / staff office	XDIVISIO	XDIVSN	Character[3]	4	27-30
**	SERVSTN	SERVSTN	Numeric	6	31-37
Station name	STNNAM	SERVSTN	Character	30	38-67
Admin / staff ofc name	XDIVLNAM	XDIVLNAM	Character	30	68-97
Fund name	FUNDSNAM	FUNDSNAM	Character	12	98-109
Program name	XPRGSNAM	XPRGSNAM	Character	12	110-121
Cost center	COSTCTR	COSTORG	Character[3]	6	122-128
**	COSTSORG	COSTSORG	Numeric	2	129-130
Cost center name	COSTNAM	COSTNAM	Character	12	131-142
Sub-account (Budget Object Code)	SUBACCT	BOC	Character[3]	4	143-146
Sub-object code	SUBOC	SUBOC	Numeric	2	147-148
BOC (sub-account) name	BOCSNAM	BOCSNAM	Character	10	149-159
Sub-object code name	SOBJSNAM	SOBJSNAM	Character	12	161-172
CM expenditures ($)	MTHEXP	MONEAMT	Numeric[4]	15	173-187
CM obligations ($)	MTHOBL	MONOAMT	Numeric[4]	15	188-202
CM employee hours	MTHHRS	MONQTY	Numeric[5]	9	203-211
CQ expenditures ($)	QTREXP	QTREAMT	Numeric[4]	15	212-226
CQ obligations ($)	QTROBL	QTROBL	Numeric[4]	15	227-241
CQ employee hours	QTRHRS	QTRHRS	Numeric[5]	9	242-250
FYTD expenditures ($)	FYTDEXP	ACREXYY	Numeric[4]	15	251-265
FYTD obligations ($)	FYTDOBL	DOLAMYY	Numeric[4]	15	266-280
FYTD employee hours	FYTDHRS	QUANTYY	Numeric[5]	9	281-289

Key: CM = current month CQ = current quarter FYTD = fiscal-year-to-date

* Probably unreliable: in the SEP00 dataset more than 35% of values are missing; other values do not appear to follow a consistent format.

** In the SEP00 dataset more than 95% of values are missing or zero.

[1] The data are in ASCII format and so variable names must be assigned. The Official Variable Names are those that appear on the file layout provided by the Austin Automation Center. Uniform Variable Names are suggested alternative names that are consistent across files.

[2] Year 2000 is coded '00' and appears as '0' in SAS; watch for erroneous values (e.g., '9900')

[3] Use SAS informat ' ?? ' ; variable format is 'nnnn00'

[4] Use SAS informat ZD15.2

[5] Use SAS informat ZD9.2

Exhibit 3.3 OBOCE/OBLOE Variable Meanings

Location & Time Variables

STATION: A 3-digit number that uniquely identifies the VA facility.

SATELLITE STATION: A 2-digit number that uniquely identifies subdivisions within a particular STATION. Most values are blank.

FISCYR: The fiscal year associated with the data file. FMS files are organized by fiscal year, and so each file contains data from two calendar years (*e.g.*, 10/01/99 – 09/30/00)

Category Variables

FUND: Specifies the appropriation code fund. This variable has 6 digits in the OBOCE file but only 4 digits in the OBLOE file.

ACC: Contains the Organization / Account Classification Code. All obligated funds have an associated ACC, and spending ceilings are established for them. ACCs replaced the *control points* used in the previous CALM system.

XDIVISIO: Contains the A/O (Administrative Staff/Office) number found on reports. Most records have either '8' (construction) or '10' (medical).

COSTCTR: Cost center that characterizes how funds were used. VA medical care falls under the Veterans Health Administration, which has COSTCTR values 800000-899999.

COSTCTR also includes asset acquisition accounts, which are not cost centers. They refer instead to acquisitions of capital assets during the reporting period. The asset acquisition accounts are distinguished by having non-zero numbers in the last two digits. By contrast, all cost centers in COSTCTR end in '00'.

The list of cost centers is updated periodically. The last full listing was issued in September, 2000, and updated in August, 2001.

BOC: The Budget Object Code. This 4-digit variable classifies the expenditure category below the cost-center level. Note: the Payroll Analysis Accounts (BOC 1100-1399) together represent the same expenditures as the Personal Services and Benefits sub-accounts (BOC 1000-1099). To avoid double-counting, therefore, use either 1100-1399 or 1000-1099 when totaling personnel expenditures, but not both.

SUBOC: An additional 2-digit identifier used for selected sub-accounts. For most values of BOC the SUBOC is missing (blank). The sub-account (BOC) numbers provide sufficient detail for all current uses of these data by VA researchers.

VA Handbook 4671.2 is available on the VA website www.va.gov/PUBL/DIREC/

finance under "VA Handbooks." That Handbook section uses different definitions of BOC and SUBOC: BOC is the first two digits of the account number (10, 20, etc.) while SUBOC is the first four digits (1001, 1002, 2001, etc.). Thus, BOC is a subset of SUBOC. In the definitions above we instead follow the variable names used by Beattie et al. (1994).

Obligation and Expenditure Variables

MTHOBL (QTROBL, FYTDOBL): Total funds obligated for the current month (or quarter, or fiscal-year-to-date) for this record.

MTHEXP (QTREXP,FYTDEXP): Total expenditures for the current month (or quarter, or fiscal-year-to-date) for this record.

MTHHRS (QTRHRS, FYTDHRS): Total employee hours for the current month (or quarter, or fiscal-year-to-date) for this record.

Exhibit 3.4 Sample FMS Program

Calculating FY2000 Hourly Compensation by Job Category (from OBLOE)

Note: replace the top two lines by typing 'JOBCARD' <enter> at the command prompt of the AAC text editor. The output dataset name 'username.SAS.FMS00' must also be replaced; the remaining text need not be changed.

```
// username JOB XXXUNKA8, username,
//   MSGCLASS=I,NOTIFY=&SYSUID
// STEP1 EXEC SAS,SOUT=R,WORK='2500,250'
// IN1    DD DSN=FMSPRD.FMS.PROD.OBLOE.SEP99, DISP=SHR
// OUT1 DD DSN=username.SAS.FMS00,DISP=(NEW,CATLG),
//      UNIT=RMTINT,SPACE=(CYL, (20,5),RLSE)
// SYSIN    DD *

DATA FMS;
INFILE IN1 MISSOVER;
INPUT
 @1  STATION 3.
 @8  FISCYR 4.
 @20 COSTCTR 7.
 @27 SUBACCT 4.
 @56 FYTDOBL ZD15.2
 @71 FYTDHRS ZD8.2

/*  Choose subaccounts and cost centers                                    */
/*   Here we limit the data to VA payroll expenses (SUBACCT between 1000 and 1099)
     for people providing direct medical care (COSTCTR between 8200 and 8299).  */

DATA FMS1;
SET FMS;
  IF (8200 <= COSTCTR <=8299) AND (1000 <= SUBACCT <= 1099);

/* Optional but advisable: Check data quality through descriptive  statistics.   */

PROC UNIVARIATE;
PROC MEANS N MIN MAX MEAN SUM; TITLE "ALL SUBACCTS";


/*      Assign job category labels            */
DATA SALB99;
SET FMS1;
FORMAT JOBNAME $40.0;
IF SUBACCT=1000 THEN JOBNAME="VCS ADMINISTRATION";
IF SUBACCT=1001 THEN JOBNAME="ADMIN PERSONNEL NOC";
```

```
IF SUBACCT=1002 THEN JOBNAME="CLERICAL PERSONNEL";
IF SUBACCT=1007 THEN JOBNAME="COMPUTER OPERS/PROGRAMMERS";
IF SUBACCT=1008 THEN JOBNAME="SALB RATE EMPLOYEES";
IF SUBACCT=1009  THEN JOBNAME="PURCHASE AND HIRE ";
IF SUBACCT=1011  THEN JOBNAME="FEE BASIS – MED/NURSING";
IF SUBACCT=1012  THEN JOBNAME="FEE BASIS - DENTAL";
IF SUBACCT=1013  THEN JOBNAME="FEE BASIS – CONSULTANT/ATTENDANCE";
IF SUBACCT=1014  THEN JOBNAME="RESPIRATORY THERAPIST";
IF SUBACCT=1015  THEN JOBNAME="PHYSICAL THERAPIST ";
IF SUBACCT=1016  THEN JOBNAME="OCCUPATIONAL THERAPIST ";
IF SUBACCT=1017  THEN JOBNAME="OTHER THERAPISTS";
IF SUBACCT=1018  THEN JOBNAME="DIETITIAN ";
IF SUBACCT=1019  THEN JOBNAME="DIETETIC TECHNICIAN ";
IF SUBACCT=1020  THEN JOBNAME="SOC WORKER ";
IF SUBACCT=1021  THEN JOBNAME="SOC WORKER AIDES/TECHNICIAN ";
IF SUBACCT=1022  THEN JOBNAME="RADIOLOGY TECHNOLOGIST ";
IF SUBACCT=1023  THEN JOBNAME="RADIOLOGY TEHNICIAN ";
IF SUBACCT=1024  THEN JOBNAME="PHARMACISTS ";
IF SUBACCT=1025  THEN JOBNAME="PHARMACY TECHNICIAN/AIDE ";
IF SUBACCT=1026  THEN JOBNAME="DENTAL ASST/HYGNST/AIDE/TECHNICIAN";
IF SUBACCT=1027  THEN JOBNAME="PSYCHOLOGY AIDES AND TECHNICIAN";
IF SUBACCT=1028  THEN JOBNAME="AUDIOLOGIST AND SPEECH PATHOL";
IF SUBACCT=1029  THEN JOBNAME="NUCLEAR MED TECHNOLOGIST ";
IF SUBACCT=1030  THEN JOBNAME="NUCLEAR MED TECHNICIANS/AIDE ";
IF SUBACCT=1031  THEN JOBNAME="OTHER HEALTH TECH/AIDE ";
IF SUBACCT=1032  THEN JOBNAME="RECREATION SPECLIST/TECHNICN/AIDE ";
IF SUBACCT=1033  THEN JOBNAME="MED/LAB TECHNOLOGIST ";
IF SUBACCT=1034  THEN JOBNAME="MED/LAB AND PATHOLOGY TECHNICIAN ";
IF SUBACCT=1035  THEN JOBNAME="LAB AIDES AND WORKER ";
IF SUBACCT=1037  THEN JOBNAME="MED MACHINE TECHNICIAN ";
IF SUBACCT=1038  THEN JOBNAME="ORTHOPEDISTS AND PROSTHETIST ";
IF SUBACCT=1039  THEN JOBNAME="PHYSICAL AND HEALTH SCIENCE PROF";
IF SUBACCT=1041  THEN JOBNAME="PHYSICIANS GERIATRICS FELLOW ";
IF SUBACCT=1042  THEN JOBNAME="SPINAL CORD INJURY FELLOW ";
IF SUBACCT=1043  THEN JOBNAME="VA FELLOW AS RWJ CLINICAL SCHOLAR";
IF SUBACCT=1044  THEN JOBNAME="SUBSTANCE ABUSE FELLOW";
IF SUBACCT=1045  THEN JOBNAME="DENTAL GERIATRIC FELLOWS PROGRAM ";
IF SUBACCT=1046  THEN JOBNAME="PSYCHIATRY RESEARCH FELLOW";
IF SUBACCT=1047  THEN JOBNAME="SCHIZOPHRENIA RESEARCH FELLOW";
IF SUBACCT=1048  THEN JOBNAME="AMBULATORY CARE FELLOW";
IF SUBACCT=1049  THEN JOBNAME="NEUROSCI/TRAUMATIC BRAIN INJURIES";
IF SUBACCT=1051  THEN JOBNAME="TRAINEE--ALLIED HEALTH";
IF SUBACCT=1052  THEN JOBNAME="INTERDISC TEAM TRAIN IN GERIATRICS";
IF SUBACCT=1053  THEN JOBNAME="GERIATRICS EXPANSION";
IF SUBACCT=1054  THEN JOBNAME="SUMMER TRAINEE ";
IF SUBACCT=1056  THEN JOBNAME="TRAINEES--ADMIN TRAINING PROGRAM ";
IF SUBACCT=1060  THEN JOBNAME="SUMMARY NURSING SUBOCS 1061-1069";
IF SUBACCT=1061  THEN JOBNAME="REGISTERED NURSE ";
IF SUBACCT=1062  THEN JOBNAME="ADMIN NURSE TRAINEE";
IF SUBACCT=1063  THEN JOBNAME="NURSE ANESTHETIST";
```

```
IF SUBACCT=1064  THEN JOBNAME="NURSE PRACTITIONER ";
IF SUBACCT=1065  THEN JOBNAME="LPN AND LVN";
IF SUBACCT=1066  THEN JOBNAME="NURSING AIDES AND ASSISTANT ";
IF SUBACCT=1067  THEN JOBNAME="CLINICAL NURSE SPECIALIST";
IF SUBACCT=1069  THEN JOBNAME="WOC NURSES WITH QS&L";
IF SUBACCT=1071  THEN JOBNAME="DENTIST - FULL TIME";
IF SUBACCT=1072  THEN JOBNAME="DENTIST - PART TIME";
IF SUBACCT=1073  THEN JOBNAME="DENTIST RESIDENT,NONCAREER ";
IF SUBACCT=1074  THEN JOBNAME="EXPANDED DENTAL AUXILIARY ";
IF SUBACCT=1077  THEN JOBNAME="PODIATRY RESIDENT ";
IF SUBACCT=1078  THEN JOBNAME="W/OUT COMP EMPLOYEES WITH QS&L ";
IF SUBACCT=1079  THEN JOBNAME="PODIATRIST ";
IF SUBACCT=1081  THEN JOBNAME="PHYSICIAN--FULL TIME";
IF SUBACCT=1082  THEN JOBNAME="PHYSICIAN--PART TIME ";
IF SUBACCT=1083  THEN JOBNAME="PHYSICIAN--RESIDENT, NONCAREER ";
IF SUBACCT=1084  THEN JOBNAME="PHYSICIAN ASSISTANT ";
IF SUBACCT=1085  THEN JOBNAME="CLIN/COUNS PSYCHOL NOT CONSULT/ TRAINEE";
IF SUBACCT=1087 THEN JOBNAME="PSYCHOL/PHYSICIAN/DENT RES ASSOC";
IF SUBACCT=1088  THEN JOBNAME="OPTOMETRY RESIDENT ";
IF SUBACCT=1089  THEN JOBNAME="OPTOMETRIST ";
IF SUBACCT=1091 THEN JOBNAME="FED SUMMER YOUTH EMPLOYMT/SUMR AIDE";
IF SUBACCT=1092  THEN JOBNAME="STAY-IN-SCHOOL PROGRAM / PT-TIME ";
IF SUBACCT=1094  THEN JOBNAME="EMPLOYEE COMP PYMTS (CENT OFC ONLY)";
IF SUBACCT=1095  THEN JOBNAME="SALARY CONTINUATION";
IF SUBACCT=1096  THEN JOBNAME="SICK LEAVE PEND DISAB RETIREMNT ";
IF SUBACCT=1097  THEN JOBNAME="UNEMPLOYMENT COMPENSATION”;

/* Sort data and summarize by subaccount and year        */

PROC SORT; BY SUBACCT;
PROC SUMMARY NWAY DATA=SALB99;
    VAR FYTDOBL FYTDHRS;
         BY SUBACCT;
     OUTPUT OUT=SUM99 MEAN= MOBLS MHOURS MFISCYR
         SUM=SOBLS SHOURS SFISCYR;
     ID JOBNAME;

/* Calculate avearge salary+benefits per hour (HRSALB) and per year  (ANNSALB) */

DATA SALBFIN;
SET SUM99;
IF SHOURS NE . THEN DO;
         HRSALB=SOBLS/SHOURS;
END;
ANNSALB = HRSALB*2088;            /* USE 2096 FOR LEAP YEARS */
LABEL HRSALB=”HOURLY COST OF SALARY & BENEFITS”
    ANNSALB=“ANNUAL COST OF SALARY & BENEFITS”;
FORMAT HRSALB ANNSALB dollar14.2;

/* Print subaccount, hourly compensation, total obligations and total hour amount by year and
```

```
   subaccount.    */

PROC PRINT;
  VAR SUBACCT HRSALB SOBLS SHOURS;
  SUM SOBLS;
  TITLE 'ALL SUBACCTS BY YEAR';

/* Print subaccount, job label, salary+benefits, and annual wage with some outlying values omitted.
Note that this eliminates some job categories.      */

PROC PRINT;
  VAR SUBACCT JOBNAME HRSALB ANNSALB;
  WHERE (1 LE HRSALB LE 1000);
  TITLE 'Subaccounts by year where mean hourly salary+benefits is in the range [$1, $1000] ';
```

Exhibit 3.5 Budget Object Codes for FMS

11 Personnel Compensation.

1101 Regular Pay (Includes merit pay).

1102 Night Differential Pay.

1103 Holiday Pay.

1104 Overtime Pay.

1105 Terminal Leave Pay.

1106 Post Differential (Manila only).

1107 Premium Pay on an Annual Basis (Standby).

1108 Sunday Premium Pay.

1109 On Call Pay.

1110 Special Pay Part-time Dentists.

1111 Special Pay Full-time Dentists.

1112 Special Pay Part-time Physicians.

1113 Special Pay Full-time Physicians.

1114 Deactivated, Fiscal Year 2000. (Use BOC 1128).

1115 Senior Executive Service Bonus.

1116 Re-employed Annuitants, Reimbursement to the Civil Service Retirement and Disability Fund for Re-employed Annuitants.

1117 Saturday Premium Pay.

1118 Premium Pay in Lieu of Overtime.

1119 Employee Special Pay.

1120 Geographic Pay.

1121 Recruitment Bonus.

1122 Retention Allowance.

1123 Hazard Pay Differential.

1124 Staffing Differential.

1125 Supervisory Differential.

1126 Relocation Bonus.

1127 Physicians Comparability Allowance.

1128 Incentive Awards, Cash or Non-Cash.

1129 Foreign Language Awards: Limited to law enforcement officers (LEOs).

1130 Locality Pay.

1131 Credit Reform. (VACO use only).

1132 Advanced Federal Employees Health Benefits (AFEHB). Includes employee's share of Advanced Federal Employees Health Benefits (FEHB). For employees in an insufficient or non-pay status, the employee's share will be charged as a salary advance to the employee.

1133 Employees Award Program - Residents, Fee Basis, Without Compensation (WOC) and Purchase and Hire. The definition of an employee as set forth in 5 U.S.C. Section 2105(a)(1) includes individuals in the civil service appointed by the President, a member of congress, a member of a uniformed service or an individual who is an employee under section 2105(a)(1), among others. Also includes formal appointments as WOC employees under VA's Voluntary Service program, manual 38 U.S.C. 4114 (now 7405), and VA Handbook 1620.1/1, paragraph 3a. All individuals appointed must be engaged in the performance of a Federal function and remain under VA supervision and control. Individuals who do not meet the definition of an employee and may not participate in the VA Employee Recognition and Awards Program are as follows: (1) Voluntary service from students, VA Manual MP-5, Part 1, Chapter 300(4C), and (2) Fee Basis employees hired through the contract authority of 38 U.S.C. Section 513.

12 Personnel Benefits.

1201 Benefits, Canteen Service.

1203 Quarters, Subsistence, and Laundry (QS&L) Allowances Provided Without Compensation (WOC) Employees.

1204 Office of Workers' Compensation Program Payments.

1205 Uniform Allowances.

1206 Severance Pay (Manila only).

1207 Unfunded Post Retirement Pension Expense - CSRS.

1208 Subsistence and Temporary Miscellaneous Moving Expenses.

1209 Real Estate Costs.

1210 Relocation Income Tax & [Federal/State] Withholding Tax.

1211 Unfunded Post Retirement Other Retirement Benefits (ORB) Expense, Federal Employee Health Benefit (FEHB).

1212 Federal Employees Life Insurance Fund - VA Contributions (FELIF).

1213 Unfunded Post Retirement Other Retirement Benefits (ORB) Expense, Federal Employee Group Life Insurance (FEGLI).

1214 Employers Tax, Old Age Survivors Disability Insurance (OASDI).

1216 Civil Service Retirement Fund - VA Contributions.

1218 Federal Employees Health Benefits - VA Contributions.

1219 Living Allowances and Educational Assistance.

1220 Medicare - VA Share.

1222 Federal Employees Retirement System (FERS) - Regular.

1223 Federal Employees Retirement System (FERS) - Special, includes firefighters.

1224 Federal Employees Retirement System (FERS) - Thrift.

1225 Fee Basis - OASDI - VA Share.

1226 Fee Basis - Medicare - VA Share.

1227 Changes in Actuarial Federal Employee Compensation Act (FECA) Liability Expense. (VACO Station #150 use only).

1228 Accrued Federal Employee Compensation Act (FECA) Expenses. (VACO Station #150 use only).

1229 Accrued Annual Leave Expense. (VACO Station #150 use only).

1285 Transit Subsidy. (Office of Federal Housing Enterprise Oversight (OFHEO) Includes fees for metro tickets for OFHEO.

13 Benefits for Former Personnel.

1301 Severance Pay, Public Law 89-301.

1302 Unemployment Compensation Payments.

1303 Voluntary Separation Incentive.

1304 Other Benefits.

Chapter 4. Overview and Update of the VA Cost Distribution Report

The Cost Distribution Report (CDR) documents the use of the VA Medical Care appropriation. It contains estimates of the expenditures for patient care and support departments at each VA medical center. It is the only comprehensive source of historical information on patient care services funded by VA. The CDR is sometimes referred to as report RCS 10-0141. It will be supplanted by the much more accurate information contained in the financial databases of the Decision Support System (DSS).

Until DSS is fully implemented, CDR has several useful applications. It can be used to find VA expenditures by program. It can also be used to find the average cost of healthcare, for example, the average cost of a day of stay in a long-term care unit, or the average cost per outpatient psychiatric visit

CDR Advantages

The CDR has a number of advantages. It is reconciled to the VA general ledger, so that it is an accurate representation of expenditures of the VA medical care appropriation. It covers all medical centers, it is available for a number of years, and it is easily accessed at the Austin Automation Center. At this writing, CDR files are available back to the fiscal year ending 9/30/1989 to the fiscal year ending 9/30/2001. A tabulation of costs reported in each Cost Distribution Account in the CDR is available from the Health Economics Resource Center.

CDR Restrictions

CDR also has several drawbacks. CDR is based on service chief estimates of how funds are used, and may not be completely accurate. At some facilities, utilization and cost are not reported in a way that is consistent, leading to erroneous estimates of unit healthcare costs. If service chief estimates are not updated, prior allocation estimates are carried forward. As a result, the CDR may be slow to reflect changes in resource allocation. The accounts used in the CDR have been repeatedly revised and renamed, as have the fields in VA utilization databases. Facilities have implemented these changes at different times, introducing a potential source of error. These changes make it difficult to analyze trends.

Older CDR data are subject to a more serious problem. When VA set facility budgets under the Resource Allocation System (before 1990) facilities had an incentive to report higher costs in certain patient care units, such as the nursing home. This is likely to have biased cost estimates, and this bias may have been carried forward into the years after the allocation system was no longer used.

4.1 Source of Expenditure Data in CDR

VA keeps careful track of its expenditures in a general ledger, called the Financial Management System (FMS). FMS tracks expenditures by *cost center*, or VA service. These services are administrative entities that do not necessarily correspond to a patient care

department. For example, Cost center 241, Nursing, reports all costs of employing nurses, regardless of where they are employed in the medical center.

The Cost Distribution Report (CDR) is an estimate of the expenditures in different patient care departments. It results from a reallocation of the expenditures reported FMS. The Chief of each service estimates the proportion of staff time and expenditures that were spent in each Cost Distribution Account (CDA). There are CDAs representing patient care and support (overhead) departments. The service chief estimates allow the distribution of costs reported in FMS cost centers to CDR cost distribution accounts.

4.2 Structure of CDR Records

The CDR reports expenditures of a single VA medical center as a large number of database records. Each record represents the cost from a cost center (CC) that are assigned to a particular Cost Distribution Account (CDA). The CDR reports the total expenditure of each CDA, as well as expenditures for personnel and all other items. It also reports the number of full-time equivalent employees. In addition, the units of utilization, and the cost of a unit of utilization are reported, however, the workload data are sometimes unreliable.

Cost Centers

The CDR uses the same cost centers that are employed by FMS. These represent the cost of approximately 82 services with the Veterans Health Administration. Examples of cost centers include: Medical (Cost Center 201), Laboratory (223), Pharmacy (224), Nursing (241), Office of Director (401), Supply (441), Plant Operations (511), and Canteen (632). Cost centers represent the way that funds are tracked in the FMS.

Cost Distribution Accounts

The Cost Distribution Account (CDA) represents an estimate of the way that funds are actually used. CDAs include direct cost accounts of patient care departments. Examples are General Medicine Inpatient (Cost Distribution Account 1100), Surgical Intensive Care (1211), Psychiatry Inpatient (1310), Nursing Home (1410), Medicine Ambulatory Care (2110), and Dialysis (2410).

Table 4.1 Type of Indirect Cost reported in the Cost Distribution Report

Indirect Cost Type	Indirect Cost Accounts
Education	.11, .12, .13, and .14
Research	.21 and .22
Administrative support	.30
Building management	.40
Engineering	.50
Equipment depreciation	.70
Building depreciation	.80

There are also CDAs to report the indirect costs of providing patient care. There are 11 types of Indirect Cost Accounts in the CDR. These are distinguished by numbers to right of decimal place. Table 4.1 gives the types of indirect cost.

These indirect costs are assigned to twelve groups of CDAs. For example, there are indirect cost accounts for inpatient medicine CDAs, inpatient surgery CDAs, and psychiatry CDAs. Each of the twelve groups may have as many as 11 type of indirect cost, and so a medical center may have as many as 121 indirect cost accounts.

The indirect costs are not distributed to individual CDAs. For example, the CDR assigns indirect cost to the group of inpatient medicine CDAs, but it does not distinguish the indirect cost of each of the 7 direct cost CDAs in this group. Thus it is not possible to tell the indirect costs associated with General Medicine or Medical Intensive Care; these costs are reported together as the indirect cost of inpatient medicine.

Cost Centers vs. Cost Distribution Accounts

The analyst should be aware that a cost-center is an administrative designation about how funds were tracked, and does not indicate how funds were actually used. For example, not all costs reported in the Dialysis Cost Center are assigned to the Dialysis Cost Distribution Account. Some of the cost of this Cost Center might be distributed to the Outpatient Medicine Cost Distribution Account. This could occur if staff, say the MD Nephrologist, is assigned to the Dialysis Service. Although her salary is reported in the Dialysis Cost Center, the cost of time she spends in the renal clinic are assigned to Outpatient Medicine, CDA account 2110. There is probably very little to be gained by analyzing expenditures by Cost Centers within Cost Distribution Account.

Sub-Accounts

There are two versions of the CDR. These are the Detail Report and the Jurisdictional Report. The Jurisdictional Report includes a sub-account field that distinguishes categories of cost. The Detail Report doesn't report cost by sub-account, but it does include the cost of the depreciation of buildings and equipment, information that does not appear in the Jurisdictional Report.

The CDR sub-Account provides some additional detail about expenditures. There are 14 types of sub-account; most VA costs appear in three accounts: Registered Nurses (Sub-account 1061), Physicians (1081), and all other (0000). Other sub-accounts track the cost of different types of contracts, education, blood products, and prosthetics. The sub-account field can be used to find the cost of physician or registered nurses by CDA.

Units and Unit Costs

Both versions of the CDR include fields for units of work, and unit costs. The unit field in CDR is a measure of workload produced. For example, for inpatient CDAs, it is the number of days of stay; for outpatient CDAs, it is the number of clinic stops visited. A few CDAs use neither visits nor days as the unit of measure (see the CDR handbook). The units of work reported in the CDR do not exactly match amount of care reported in VA utilization files.

Great care must be used in employing the units field in the CDR. For a given medical center, the CDR has multiple records for each CDA (one for each cost-center, or, in the Jurisdictional file, one for each cost-center sub-account combination). We add these records together to find the total expenditure on the activities in a CDA. Records should not be added together to find units of work in the CDA, however. Every record from a given medical center with same CDA has the same value, the total units of workload for the CDA. The analyst should not add these records together to find the total number of units of workload.

The CDR also reports a unit cost for the facility, for its peers, and a national unit cost. This is the average cost of providing a unit of workload in this cost distribution account. The unit cost is the cost reported in this cost center in this cost distribution account, divided by the number of unit of workload provided in this CDA:

$$\frac{\text{cost in one cost center in one CDA}}{\text{units of workload in the CDA}}$$

Records need to be added together to find the unit cost for a CDA.

There are problems with the unit cost field, however. At some sites, there is an imperfect match between workload and expenditures. In some cases, there is no workload reported in a CDA. Since the cost cannot be divided by zero, the designers of the CDR decided to report unit cost as zero. This excludes the cost of this site from the calculation of unit cost. It is also likely that some workload is never reported in the CDR. We believe that some sites allocate workload to a CDA where they have not reported any costs. It appears that such workload is dropped, as there are no records in the CDR with utilization and no cost.

4.3 CDR Documentation

VA documented CDR with the CDR handbook. The most recent version of the handbook, issued in 1996, is available form HERC. The CDR is also documented in Volume IV of the VA databases resource guides, (also called the Blue Books). This book is available from the HERC website (www.herc.research.med.va.gov).

The CDR files at the Austin Automation Center are text files that must be read into a database program to be manipulated. The key files are the detail file (RMTPRD.SYS.CDR.DETAIL.EOY01) and the jurisdictional file (RMTPRD.SYS.CDR.JURIS.EOY01). SAS programs for reading these files appear at the end of this chapter in Exhibit 4.3.

The analyst should ordinarily exclude the 9000 series CDAs. This series of accounts reports the cost of AIDS care that is already reported in other CDAs. These estimates of the cost of AIDS care are of themselves of doubtful accuracy. An analysis should never includes both the 9000 series CDAs and additional CDAs, as this would double-count cost.

The analyst should use the End of Year (EOY) file. The CDR is updated each month, but these monthly files should be avoided. There are interim results that aren't reconciled to FMS.

Unit Cost Estimates

It is recommended that analysts not rely on the fields for units of workload or unit costs. More reasonable estimates of average costs will be found by finding utilization data from the Medical SAS files, the Patient Treatment File (PTF) and the Outpatient Care File (OPC). National average costs are available for groups of inpatient and outpatient CDAs (which we call categories of care) from the Health Economics Resource Center

The analyst should proceed with caution in determining costs at facility level. A detailed analysis of the accuracy of unit cost data can be found at the website of the Allocation Resource Center.

A discussion of the limitation of the CDR can be found in a special supplement to Medical Care on VA databases. In particular, see Swindle et al. (1996).

4.4 Update to CDR Documentation.

The CDR has changed since the most recent documentation was completed. New Cost Distribution Accounts (CDAs) have been added to the CDR, to correspond to the new bedsections and clinic stops that have been added to VA utilization databases.

We are unaware of any written policy that describes the relationship between the new bedsections added to the Patient Treatment File (PTF) and the new inpatient CDAs that have been added to the CDR. This relationship is implicit in the way data are recorded in the PTF, however. The PTF characterizes the type of inpatient care by the "bedsection" (BESECN) associated with that portion of the stay. It also reports the cost distribution report CDA associated with the bedsection, in a variable called BEDCDR. There is an exact relationship between BEDSECN and BEDCDR. Each BEDSECN is associated with a particular BEDCDR, or cost distribution account (see Exhibits 4.1 and 4.2).

VA has also created new Clinic Stops and new outpatient CDAs. The relationship between clinics and outpatient CDAs is defined in VA policy. The most recent version of that policy is "Fiscal Year 2000 Decision Support System (DSS) Outpatient Identifiers. VA Directive 2000-009. March 3, 2000". A copy of this policy is available from HERC, as is a spreadsheet that lists VA clinic stops (now called DSS identifiers) and the corresponding outpatient CDAs.

Additional specific techniques for working with the Cost Distribution Report can be found in the HERC manuals on average cost datasets, and in a working paper.[6] They describe the handling of facility mergers, the distribution of Indirect Cost CDAs, merging CDR cost data with utilization files, the need to aggregate reporting categories, how to handle matches that are difficult, and how to handle facilities without patient care. It also describes techniques for matching CDR cost data, which represent activities that occur in a particular fiscal year, with data on inpatient stays, which sometimes cross fiscal years.

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[6] For Phibbs et al. (2001) concerning outpatient data and Wagner et al. (2001) for inpatient data. Both publications are available on the HERC website, *www.herc.research.med.va.gov*. The working paper is Barnett et al. (2000), available from HERC on request.

Exhibit 4.1 Inpatient Bedsections Grouped by Corresponding Cost Distribution Account

Bed section Number	Bedsection Name	Cost Distribution Account	Bed section Number	Bedsection Name	Cost Distribution Account
2	CARDIOLOGY	1110.00	59	UROLOGY	1210.00
3	PULMONARY TB	1110.00	60	ORAL SURGERY	1210.00
4	PULM NON-TB	1110.00	61	PODIATRY	1210.00
5	GERONTOLOGY	1110.00	62	PERIPHERAL VASCULAR	1210.00
6	DERMATOLOGY	1110.00	65	SURGICAL OBS	1210.00
7	ENDOCRINOLOGY	1110.00	63	SURGICAL ICU	1211.00
8	GASTROENTEROLOGY	1110.00	70	ACUTE PSYCH	1310.00
9	HEMATOLOGY/ONCOLOGY	1110.00	71	LONG-TERM PSYCH	1310.00
14	METABOLIC	1110.00	76	PSYCH MED INFIRM	1310.00
15	GEN(ACUTE) MED	1110.00	93	HI INT GEN PSCH-INP	1310.00
16	CARDIAC STEP DOWN	1110.00	94	PSYCHIATRIC OBS	1310.00
17	TELEMETRY	1110.00	92	PSYC-GENERAL INTER	1311.00
24	MEDICAL OBSERVATION	1110.00	84	PSY SA (INTER CARE)	1312.00
83	RESPITE CARE	1110.00	72	ALCOH DEPEND-HI INT	1313.00
10	NEUROLOGY	1111.00	73	DRUG DEPEND-HI INT	1313.00
20	REHAB MEDICINE	1113.00	74	SUBS ABUSE-HI INT	1313.00
41	REHAB MEDICINE OBS	1113.00	79	SPEC INP PTSD UNIT	1314.00
11	EPILEPSY CENTER	1114.00	91	EVAL/BRF TRMT PTSD	1315.00
21	BLIND REHAB	1115.00	89	STAR I,II,&III PGMS	1316.00
22	SPINAL CORD INJ	1116.00	33	GEM PSYCHIATRY	1320.00
23	SCI OBSERVATION	1116.00	80	NURSING HOME CARE	1410.00
12	MEDICAL ICU	1117.00	81	GEM NHCU	1420.00
31	GEM ACUTE MEDICINE	1120.00	85	DOMICILIARY	1510.00
35	GEM REHAB	1120.00	86	DOM SUBSTANCE ABUSE	1511.00
50	SURGERY (GEN)	1210.00	88	DOM PTSD	1512.00
51	GYNECOLOGY	1210.00	40	INTERMEDIATE MED	1610.00
52	NEUROSURGERY	1210.00	32	GEM INTERMEDIATE	1620.00
53	OPTHALMOLOGY	1210.00	25	PSYC RES REHAB TRMT	1711.00
54	ORTHOPEDIC	1210.00	26	PTSD RES REHAB PGM	1712.00
55	EAR,NOSE&THROAT	1210.00	27	SUB ABUSE RES REHAB	1713.00
56	PLASTIC SURGERY	1210.00	28	HCMI CWT/TR	1714.00
58	THORACIC SURGERY	1210.00	29	SA CWT/TR	1715.00

Exhibit 4.2 Inpatient Bedsections and Cost Distribution Accounts, by Bedsection Number

Bed section Number	Bedsection Name	Cost Distribution Account	Bed section Number	Bedsection Name	Cost Distribution Account
2	CARDIOLOGY	1110.00	62	PERIPHERAL VASCULAR	1210.00
3	PULMONARY TB	1110.00	63	SURGICAL ICU	1211.00
4	PULM NON-TB	1110.00	65	SURGICAL OBS	1210.00
5	GERONTOLOGY	1110.00	70	ACUTE PSYCH	1310.00
6	DERMATOLOGY	1110.00	71	LONG-TERM PSYCH	1310.00
7	ENDOCRINOLOGY	1110.00	72	ALCOH DEPEND-HI INT	1313.00
8	GASTROENTEROLOGY	1110.00	73	DRUG DEPEND-HI INT	1313.00
9	HEMATOLOGY/ONCOLOGY	1110.00	74	SUBS ABUSE-HI INT	1313.00
10	NEUROLOGY	1111.00	76	PSYCH MED INFIRM	1310.00
11	EPILEPSY CENTER	1114.00	79	SPEC INP PTSD UNIT	1314.00
12	MEDICAL ICU	1117.00	80	NURSING HOME CARE	1410.00
14	METABOLIC	1110.00	81	GEM NHCU	1420.00
15	GEN(ACUTE) MED	1110.00	83	RESPITE CARE	1110.00
16	CARDIAC STEP DOWN	1110.00	84	PSY SA (INTER CARE)	1312.00
17	TELEMETRY	1110.00	85	DOMICILIARY	1510.00
20	REHAB MEDICINE	1113.00	86	DOM SUBSTANCE ABUSE	1511.00
21	BLIND REHAB	1115.00	88	DOM PTSD	1512.00
22	SPINAL CORD INJ	1116.00	89	STAR I,II,&III PGMS	1316.00
23	SCI OBSERVATION	1116.00	91	EVAL/BRF TRMT PTSD	1315.00
24	MEDICAL OBSERVATION	1110.00	92	PSYC-GENERAL INTER	1311.00
25	PSYC RES REHAB TRMT	1711.00	93	HI INT GEN PSCH-INP	1310.00
26	PTSD RES REHAB PGM	1712.00	94	PSYCHIATRIC OBS	1310.00
27	SUB ABUSE RES REHAB	1713.00			
28	HCMI CWT/TR	1714.00			
29	SA CWT/TR	1715.00			
31	GEM ACUTE MEDICINE	1120.00			
32	GEM INTERMEDIATE	1620.00			
33	GEM PSYCHIATRY	1320.00			
35	GEM REHAB	1120.00			
40	INTERMEDIATE MED	1610.00			
41	REHAB MEDICINE OBS	1113.00			
50	SURGERY (GEN)	1210.00			
51	GYNECOLOGY	1210.00			
52	NEUROSURGERY	1210.00			
53	OPTHALMOLOGY	1210.00			
54	ORTHOPEDIC	1210.00			
55	EAR,NOSE&THROAT	1210.00			
56	PLASTIC SURGERY	1210.00			
58	THORACIC SURGERY	1210.00			
59	UROLOGY	1210.00			
60	ORAL SURGERY	1210.00			
61	PODIATRY	1210.00			

Exhibit 4.3 Programs to Read CDR Data

Note: text in **boldface** will differ depending on the fiscal year chosen.

Program 1: Reads the 2001 Detail File (creates file called RMTPRD.username.SAS.CDR01)

```
// username JOB  TSO01C18,S640PGB,
//    NOTIFY=&SYSUID,MSGCLASS=I
//STEP1   EXEC SAS
//IN1 DD DSN=RMTPRD.SYS.CDR.DETAIL.EOY01,DISP=SHR
//OUT1  DD DSN=RMTPRD.username.SAS.CDR01,DISP=(NEW,CATLG),
//          SPACE=(CYL,(50,10),RLSE),UNIT=RMTINT
//MAINFILE DD DSN=MDPPRD.SYS.SAS.NAT.LIB.MAINFILE,DISP=SHR
//LIBRARY  DD DSN=MDPPRD.MDP.FMTLIB6,DISP=SHR
//SYSIN    DD *

OPTIONS NOCENTER
       LS = 130
       PS=500
       NOCENTER;
    * OPTIONS OBS=100

DATA OUT1.CDR01;
INFILE IN1 MISSOVER;
INPUT GROUP        1-2
     REGION       3-4
     DIST         5-6
     STA3N        7-9
     STA5      $  7-11
     FY          12-13
     ACCTNO      14-19
     ACCTNAME  $ 20-39
     CC          40-42
     CCNAME    $ 43-62
     FTE        PD5.2
     PSCOST     PD8.2
     OTHCOST    PD8.2
     TOTCOST    PD8.2
     UNITS      PD7.
     UNITFAC    PD5.2
     UNITDEPT   PD5.2
     UNITGRP    PD5.2;
FORMAT FTE 5.2;
FORMAT PSCOST 10.2;
FORMAT OTHCOST 10.2;
FORMAT TOTCOST 10.2;
FORMAT UNITS 6.0;
FORMAT UNITFAC 5.2;
FORMAT UNITGRP 5.2;
FORMAT UNITDEPT 5.2;
  ACCT=INT(ACCTNO/100);
  ACCTNO=ACCTNO/100;
```

```
  IF 1000 < ACCTNO < 9000; * Exclude redundant AIDS cost distribution accounts;
 TITLE "NATIONAL TOTAL BY ACCOUNT FOR CDR DETAIL FOR FY 01";
 PROC SUMMARY NWAY;
  VAR TOTCOST;
  CLASS ACCTNO ACCTNAME;
  OUTPUT OUT=TOTAL SUM=;

 PROC PRINT NOOBS;
  VAR ACCTNO ACCTNAME TOTCOST;
  FORMAT TOTCOST 16.0;
  SUM TOTCOST;
```

Program 2: Reads the 2001 Jurisdictional File (creates file called RMTPRD.username.SAS.CDR01J)

```
//username JOB  XXXUNKA8,username,
//    NOTIFY=&SYSUID,MSGCLASS=I
//STEP1   EXEC SAS
//IN1 DD DSN=RMTPRD.SYS.CDR.JURIS.EOY01,DISP=SHR
//OUT1  DD DSN=RMTPRD.username.SAS.CDR01J,DISP=(NEW,CATLG),
//          SPACE=(CYL,(50,10),RLSE),UNIT=RMTINT
//MAINFILE DD DSN=MDPPRD.SYS.SAS.NAT.LIB.MAINFILE,DISP=SHR
//LIBRARY  DD DSN=MDPPRD.MDP.FMTLIB6,DISP=SHR
//SYSIN    DD *

OPTIONS NOCENTER
       LS = 78
       PS=50;

DATA OUT1.CDR01J;
INFILE IN1 MISSOVER;
INPUT GROUP        1-2
     REGION       3-4
     DIST         5-6
     STA3N        7-9
     FY          12-13
     CC          14-16
     CCNAME    $ 17-36
     SUBACCT     37-40
     ACCTNO      41-46
     ACCTNAME  $ 47-66
     FTE        PD5.2
     PSCOST     PD8.2
     OTHCOST    PD8.2
     TOTCOST    PD8.2 ;
FORMAT FTE 5.2;
FORMAT PSCOST 10.2;
FORMAT OTHCOST 10.2;
FORMAT TOTCOST 10.2;
ACCTNO=ACCTNO/100;
IF 1000 < ACCTNO < 9000;

PROC MEANS N MEAN MIN MAX SUM;
```

Chapter 5. Direct Measurement of Costs

A challenging element of cost-effectiveness analysis is the proper measurement of costs. While frequently costs incurred by patients in VA-sponsored studies can be determined through HERC average cost estimates, DSS, non-VA data systems, or published clinical studies, in some cases these will not provide enough information. Summary administrative data cannot identify an individual person or intervention, and there may be no published studies of the cost of new interventions or those unique to the VA. In some cases, administrative data exist but do not correspond to the study perspective. When existing sources are insufficient, researchers can gather data through surveys and personal observation. This is called *direct measurement*. Common methods of direct measurement include the following:

- A rater observes staff members or patients to determine how much time is spent on the intervention
- A staff member fills out a log of activities relating to the intervention
- A patient completes a survey about time spent for direct care, transportation, and unpaid care at home
- A supervisor fills out survey, estimating the number of hours spent on the intervention by each type of staff member (nurse, physician, social worker, etc.).

This chapter describes how to use direct measurement to estimate the cost of an intervention.

Researchers may use direct measurement alone or in combination with other methods. In some cases direct measurement will be the only available source of information on an intervention, as when the intervention is new or unique to the VA. Researchers may use direct measurement to find the cost of a new or unique intervention, while using a less precise method like average costing for all other care. Since micro-costing requires many research resources, it use is limited to the parts of the study where a high level of precision is needed.

5.1 Three Methods for Measuring Activities

This section describes common methods of direct measurement. These include traditional time-and-motion studies, in which someone observes the process of care; activity logs, in which providers monitor their own time; and surveys of managers and patients. Each of these methods may be used alone or in combination to measure provider and patient activities. Examples of these activities include medical procedures, physical therapy, psychotherapy, and training.

Time-and-Motion Study

In this approach, the analyst directly observes the staff members and keeps track of the time spent on each activity throughout the day. Observing staff members may yield very precise results but is costly because observers must be paid for their time both in training and in data collection.

Activity Logs

A second approach is to have employees keep daily activity logs for a sample of survey dates. The staff members record activities during each 30-minute interval of work (or 15-minute, 10-minute, etc.) and characterize whether the activities involve the intervention being studied, or some other activity. Accuracy can be nearly as good as with time-and-motion studies. Time logs carry additional administrative burdens as well: developing and pre-testing the survey instrument with allowance for staff members' input, training staff members to use the logs, and following up to ensure that logs are completed and gathered. It may be necessary to survey program managers beforehand to learn which staff members will need to complete logs.

It may not be necessary to use activity logs for every day of an intervention, particularly if it extends for weeks or months. A random sample of days will suffice, or a random sample of hours within a day, but the sampling frame must be designed with care. If an intervention becomes less intensive over time, for instance, basing an estimate on activity logs from the early days of the intervention would lead to an overestimate of total time spent.

Manager Survey

A third method for gathering staff data is to survey managers. The surveys can collect two types of information: the number of full-time-equivalent employees involved in the intervention, and the number of hours spent on the intervention per day or per week. In order to calculate staff compensation costs accurately, separate responses should be obtained for each category of employee involved: registered nurses, physicians, lab technicians, and so on. Finer detail may be needed if experienced or specially trained providers predominate, as in a geriatric care unit.

Manager surveys are common because they take less time to prepare or complete. A single manager can report on activities of many staff members, and so another advantage is the relatively small number of people who must be surveyed. The primary drawback of manager surveys is a relative lack of accuracy and precision. Managers may have a good sense of the number of days spent on the intervention in a week, for example, but probably will not be accurate at the level of hours or half-hours. The quality of data from manager surveys depends on the effort of the mangers themselves. Manager surveys are not advisable when high precision is needed or when many managers would have to be surveyed to cover the actions of all staff members involved.

Combining Methods

It is often advisable to use two or more methods in the same study to save money while obtaining an acceptable level of precision and accuracy. Consider a study comparing surgical and drug treatment. An analyst might use staff surveys or study logs to determine the cost of the initial treatment. A less precise but less costly method such as average costing could be employed to determine the cost of subsequent healthcare.

5.2 Considerations in Designing a Cost Analysis

Aggregation Level

The costs of an intervention may be analyzed at many different levels: the cost per intervention, per clinic visit or hospital stay, per patient contact, per day, etc. The aggregation level will guide the choice of data collection methods. Both the methods and the aggregation level will affect the overall reliability and external validity of the results.

The choice of analysis level should be guided by the feasibility of the data collection that would be necessary. There are two basic elements to consider: the *ability* to observe the data with accuracy and precision; and the *cost* of collecting data. For example, cognitive impairment may prevent patients from completing self-reports accurately (without bias) or precisely (with sufficient detail). But self-reports may be necessary to track at-home care because sending a third party to scores of patient homes could be prohibitively costly. A data collection method would also be infeasible if many potential patients find it intrusive and refuse consent.

The aggregation level should also match the clinical endpoints. For example, it would be natural to estimate per visit cost for an intervention intended to reduce the number of outpatient visits. Although an intervention may require a threshold level of treatment for clinical effectiveness, it is still important to measure the cost of partial treatment. Partial treatment occurs both in clinical studies and in general practice, and there is no justification for ignoring the resources expended simply because the patient dropped out before the threshold of clinical effect.

The Comparator

Whenever possible, the cost of an intervention should be measured against a comparator, whether placebo, "usual care," or another new treatment. The choice of comparator will guide how costs should be measured. A finer level of detail may be needed when alternative treatments are close substitutes than when they are quite different. For example, a comparison of two surgical techniques for coronary bypass would require time in the surgical suite to be recorded in minutes, in order to accurately capture important differences in the costs of the two procedures. If the comparison were between surgery and pharmacotherapy, however, capturing fine distinctions in surgery time may be unnecessary and a less precise method would probably suffice.

Researchers must scrutinize data collection methods to avoid bias that might favor one treatment arm. For instance, suppose that a new drug treatment program aims to reduce VA hospitalizations. If it simultaneously leads to greater use of non-VA services, the cost estimation method should be able to account for both VA and non-VA services with similar levels of accuracy. If the control arm uses more VA care than the experimental arm, then bias could be introduced by relying on more accurate methods for VA services but less accurate methods for non-VA services that tended to underestimate their cost.

Joint Production[7]

In some instances a single product is produced simultaneously with other products. Consider the time of a nurse involved in a clinical research trial. Suppose that patient care activities unrelated to a research protocol take up 25% of the nurse's time; activities which benefit both research and patient care take 50% time; and activities only needed for the research protocol take the remaining 25%. An analyst could justifiably assign as little as 25% or as much 75% of the costs of this time to research. Which figure is appropriate depends on the question being asked. For example, the percentage of time that would be released if research activities ceased is only 25%.

Incremental cost is often a more useful concept for making decisions about the impact of changes in activities. Incremental cost is the additional cost that results from the production of a good or service, holding the production of all other products constant. The incremental cost of an intervention is the additional cost incurred by conducting the intervention, given that other clinical activities already exist. In the preceding scenario, the incremental cost of research is 25% of the nurse's time. Incremental costs must be stated in terms of a given level of production of other products. The extra cost from an intervention adds to total healthcare costs given current levels of patient care.

Hawthorne Effects

In a famous study of General Electric's Hawthorne plant, researchers determined that employees were becoming more productive not from repeated changes in the work environment but from the knowledge that they were being carefully watched (Franke and Kaul, 1978). The same issue can arise in clinical studies. Patients under study may be more likely to take medications; clinicians may work more slowly in order to avoid accidents, or conversely they may work more quickly in order to appear more efficient. Regardless of the direction of effect, Hawthorne effects will bias study results because they will not appear under normal circumstances if the intervention is adopted widely. Researchers collecting data by direct observation can reduce the probability of Hawthorne effects by making the observation process as unobtrusive as possible. For example, recording an intervention on film and later assessing the time spent would be less intrusive than standing at bedside with a stopwatch and a clipboard.

The process of studying an intervention may itself change the cost. Patients may need to travel farther to a study site than to their usual healthcare facilities, for instance. Likewise, time spent by clinicians or managers filling out data collection forms should not be counted as an intervention cost. When an activity involves both delivery of the intervention and research on its effect, the cost of that activity should be included if the activity was needed to deliver the intervention.

[7] This section is drawn from Barnett and Garber (1996).

5.3 Calculating Costs

VA Costs for Medical Care

Medical care includes supplies, medicines and compensation for providers and other staff members. There is also the cost of overhead expenses such as building maintenance and utilities.

Cost of Training Staff to Use the Intervention

The cost of an intervention includes the cost of training staff to implement it. This cost needs to be estimated with caution. The cost of training might fall if the intervention were implemented on a large scale. If that seems likely, researchers should make a note of it and prepare an additional set of results with the lower training costs to represent the longer-term cost of the intervention. If the intervention became common, the true training cost would likely be small when averaged across many patients. If so then the cost of training may be disregarded from society's viewpoint, although short-term training costs may be of interest to management decision-makers.

Administrative Cost

Every intervention will have some administrative costs as well, particularly those requiring many separate items or people, or which extend over a long period. Administrative costs should be included if they are not trivial and if they would apply in a typical clinical setting. Time spent on administration can be collected through manager surveys.

Average annual or hourly personnel costs (including both wages and benefits) are available through the VA Financial Management System (FMS), which includes data sets containing total payments and total hours per fiscal year for about 80 classes of employees (e.g., MD, RN, clinical psychologist, lab technician). See Chapter 3 of this handbook for details on how to extract personnel cost data from FMS.

Medication Costs

Drug prices vary considerably by buyer, and so interventions that primarily consist of prescription drugs may be cost-effective for some buyers but not for others. The current prices for pharmaceuticals paid by each federal agency are stored in electronic format by the VA's Pharmacy Benefits Management (PBM) Strategic Healthcare Group (http://www.vapbm.org/PBM/menu.asp).[8] Patients, providers and managers are unlikely to know drug prices, and so collecting them through surveys is not advisable.

Drug prices for private buyers are harder to estimate. Many studies use the average wholesale price (AWP), available in trade publications. This approach is flawed: wholesale

[8] The PBM drug price data are updated daily. PBM staff have created an historical price file that has a single entry for each NDC each time the price for that NDC changes. HERC has also saved a copy of the price file once per quarter since September, 2001. Contact HERC staff for more information.

prices do not reflect actual prices paid by providers or patients. Specialized sources of data on VA pharmacy costs include the DSS Pharmacy Extract and the Pharmacy Benefit Management V3.0 database. These and other sources are described in Smith and Joseph (2002), available on request from HERC.

Supply, Equipment and Capital Costs

The costs of supplies and equipment may be gathered through manager surveys or by contacting manufacturers. In the context of direct measurement, manager surveys can be used to collect data on typical wages for each type of employee and for the cost of supplies and equipment. Data collected in this way naturally relies on the knowledge of the managers completing the surveys.

Two caveats are in order. First, supply and equipment costs may fall if a new intervention is widely adopted. Both competition and economies of scale in production can lead the price of goods to fall as the number of items produced rises. Second, large providers like VA can often negotiate substantial discounts. Using the list price of a good may greatly overstate the cost of supplies and equipment.

See Chapter 9 of this handbook for a detailed discussion of methods for estimating VA capital costs.

Other Costs

Other types of costs that need to be measured include the cost of care provided in other healthcare systems, out-of-pocket costs incurred by patients, including the travel cost and non-prescription medications, and the value of patients and informal caregivers' time. This section describes methods for estimating each of these.

Travel Costs

Analyses from a societal viewpoint include travel costs. Patients may be surveyed about the specific mode of conveyance and the number of miles traveled. This adds considerable complexity and may not be worthwhile if patient-incurred travel costs are a small fraction of total costs. An alternative approach is to calculate the straight-line distance from the patient's residence to the healthcare provider and then apply a standard mileage rate, such as the amount allowed by the U.S. Internal Revenue Service for business expenses. Without much loss of accuracy, this may be further simplified by estimating travel cost using the distance between the geographic center of the postal zip code of the patient's residence and that of the provider's location. Once a typical mileage has been determined, a reasonable cost estimate may be found by multiplying the miles traveled by the standard IRS mileage reimbursement rate. Rates for recent years are available on an IRS web page: look under "mileage rate" in the agency's FAQ site, *http://www.irs.gov/prod/tax_edu/ faq/#M*.

Patients may use public transportation to reach the site of an intervention. In some instances this cost is reimbursable by the VA. From the VA's perspective, transportation and other nonmedical services represent costs of an intervention to the extent that the agency reimburses patients for them. Details of VA benefits are available at the agency website

(*www.va.gov*). From the perspective of society the total payments for these services must be counted.

Beyond the direct cost of travel is the implicit value of time spent traveling. Patients also spend time in obtaining care. For employed persons the hourly wage is a reasonable measure of time cost. Many veterans and their caregivers are retired, however, and so a wage is often unavailable. To our knowledge, no studies have estimated the time-value of veterans and their caregivers. Analysts will need to make assumptions as a result, and sensitivity analyses are indicated.

Non-VA Care Costs

Patients may obtain healthcare beyond the institution where an intervention occurs. In theory, it could account for a substantial proportion of healthcare spending. As noted earlier, inpatient cost and utilization is best captured by asking patients to submit logs of outside care and then writing to providers for details. An alternative is to conduct periodic surveys that ask the patient to report on healthcare used. If neither patient log nor survey is feasible, administrative sources may be consulted. These include the VA fee basis files, and Medicare or Medicaid files.

The VA Fee Basis files contain the cost of inpatient and outpatient services provided to VA patients by contract providers, and by non-contract providers who gave care on an emergent basis. The VA discharge files, the Patient Treatment Files (PTF), include non-VA inpatient stays provided under contract to VA. The PTF reports discharge date, length of stay, and Diagnosis Related Group, but not the cost of these stays. Researchers may also obtain the cost of care obtained by VA patients but paid by Medicare by making a formal request to the Center for Medicare & Medicaid Services. There is a charge for this service.

Patient logs and surveys provide information on health services utilization, but not their cost. Cost may be estimated from national surveys such as the Medical Expenditure Panel Survey (MEPS), the Healthcare Cost and Utilization Project (HCUP), and the Medicare Provider Analysis Review (MEDPAR), from surveys carried out by professional societies, and from private firms that manage healthcare claims. Combining utilization and cost data from separate sources requires particular care. Costs in one source may refer to utilization categories that do not match those in other sources. Arbitrary simplifications are often necessary.

Time Costs

Interventions have an economic time cost even when services are provided for free. Patients must spend time to receive an intervention and for transportation to and from the place where it is received. Informal caregivers may also spend time transporting patients and providing unmarketed (unpaid) healthcare. The time spent by patients and informal caregivers carries an "opportunity cost" based on the notion that time is limited, and that absent the intervention, patients and others would use their time for other purposes. If volunteers contribute an important amount of time to an intervention (as they might at a hospital), then their time should be valued as well.

Time costs of patients and unpaid caregivers are not counted in cost-effectiveness analyses from the perspective of the VA. Russell et al. (1996) recommend a societal perspective for cost-effectiveness analyses, however, and society does value patients' and informal caregivers' time. For employed persons and their caregivers, the hourly wage is a reasonable measure of time cost, but because many veterans are retired a wage may not be available for patients in many VA studies. There are a number of issues to consider in determining a fair time value for persons who are not currently employed; Garber et al. (1996) provide an overview and recommendations.

5.4 Characteristics of Survey Instruments

Survey design is an important topic often neglected by health services researchers. Readers should familiarize themselves with the major ideas in order to have a basic understanding of the psychometric properties of survey instruments. References are provided for those who would like to investigate the topics more fully.

A relatively new resource on survey design and psychometry is the Measurement Excellence Initiative (MEI). MEI is an organization funded by VA whose mission includes disseminating information on survey instruments and conducting original psychometric research. For information on its programs, see the MEI website at URL www.measurementexperts.org.

Validity

In cost-effectiveness research, surveys are used to measure quality of life, clinical outcomes, and cost components. We refer to the object of measurement as the *construct*, a term from psychology that reflects the intangible nature of concepts like pain, health, and utility (or happiness, or well-being).

A key attribute of a survey instrument is validity. Validity refers to the survey's ability to measure the construct successfully. Aspects of validity include *face validity* (does the survey appear on the surface to measure the construct?), *content validity* (do the survey questions pertain to the construct?), and *construct validity* (does the survey measure the construct well?). Related to construct validity is *discriminant validity*, the ability of the survey questions to distinguish between different constructs. When a new survey yields results similar to a previously validated survey, the new instrument is said to have high *criterion validity*. Sometimes criterion validity is used as a synonym for *predictive validity*, the ability of a test (or question) to predict results of another test or outcome. For example, the SAT exam would have good predictive validity if it were able to predict college achievement, its stated aim.

Reliability

A second important property of surveys is reliability. Reliability refers to the consistency of survey results across time, raters, and questions. For instance, *inter-rater reliability* measures the extent to which different raters observing the same situation will complete a survey the same way. *Test-retest reliability* shows whether a patient completing a survey twice in a short period

will give the same answers both times. *Internal reliability* refers to whether questions measuring the same construct receive similar answers.

When data are collected through direct observation, the accuracy of the data will rely on the people collecting it. There are several steps that can be taken to increase reliability. Data collectors must be trained to ensure that they understand the collection forms. Retraining is advisable during lengthy collection periods. The degree of consistency between collectors—known as inter-rater reliability—is an important measure (Dunn 1992; Kelsey et al. 1996). It can be assessed by comparing the results when two or more people collect data from the same source.

Accuracy

Even small errors in reporting can accumulate if many separate people take part in the intervention. If an activity log requests staff members to list tasks in 15-minute intervals, how will they record interventions that take 5, 10 or 20 minutes? Total intervention time will be underestimated if they round down to the nearest 15-minute interval or overestimated if they round up. Small individual errors can become large if the same upward or downward bias is repeated many times. Solutions include using a more precise measurement system that collects data in 5-minute intervals, using direct observation by a third party who can note the exact time spent, and asking staff members to tally which actions occurred and then assigning each action an average time based on a few direct observations.

Patient surveys rely on the accuracy of individuals' memories. Aside from the usual problem of memory decay, healthcare studies may face additional obstacles. If patients are cognitively impaired or deceased, it may be necessary to locate a proxy who can accurately report the data. And the direction of bias is not consistent: a recent study of mentally ill individuals found that those considered high utilizers tended to understate their service use when surveyed, whereas low utilizers tended to overstate their use (Kashner et al., 1999).

Even relatively healthy patients may have inaccurate recall, and the quality of recall will vary across people. Factors found to affect recall in social science surveys include the length of the recall period, the complexity of the respondent's experiences, the quantity of information requested, the number of topics, and whether the events being recalled stand out from other events in the person's mind (Pierret 2001; Sudman et al. 1996; Dugoni et al. 1997; Mathiowetz 1998; Simmons and Schnelle 2001; Clegg et al. 2001; Nicholson et al. 2000). Studies generally find that more accurate recall is associated with a shorter recall period, fewer questions, focus on a single topic, and fewer events that are confusingly similar to those being queried.

In an event-history analysis, both the presence of an event and its date are collected. These may be used in health services research to date utilization before or after an intervention. Event-history analyses face the special problem of *telescoping*, in which patients recall an event but assign the wrong date to it. One study reported that accuracy of event dates fell below 20 percent when the recall period was about 12 months (Thompson et al. 1996; Wu et al. 2001). A natural approach is to shorten the recall period. In longitudinal (repeated cross-section) surveys,

another tactic is to remind the patient of answers from the previous survey and then to ask whether any changes have occurred since then (Sudman et al. 1996).

In sum, there are a number of strategies to increase the accuracy of survey data. Rather than relying on personal memory, consider having patients and providers keep logs of study-related events. Ask patients to grant permission for you to obtain bills from non-VA hospitals. For questions that rely on memory, minimize the recall period. Ask as few questions as are necessary and limit the focus to a small number of areas.

Testing survey characteristics

A variety of methods are used to judge validity and reliability. A few rely on interviews with potential subjects (face validity) or content experts (content validity). Most are judged by a statistical test of similarity between two sets of results. For inter-rater reliability, for example, the test is of similarity between observations made by two different raters. The particular test chosen will depend on whether the variable being compared is binary and on whether two distributions are being compared versus three or more at once. A wide range of tests may be implemented using standard statistical software packages. For example, Cronbach's alpha, a commonly reported measure of internal reliability, can be estimated through the SAS procedure PROC CORR (SAS Institute 1999). A good resource for definitions and standards is AERA et al. (1985), a document produced by three professional organizations in education and psychology. For an interpretation of reliability and validity as consistency and bias of a distribution, see Salvucci et al. (1997).

When measuring the results, how good is good enough? Over time, standards have arisen for certain tests. For example, a Cronbach's alpha score of 0.80 or higher is considered evidence of strong internal reliability. There is no widely accepted standard for data accuracy. The accuracy of one source must be judged against a standard, and in some cases no independent, highly reliable standard will exist. When it does, as with chart reviews for judging patient or physician reports, collecting the data may be prohibitively expensive.

5.5 Summary

This chapter has presented guidelines for directly measuring costs of VA and non-VA healthcare. Direct measurement is recommended when existing data sources cannot provide enough detail on the effort or cost of an intervention. Data may be collected through direct observation or through surveys of managers, providers, and patients or their proxies. In many cases, a single study will combine direct measurement with data collection from administrative sources and published studies.

There are a number of elements to consider when developing a plan for direct measurement:

- **Perspective**: a perspective for the cost-effectiveness analysis must be chosen; options include societal, VA, and patient/family viewpoints; some studies include two cost-effectiveness analyses from different perspectives (e.g., VA and societal)

- **Cost Elements**: a plan for collecting data on each cost element should be determined during the planning phase of a study
- **Healthcare Process**: the process of care must be understood in order to distinguish actions need to carry out the intervention from actions taken only to study it
- **Method**: the use of direct observation, activity logs, manager surveys and patient/proxy surveys must be tailored to meet the data needs and financial limits of the study; avoid methods that may bias the outcome due to data collection difficulties
- **Feasibility**: the method must be affordable and must yield results that are sufficiently accurate and precise

Researchers considering whether to use direct measurement methods may contact HERC for guidance. This should be done during the planning phase of the study in order to ensure that feasible methods are chosen.

5.6 Example Survey Instruments

HERC has collected survey instruments from previous VA studies for use by researchers contemplating the use of surveys. The instruments vary in scope and purpose but fall naturally into two groups: manager surveys and patient surveys. The files are available on the HERC website or by request to HERC staff members. They are in Microsoft Word format but can be converted to PDF format on request. Explanatory material presented at the head of the document lists the survey name, study name, and a contact person knowledgeable about the study and the survey.

Chapter 6. Inpatient Medicare Pseudo-bill Estimation

Chapter 5 illustrated one micro-cost method, direct measurement. This chapter introduces a second micro-cost method, the *pseudo-bill*. The pseudo-bill method can be used to estimate the cost of inpatient care; it can also be used to estimate outpatient costs, as described in Chapter 7. Like all micro-cost methods, creating pseudo-bills consists of assigning costs to each part of an encounter, and then summing to find a single cost for the entire encounter.

The pseudo-bill method for inpatient VA care relies on Medicare payment methods. VA cannot bill Medicare for care that it provides to veterans, but calculation of a hypothetical Medicare reimbursement may still be useful to cost analysts who wish to estimate the resources used to provide VA inpatient care. Medicare reimburses both hospitals and providers for the cost of an inpatient stay. These two components are considered in turn.

6.1 Hospital Payment

Medicare reimburses hospitals based on the Diagnosis Related Group (DRG) assigned to the hospital stay. Medicare determines the national average charge for each DRG and expresses them as relative values; these are known as DRG weights. A schedule of DRG weights is published annually by Center for Medicare and Medicaid Services (formerly the Healthcare Financing Agency) on its website (www.hcfa.gov). The weights are also available at the VA Austin Automation Center in a SAS file and are printed as a Final Rule in each September issue of the *Federal Register*.

Medicare pays a standard amount for each unit of DRG weight. The program makes additional payments to hospitals for capital, to compensate them for outlier cases, for the indirect and direct costs of medical education, and to assist hospitals that have a disproportionate share of indigent and Medicaid patients. Over time, capital payments are being phased into the DRG payments.

Here is one method of estimating the Medicare reimbursement. This method assumes that the additional payments for capital, outliers, medical education, and disproportionate share, should be assigned to stays in proportion to their DRG weight. This assumption will result in a estimate that is likely to be very near the national average Medicare payment for that DRG. This assumption means that the cost estimate won't reflect the effect of the hospital's own medical education or wage costs, which do influence Medicare reimbursement.

We will illustrate with an example. The average Medicare payment per DRG weight in 1996 was $5,267 (ProPAC 1997, "Medicare Program" 1995) Table 6.1 lists the components that entered the payment calculation.

Standard payment rate. We started by taking estimates of DRG Relative Value Units (RVUs) from a ProPAC report (ProPAC 1997). These RVUs were applied to the standard payment rate

for each DRG, as printed in the *Federal Register* ("Medicare Program" 1995). The weighted average of the standard payments was $3,808. This figure reflects the weighted average of rates for large urban areas and for other areas.

Table 6.1 Elements of Average Medicare Payment for DRG Weight in 1996

Payment per DRG weight	Payment Type
$ 3,808.00	Standard Payment
$ 194.22	Outlier payments
$ 512.15	Capital payments
$ 298.43	IME: Indirect Medical Education
$ 291.94	DSH: Disproportionate Share Provider payments
$ 162.19	DME: Direct Medical Education
$ 5,266.93	**Total Payment**

Additional payments

We calculated rates for additional payments based on the ProPAC (1997) report. The Medicare program projected that outlier payments would be 5.1% of DRG payments, or $194.22 per DRG weight. It projected that 1996 capital payments would be $727.26 per discharge. Based on an average of 1.42 DRG weights per discharge in FY1996, capital payments would be $512.15 per DRG weight. The Indirect Medical Education (IME) Payments were 7.84% of DRG payments, or $298.43.[9] Disportional Share Provider (DSH) payments were 7.67%, or $291.94, and Direct Medical Education (DME) payments were 4.26%, or $162.19.

Alternate calculation method

MEDPAR data (http://www.hcfa.gov/stats/medpar.htm) and the schedule of DRG weights per discharge were used to calculate what Medicare paid for 11.7 million discharges in FY1996. The discharges had an average DRG weight of 1.422, and so the sum of all DRG weights was approximately 16.7 million. As Medicare payments for inpatient care at acute hospitals were $87.5 billion in FY1995 and grew 5.2% per year from 1990-1996, then we may project payments of $92.05 billion in FY1996. Together, these figures imply an average payment of $5,509 per DRG weight in FY1996. As some discharges are excluded from the DRG report to avoid disclosing patient data, this figure represents an upper bound on the cost.

6.2 Payments to Physicians for Hospital Care

Physicians prepare bills to Medicare using Current Procedural Terminology (CPT) codes to characterize the services that they provide. The Medicare fiscal intermediary confirms that

[9]The estimated Total Payment ($5,266.93) is the sum of the standard payment and additional payments listed in Table 6.1. It represents what Medicare terms "operating payments" less the outlier, IME, and DSH payments. Capital and GME were assumed not to be operating payments.

each bill is appropriate and calculates a payment based on a system of relative values assigned to each code. The Medicare conversion factor was $36.61 per billed relative value unit in FY2000.

VA physicians do not use CPT codes to characterize the services that they provide to inpatients, and so analysts must calculate the average payment for each DRG by other means. Two studies that have determined the mean Medicare payment to physicians for services provided to hospitalized patients in each DRG are Miller and Welch (1993) and Mitchell, et al. (1993). Their estimated payment rates may be used for VA research, but doing so implies that every patient assigned to a given DRG received exactly the same physician services. This assumption is not far-fetched, however, as provision of additional physician services often results in a stay being assigned to a different, more expensive DRG.

In some cases it will be advisable to adjust the physician payment. For example, a patient with an unusually long length of stay (LOS) most likely has more physician visits than the average. In this situation, one might increase the physician payment to account for the longer stay, or reduce the payment to account for shorter stays. For example, the typical Medicare payment for a physician visit (CPT 99232) was $56.01 in FY2000; one method would be to add $56.01 for each day that an inpatient stay extends beyond the national mean LOS. Other adjustments to physician payments are possible as well.

6.3 Medical Care Cost Recovery Program

Some VA patients are covered by private insurance policies. By law, VA has the right to bill the private insurers for treatment of non-service-connected conditions. Some co-payments are recoverable as well. These efforts fall under the Medical Care Cost Recovery (MCCR) Program. The program is implemented at each VA medical center. Summary data are stored in the MCCR National Database in VA FileMan format. We have chosen not to use MCCR data in the estimation of inpatient pseudo-bills from a belief that they are incomplete and would not substantially improve to the Medicare-based method described earlier.

Chapter 7. Outpatient Pseudo-Bill Estimation

A pseudo-bill can be created for outpatient payments in a way similar to that outlined in Chapter 6 for inpatient treatment. This chapter describes methods and data sources for doing so. It outlines the methods used to create the HERC outpatient average cost datasets. HERC staff have prepared a report (Phibbs et al. 2002) that provides additional details on the creation of the average costs datasets.

Researchers who need to estimate the cost of VA care may choose a micro-cost approach such as pseudo-bills, or may choose an average-cost approach using the HERC average cost datasets. The HERC average-cost method made a number of simplifying assumptions that understates the true variation in costs. This chapter is offered to assist the analyst who wishes to prepare a pseudo bill with her own assumptions.

7.1 Overview: Estimating Payments and Costs

VA characterizes the services it provides to outpatients using the Current Procedure Terminology (CPT) coding system.[10] In a typical year, VA provides some 60 million outpatient encounters in hundreds of VA clinics. The VA characterizes these services with more than 10,000 different CPT codes.

The Medicare reimbursement method is an good source of payment rates because Medicare is a national program. Its payments are based on the economic cost of providing services, rather than the accounting cost.[11] Medicare is also a major healthcare provider, paying 22% of the cost of physician services provided in the U.S. Finally, its reimbursement rate represents costs from a useful perspective, that of the healthcare payer.

Because VA also provides services not covered by Medicare, one must use other sources as well. Surveys of physicians and health plans are the primary sources of additional information.

Assumptions made to estimate payments and costs

A number of assumptions are needed to create a pseudo-bill based on VA outpatient records. In order to apply Medicare reimbursement methods, HERC made the following assumptions:

1. All ambulatory care is comprehensively characterized by the CPT codes used in national VA databases.
2. All CPT codes used by VA represent valid services that should be assigned a cost.
3. Costs are proportionate to payment rates.

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[10] In this chapter the phrase "CPT codes" will include HCPCS codes.

[11] Economic costs equal accounting costs plus the opportunity costs of production. In the long run the economic costs represent society's expenses more accurately.

4. Some of Medicare's reimbursement methods are not appropriate for the VA.
5. Non-standard CPT codes represent valid costs.
6. Total payments should include facility payments.

A discussion and application of each assumption appears in Phibbs et al. (2001).

Facility Payments Necessary

Most VA care is provided in a setting that meets the Medicare definition of a facility. Medicare defines a facility as a hospital-based clinic, a skilled nursing facility, a free-standing surgery center, a comprehensive outpatient rehabilitation facility, or a community mental health center. The VA has these facilities and others. When care is provided in this type of facility, researchers should include a facility payment in addition to a provider payment when calculating a pseudo-bill. The HERC average cost estimates always include a facility payment; the analyst may want to exclude this payment in estimating the cost of care provided in satellite clinics.

7.2. Provider Payments

One method for determining provider payments is to determine charges, costs or payments for similar services outside the VA. A natural choice is Medicare. Medicare payments differ between office-based and facility-based physicians. When care is provided in a "facility" (as defined by Medicare) , then Medicare payment rate for facility-based physicians may be used. When care is provided outside of facility, as in a office-based physician's practice, the non-facility payment should be used.

Medicare provider payments cover physician services, laboratory tests, diagnostic imaging, and medical supplies. Medicare uses the Resource-Based Relative Value Scale (RBRVS) to calculate provider payments. It produces *RBRVS values*, weights based on the time needed to provide a service or perform a procedure. The values also reflect the minimum training required to provide a given service and the stress level of the task. The RBRVS system replaced reimbursement based on historic payment rates.

Application of Medicare Reimbursement Methods

The Medicare reimbursement algorithm is complex. HERC adapted it in creating its average cost estimates. These adaptations are briefly discussed below.

- **Geographic Adjustment** HERC used the national average RBRVS payment rather than the payments adjusted for geographic differences. Researchers interested in creating pseudo-bills applicable only to local areas may wish to use the geographic adjustments.

- **Procedures Subject to Global Reimbursement Rates** Medicare reimburses providers with a global payment for most procedures. The global payment is for pre-operative visits, the procedure, and post-operative care, regardless of the number of visits requited. HERC did not use the global rate; instead, it estimated the reimbursement for each visit and the procedure. Because post-operative visits are reimbursed via global payments, Medicare does

not reimburse for post-operative visit (CPT code 99024). HERC used the reimbursement rate for an Evaluation and Management visit with an established patient (CPT code 99211).

- **Bundling of Professional and Technical Components** Medicare allows payment for certain services to be divided into a professional and technical component. For example, an x-ray consists of the technical component, taking the x-ray, and a professional component, the physician's interpretation of the x-ray. These services are distinguished by a two digit code, in addition to the 5-digit CPT code; the technical code is identified as "TC" and the professional component as "26". At this writing, these supplemental codes are not used by VA. HERC used the bundled reimbursement rate. Pseudo-bills for VA utilization should include both the professional and technical components.

Relative Value Units and Fee Rate Conversation Factors

The RBRVS is expressed in terms of relative value units (RVUs). Medicare issues two conversion factors for converting RVUs to dollars: one for anesthesiologists and one for all other providers. The conversion factors for anesthesiology and for other providers used to create the HERC values are listed in Table 7.1.

Table 7.1 Medicare Conversion Factors, RVUs to Dollars, for FY1998-FY2000

	1998	1999	2000
Anesthesiologists	$16.88	$17.24	$17.77
All Other Providers	$33.64	$34.73	$36.61

Sources of Provider Payment Data

This section describes assumptions that HERC used to estimate payments for VA services characterized by non-standard use of CPT codes. While we believe these methods and sources are generally applicable, there may be others that are equally appropriate for a particular study.

Year 2000 Medicare Reimbursement Schedule

To estimate the payment for services provided between FY98 and FY00, HERC used the 2000 Medicare RBRVS payment schedule as the primary source of RBRVS relative values. The relative value was multiplied by the conversion factor for the year in which the service was actually provided.

For a small number of procedures it was necessary to use Medicare RVUs from other years. Some CPT codes were dropped and others added between 1998 and 2000, for example, and so we consulted the 1997 and 2001 Medicare RBRVS schedules to find RVUs for the codes that were added or deleted in the intervening years.

Gap Codes - RBRVS Methods for Services not Covered by Medicare

Many outpatient professional services provided by VA are not covered by Medicare, such as telephone contacts and some preventive care activities. One may nevertheless wish to assign comparable reimbursements and to estimate their costs.

The RBRVS method is used to estimate RVUs for the provider payment for most services not covered by Medicare. A table of these listings appears in the St. Anthony's RBRVS 2000 (2000). As these professional services represent gaps in Medicare coverage, codes for these services are often referred to as *gap codes*.

Payments for Non-Standard Codes

Some CPT codes used by VA are not normally used to bill for ambulatory care. HERC made assumptions to estimate a hypothetical payment associated with each of these codes. The examples below are the coding problems encountered by HERC in creating the average costs outpatient datasets and the assumptions made in order to assign payments.

Codes for Unlisted Services and Procedures

Each group of CPT codes includes a code for "unlisted service or procedure," designed to allow coders to represent services that are not otherwise represented with a CPT code. These codes are widely used by VA. The code for "unlisted hematology and coagulation procedures" was used 1.9 million times in 1998, making it one of the 10 most common procedures performed by VA. The CPT codes for unlisted miscellaneous pathology procedure, unlisted microbiology procedure, and unlisted chemistry procedure were also all used more than 500,000 times.

Neither Medicare nor any other provider assigns an RVU or payment to codes for unlisted procedures. These codes may in fact represent services for which there is a more specific CPT code and an associated RVU. In the absence of more precise information about the services represented by the unlisted codes, our strategy was to apply the weighted average payment for similar procedures. For example, HERC staff calculated a payment for "unlisted hematology and coagulation procedures" as the weighted mean payment of hematology and coagulation procedures actually performed by VA, weighted by their frequency.

Obsolete Codes

VA uses CPT codes that have become obsolete and therefore did not have a payment associated with them in the St. Anthony's RBRVS 2000. We used the following rules to assign values to obsolete codes:

- When an old code was replaced by a single new code, we used the RVU of the new code.
- When an old code was split into two or more codes with identical RVUs, we used this RVU. If the old code was split into two or more new codes with different RVUs but only one appears to apply to VA patients, we used that RVU.
- When an old code was replaced by more than one new code with different RVUs, we estimated the payment for the old code as the average payment for the new codes weighted by their frequency in VA data.

Inpatient Procedures

Medicare has identified CPT codes for services that may only be performed on an inpatient basis. Medicare does not reimburse providers for these services when they are provided in the ambulatory setting.

VA used 1,031 different CPT inpatient codes to characterize ambulatory care in 1998. Most of these codes were used infrequently, with the exception of 32 CPT inpatient "evaluation and management" (E&M) codes. These 32 codes were used to characterize more than 250,000 ambulatory encounters in 1998. In the absence of more precise information about the services provided, we assumed that they were actually ambulatory care evaluation and management visits and assigned them payments based on the RVUs associated with the corresponding outpatient E&M codes. Uncommon inpatient codes may be assumed to reflect coding errors. Without further information, we assigned the service average VA payment per CPT code for that category of care. (The HERC categories of care are group of Cost Distribution Accounts and their associated care locations, called clinic stops; see below.)

Similar Modes of Care

In some cases VA uses codes that are similar but not exactly the same as CPT codes currently in use. We assigned them the RVUs basis of similar CPT codes. Guidance from a knowledgeable clinician should be obtained before doing making this type of assumption. If there are no similar codes, one solution is to assign an average payment based on all similar CPT codes. In the HERC outpatient average cost datasets, for example, we calculated a national average payment per CPT for each category of care, identified by clinic stop:

$$\text{national average payment per category} = \frac{\text{total payments in the category}}{\text{no. of procedures/services represented by CPT codes in the category}}$$

Other Sources for Provider Payments

Additional sources of data on provider payments used by HERC include the following:

- Dental Fee Surveys: 2000 National Dental Advisory Service comprehensive fee report (NDAS 2000); American Dental Association 1999 Survey of Dental Fees (ADA 2000).

- VA Contract Rates: VA data on the national average contract cost for compensation and pension exams.

- California Workers Compensation Charges (for rehabilitation services not covered by Medicare): California Workmen's Compensation System Official Medical Fee Schedule (1999). HERC scaled the California payments to be similar to Medicare payment rates. This was done by comparing services in the California RVU schedule that were also covered by Medicare. We found the ratio of Medicare to California RVUs, and used this to adjust payments for services not covered by Medicare.

- Physician Charge Surveys: 2000 Physicians' Fee Reference Comprehensive Fee Report (2000). HERC also adjusted these payments so that they were consistent with Medicare reimbursement rates.

7.3 Facility Payments

In addition to a physician payment, Medicare reimburses healthcare facilities for certain types of ambulatory care. The types of facilities eligible for the additional reimbursement include hospital-based clinics, emergency rooms, free-standing ambulatory surgical centers, Federally-qualified health centers, skilled nursing facilities, rural health clinics, comprehensive outpatient rehabilitation facilities, home health agencies, and hospices. Facility reimbursements are a significant expense to Medicare, typically equal to the total payment for physician services at the same facility.

All VA acute care hospitals meet the Medicare definition of a "healthcare facility," but some VA visits occur in satellite outpatient clinics that may not. HERC decided to include the facility payment for all outpatient visits. This was done because of concern that VA databases may not reliably identify the site where care is provided. For example, visits to satellite clinics that involve laboratory tests run at the parent hospital are sometimes assigned the hospital's location code.

Identifying Medicare Facility Reimbursement

In August, 2000, Medicare adopted a new method of paying ambulatory care facilities. This method assigns CPT codes to Ambulatory Payment Categories (APC). A facility reimbursement was assigned to each APC. The same method may be used to estimate the appropriate payment for facilities not covered by Medicare.

Medicare assigned CPT codes representing similar services with similar facility costs to Ambulatory Payment Classification (APC) groups. It determined the average facility reimbursement for each APC from historical payment data. When a visit involves several CPT codes, the facility receives an APC payment for each code. In the case of multiple procedures, the APC payments for many surgical procedures are reduced by 50%. The APC payment for a surgical procedure is not reduced, however, if it is the largest APC payment for the visit.

Under the Medicare rules, the following services and procedures are not eligible for facility payments:

- Procedures for which the facility reimbursement comes from the APC payment for another CPT code (e.g., anesthesia)
- Services in which the facility payment is provided with provider reimbursement (e.g., laboratory tests, dialysis, medical supplies)
- Procedures that can only be provided in an inpatient setting

Two primary sources of payment rates are Medicare rules for year 2000, the first year in which Medicare used the APC to calculate facility payments, and the new APC categories created for 2001. HERC estimated facility payments for earlier years by assuming that facility payments grew at the same rate as physician payments. We found this growth rate by comparing the conversion factor for physician payments in the year of the visit to the conversion factor for the year of the APC payment schedule.

Other Codes without Facility Payments

VA used many codes that are not covered by Medicare and have not been assigned an APC. The analyst must consider if a facility payment is appropriate. The Medicare rules do not allow facility payments for laboratory tests, dialysis, dental services, and medical supplies. Also excluded are services ordinarily provided in the inpatient setting, and payments for procedures like anesthesia; the facility reimbursement comes from the APC payment for another CPT code. For services for which an APC payment seemed appropriate, HERC used the APC payment of similar procedures. We advise checking these substitutions with a clinical researcher.

Gap Codes—Facility Payments for Services not Covered by Medicare

There may be additional CPT codes that should be assigned a facility payment but are not assigned an APC group by Medicare. For services that can be provided in an office-based setting HERC calculated the facility payment based on the RVU for practice expense.

The RVU for practice expense was scaled to the Medicare payment for facilities by comparing Medicare-covered services that have both a facility payment based on APC group and a provider practice expense for office-based providers. We found the median ratio of APC facility value to provider practice-expense payment was 2.22. We estimate the facility payment by multiplying this the gap-code practice-expense RVU by this ratio.

Other Non-standard Codes

Unlisted Services and Procedures. Medicare does not assign an APC payment to codes for unlisted procedures (miscellaneous categories of procedures not otherwise assigned CPT codes). HERC estimate that codes of these procedures as the weighted average facility payment for similar procedures, where the weights are the frequency of VA use of each of the similar procedures.

Obsolete Codes. We followed the same method we used for provider payments to estimate facility payments for services characterized by obsolete codes. If there is only a single replacement APC code that made sense, we used that code. Otherwise, we used a weighted average of replacement APC codes.

Inpatient Codes. VA characterizes some outpatient care with inpatient Evaluation and Management (E&M) CPT codes. HERC estimate the facility payment to be the facility payment for a comparable outpatient E&M codes. For other inpatient CPT codes used by VA to characterize outpatient services, we assigned them a weighted national-average facility payment.

Average HERC Facility Payment per Clinic Type

There were still some CPT codes that were not assigned a facility payment by the methods described above. HERC assigned these the average facility payment for all other codes for that type of outpatient clinic.

7.4 Other Data Sources

Beyond Medicare there are many data sources are available for use in creating pseudo-bills. Private-sector healthcare payments are captured by hospital and clinic administrative records. Some published studies have used surveys to collect data from one or more individual providers on the cost of a relatively small number of procedures or events. Large provider organizations such as Kaiser-Permanente have used their own administrative records to produce average prices for outpatient procedures. Data from a range of providers nationwide are available from private firms that have built databases of medical claims (encounters for capitated plans).

There are several sources of data for prescription drugs as well. The VA's Pharmacy Benefits Management (PBM) Group has placed on its website (http://www.vapbm.org) several text files containing the contracted prices paid by every federal agency for roughly 15,000 pharmaceuticals. These contract prices are updated daily. PBM staff also maintain an historical file featuring changes in contract prices over the past several years.

For pharmaceuticals not covered by federal contracts, there are private-sector sources of drug prices. A widely used reference is the Red Book, published by Medical Economics Co. and updated annually. Its Average Wholesale Price (AWP) tends to overstate negotiated prices for federal agencies. Medicaid drug payments tend to follow this formula:

$$\text{Medicaid reimbursement} = (\text{AWP}-10\%) + \text{dispensing fee}$$

The dispensing fee is small, less than $5.00 per prescription. Thus, the AWP is reasonably proportional to the Medicaid price, although not equal to it. A number of private firms also sell drug price data. These have the advantage of being payments rather than wholesale charges. They will be most accurate for estimating average private-sector drug payments.

Chapter 8. Estimating Costs with a Statistical Cost Function

A *statistical cost function* represents the third micro-cost method for estimating the cost of VA hospital stays. It requires a suitable source of non-VA data that includes costs (or cost-adjusted charges) and the factors most influential in explaining the variation in resources, such as the characteristics of the patient, the hospital, and the hospital stay. The cost function is estimated through regression analysis with cost as the dependent variable and the characteristics as independent variables. The resulting coefficients may be used to create fitted values of the dependent variable, representing VA costs given the observed levels of VA utilization and the function's parameters.

Cost functions require less data than a pseudo-bill. Creating a pseudo-bills can be difficult because VA doesn't gather the same information that non-VA hospitals and physicians use to bill for their services. An especially important deficiency in the VA data is potentially incomplete recording of non-surgical procedures.

Cost functions were used to estimate the cost acute medical-surgical stays in the HERC average cost estimates. The careful analyst may want to improve on the HERC method, by estimating a regression that includes additional factors, such as combordities and procedures that do not affect DRG assignment; the patient's vital status at discharge, or data not available from administrative datasets.

8.1 Independent Variables

The analyst will certainly wish to include length of stay (LOS) as an independent variable in models of the cost of hospital stays. Avoid the assumption that the costs of acute medical-surgical stays are proportionate to the length of stay, however. The daily cost of care is highest in the early part of the stay, and declines as the stay progresses. Using the square and cube of LOS is advisable, or some other specification that allow the coefficient on LOS to change as the stay progresses.

Hospital stays at VA facilities are longer on average than those at non-VA facilities. It is unlikely that extra days of stay in VA facilities have the same cost as extra days of stay at non-VA facilities. Therefore care must be exercised in simulating VA costs. One approach assumes that the median length of a VA stay has the same cost as the median length of a non-VA stay, holding all other factors constant. An extension of this method would be to replace the LOS with the rank of the patient's LOS among all stays.

The DRG weight is another important explanatory variable. HCFA uses this relative weight to reimbursement hospitals; it captures the effect of diagnosis and procedures on hospital costs. The DRG weight explains more of the variance in the cost of acute medical and surgical hospital stays than does length of stay.

8.2 Choosing the Model Specification

Choosing an acceptable model starts with a consideration of bias and precision. Bias, the opposite of accuracy, reflects how well the chosen model estimates the "true" coefficient. Precision relates to statistical significance: the greater the precision of the estimate, the smaller the confidence region around the estimate and the greater the level of statistical significance. If the purpose of the regression analysis is simply to estimate predicted values of the dependent variable, then any unbiased (or *consistent*) model will suffice, including ordinary least squares (OLS) in most (but not all) situations. If the analyst wishes to make statements about the statistical significance of coefficients, however, then precision must also be taken into account, and the choice between models becomes substantially more complex.

Why is OLS not right for every situation? Cost data typically are not normally distributed. Estimating a function with a skewed (non-normal) dependent variable violates the assumptions of OLS and causes inconsistency. This problem can be overcome by assuming a nonlinear relationship between the dependent and independent variables. A common choice is a logarithmic relationship implemented by transforming the dependent variable, substituting the natural log of costs for actual costs. Other nonlinear relationships may be appropriate as well. Two alternative formulations of the logarithmic linkage are given below:

(1.a) $\ln(cost) = \beta_0 + X_1\beta_1 + X_2\beta_2 + \ldots + \varepsilon$

(1.b) $\text{cost} = exp(\beta_0 + X_1\beta_1 + X_2\beta_2 + \ldots) + \varepsilon$

Equation 1.a is the standard log-linear model usually estimated by OLS. Equation 1.b is similar but shifts the (anti-)logarithm to the right side of the equal sign. As regression models they produce similar but not identical coefficients and standard errors. Both models can be estimated easily in major statistical packages, model 1.a with ordinary least squares regression (PROC REG in SAS, *reg* in Stata) and model 1.b with iteratively reweighted least squares (PROC NLIN in SAS, *xtgee* or *glm* in Stata).

8.3 Predicting Costs from Regression Results

Regression analysis is often performed in order to predict costs under hypothetical circumstances. This section describes methods for predicting costs, drawing heavily on Manning and Mullahy (2001). Although that paper is statistically sophisticated, we recommend investing time to read it. The payoff will be largest for researchers interested in determining the partial effect of a particular factor on total costs, such as the impact of an intervention.

OLS with Log Transformation: Homoskedastic Case

One cannot predict costs from equation 1.a simply by taking the anti-log (exponential) of the fitted value ($\hat{\beta}_0 + X_1\hat{\beta}_1 + \ldots + X_k\hat{\beta}_k$). The fitted value is subject to a retransformation bias.

There is a simple approach to retransformation, called *smearing*, that will be appropriate under two conditions: the model was estimated with OLS, and the error term does not depend on any function of the X variables (a property known as *homoskedasticity*).

The expected value of cost when $X=X_0$ is

(2) $$E(cost) = E\left(\exp(X\hat{\beta} + \varepsilon)\right)$$
$$= \frac{1}{n}\sum_{i=1}^{n}\left((\exp(X_i\hat{\beta} + \hat{\varepsilon}_i)\right)$$
$$= \left(\exp(X\hat{\beta})\right)\left[\frac{1}{n}\sum_{i=1}^{n}\exp(\hat{\varepsilon}_i)\right]$$

The smearing estimator is the term in square brackets, the mean of the exponential of the residuals.

To find the smearing estimator, save the regression residuals. Then exponentiate each residual and calculate their mean. Typically this will be a value between 1 and 2. The smearing estimator is then multiplied by the fitted value ($\exp(X\hat{\beta})$) to yield the predicted value of the dependent variable.

As emphasized in Mullahy (1998), the smearing method is *only* applicable to log-linear models estimated by OLS that have homoskedastic errors.

OLS with Log Transformation: Simplest Heteroskedastic Case

If the error term from the log-linear regression (equation 1.a) depends on some combination of X variables, then there is *heteroskedasticity*. The smearing method will produce biased results in the presence of heteroskedastic errors, but a heteroskedastic retransformation may be available instead (Mullahy 1998; Manning and Mullahy 2001).

To determine the cause of the heteroskedasticity, regress the square of the log-scale errors (those from equation 1.a) on the independent variables:

(3.a) $$\hat{\varepsilon}^2 = \gamma_0 + X_1\gamma_1 + X_2\gamma_2 + \ldots + \eta,$$

where η is an error term for the new regression.

The errors are homoskedastic if there are no significant coefficients on the X variables. In that case, the simple log-linear model (equation 1.a) is unbiased and the smearing method would be appropriate. If there are only one or two significant coefficients and they correspond to binary or variables, then a correction for heteroskedasticity is needed but will not be taxing. If many variables are significant, however, or if one is continuous, then it may take considerable work to create a retransformation factor.

Consider the simplest case, where one binary variables, X_1, is significant in equation 3.a. Using the estimated coefficients from 3.a, calculate the predicted value of each square-error term:

(3.b) $\hat{v} = X_1\hat{\gamma}_1 + X_2\hat{\gamma}_2 + ...X_k\hat{\gamma}_k$,

where *v* stands for the predicted variance of the log-scale errors. The expected value of Y (raw dollars) will then be

(3.c) $E(y|x) = \exp(\hat{\beta}_0 + X_1\hat{\beta}_1 + ... + 0.5\hat{v})$,

if we assume a logarithmic transformation (as in equation 1.a) and a Normally distributed error (Duan 1983).

Marginal Effect of an Independent Variable

Often a researcher wants to know the impact of some variable X_j on predicted costs. The general formula is

(3.d) $$\frac{dE(y \mid x)}{\delta x} = \left(\beta_1 + 0.5\frac{\delta\hat{\varepsilon}^2}{\delta x}\right)E(y \mid x),$$

where $\left(\frac{\delta\hat{\varepsilon}^2}{\delta x}\right)$ is the first derivative of the variance with respect to X_i. If we are using a log transformation (as in equation 1.a), then this marginal effect equals the percentage change in Y due to a unit change in X_i.

If the variable X_i is binary, equation 3.d reduces to

(3.e) $$\frac{dE(y \mid x)}{\delta x} = (\beta_1 + 0.5\hat{\gamma}_1)E(y \mid x)$$

This value can be determined with a calculator using the results from regressions 1, 3.b, and 3.c.

In practice, the marginal effect can be calculated using the result of equation 2 (the smearing estimate) or equation 3.c (the heteroskedastic correction), whichever is most appropriate given the absence or presence of heteroskedasticity. A third method is a nonparametric Monte Carlo-type method, such as bootstrapping. Mullahy (1998) and Manning and Mullahy (2001) provide guidance on how to choose an appropriate method.

8.5 Other Cost Models

Although OLS is always consistent (unbiased) when errors are homoskedastic, it still may not be the best model. Another important consideration is precision (or *efficiency*), which reflects the size of the significance interval bracketing each coefficient. Manning and Mullahy (2001) details several models that are superior to OLS under certain conditions, including nonlinear least squares, poisson, and gamma specifications. It also provides diagnostic tests to reveal the optimal choice among those models. The discussion in Mullahy (1998) is also helpful in understanding the distinctions among these models.

8.6 Other Specification Issues

A small library worth of books cover methods of model specification, and this chapter will not try to summarize them. Many articles using VA data have raised additional pertinent issues and discuss problems specific to VA analyses. Some of the major issues are listed below, with citations to sources that treat the topic:

Case-mix adjustment

The nature and severity of patients' illnesses are strongly linked to total healthcare costs. One method of controlling for these factors is case-mix adjustment. Readers can familiarize themselves with the alphabet soup of adjustment schemes (ACGs, ADGs, HCCs, MDCs, and so on) by reading Anderson et al. (1990), Ellis et al. (1996), or Ettner et al. (2000), among many others. Applications to VA data appear in Phibbs et al. (1997) and Rosen et al. (2001). A general finding in both private and public health plans is that adding risk-adjustment scores greatly increases the predictive power of healthcare spending models. Few if any risk-adjustment schemes are in the public domain, and so the programs that implement them—known as "groupers"—must be purchased from their manufacturers.

Unobserved patient characteristics

Unobserved patient characteristics such as the propensity to seek care can strongly affect total healthcare spending. Some may be observable in theory, such as health history, while factors like personal motivations and beliefs may be strictly unobservable without interviewing each patient. Fixed effects (FE) and random effects (RE) are two common methods for controlling for unobservable variation, whether at the level of the person, the physician practice, the facility, or some other grouping. Good general discussions of the FE and RE models appear in Greene (2000) and other econometrics textbooks. For applications in standard statistical packages, see the manuals of SAS and Stata (SAS Institute 1997; Stata Corp. 2001). A model of VA costs that includes patient-level random effects appears in Barnett and Swindle (1997).

Robust error specifications

As noted above, heteroskedasticity is common in cost data. Manning and Mullahy (2001) recommends specifying "robust" error structures that allow for heteroskedasticity, and the examples contained therein do so. All standard statistical packages allow the use of robust error terms as part of many regression commands, including SAS (SAS Institute 1997; see instructions for "PROC MIXED") and Stata (Stata Corp. 2001; see User's Guide).

Sensitivity analyses

Cost models invariably require the researcher to make assumptions, as when using non-VA costs as proxies for VA costs. A good practice is to carry out sensitivity analyses in which the assumed values are raised or lowered by a nontrivial amount. If the final result is not particularly sensitive to these variations then the result gains in credibility. A recent example in a VA context is Barnett (1999).

Overfitting

A second type of sensitivity analysis concerns the fit of the model. Regression models attempt to fit the data according to specific criteria, such as the sum of squared errors for OLS. There is a danger that they will "overfit" the data so that the regression coefficients would change considerably if a different data set were used. If enough data are available, it is good practice to set aside a portion of the original data (20-35% is typical) and then estimate the original model on the remaining data. The regression coefficients are used to predict values for the data set aside. If the fitted values are close to the real values, then the original model is not overfitted. For a rigorous and thorough example, see Blough et al. (1999).

Chapter 9. Hidden VA Cost: Capital and Malpractice Expense

Two costs of the VA healthcare system are borne by other federal agencies: financing capital acquisitions and malpractice liability. This chapter discusses available information on these hidden costs of VA healthcare.

9.1 VA Capital Costs

Capital--the cost of buildings and equipment--is an important part of healthcare costs. In 1997, capital payments made up 11.1 percent of the Medicare payments to U.S. hospitals covered by the Prospective Payment System (ProPAC, 1997). Economic analysis must consider this cost, which includes both depreciation and financing. VA accounting of assets only considers the purchase price, not the cost of financing a purchase. This is because the financing cost is borne by another Federal Agency. VA calculates the depreciation of assets, but does not estimate the cost of financing their acquisition. The U.S. Treasury Department sells bonds to raise money to make these purchases. The treasury pays interest on these bonds, an economic cost that should not be ignored.

The VA budget for major capital purchases is separate from the medical care operating budget. VA maintains a database of capital acquisitions, called the Fixed Asset Package. These data are kept as a text file at the VA Austin Automation Center and periodically distributed on CD-ROM to VA financial officers. The database includes the name of the asset, when it was purchased, where it is located, its useful lifetime, the current year's depreciation, and the balance of the remaining undepreciated value. The Fixed Asset database is the source of the annual depreciation costs reported in the Cost Distribution Report (CDR) Detail File. Depreciation is not reported in the CDR Jurisdictional File (for more information on these files, see Chapter 4).

To estimate the cost of capital for a specific intervention, the analyst can estimate the rental cost of capital by finding comparable leasing costs. An equipment manufacturer can be asked for the annual cost of leasing the equipment, including the cost of maintenance support. A commercial real estate rental agency can be asked for information on the monthly cost of leasing medical office space.

A more specific method of finding the rental cost of capital requires information on the acquisition cost of the equipment, the length of its useful life, and the interest rate. The useful lifetimes for capital goods are described in the regulations of the U.S. Internal Revenue Service. These are used to calculate depreciation for taxation purposes. The lifetime of equipment generally ranges from 3 to 10 years. Buildings are depreciated over a 30 year lifetime. The real rate of return on U.S. capital has been found to be 11.5 percent (Feldstein, et al., 1983), but an equally reasonable estimate of financing cost is the interest rate on long-term federal treasury bonds.

A simple approach to find the rental cost of a single piece of equipment would be to calculate the payment on a loan to acquire the equipment over its lifetime. This could be done

using the PMT function in Excel. A nearly equivalent method that uses continuous compounding, is to apply the following formula to find the annual payments for a loan (P) as follows:

$$P = \frac{r}{\left(1 - e^{-rL}\right)} A$$

where:
A = acquisition cost of the equipment in nominal dollars
L = life time of equipment, in years
r = nominal rate of return of U.S. treasury bills (e.g. .075 or 7.5%)
e = the base of the natural logarithm (~2.71828)

Rosenheck, Frisman and Neale (1994) compared alternative valuation methods for VA capital, one based on rental rates for similar properties and another based on replacement costs. Unfortunately the methods led to very different conclusions. Across nine VA facilities, Rosenheck and colleagues found the capital cost based on rental rates to be nearly 40% lower than costs based on replacement. There is no *a priori* grounds for preferring one method to the other. A rental market for certain medical facilities may not exist, however, such as specialized surgical suites. If a rental market does not exist, then the replacement-cost method must be used.

9.2 Malpractice Costs

Malpractice liability is another cost of healthcare. VA cost databases do not include this cost.

The cost of VA malpractice liability is borne by the U.S. Department of Justice. Lawyers from the Department defend VA from liability claims. The Justice Department also pays awards to claimants who successfully pursue their claims of malpractice.

VA maintains a database of paid malpractice claims. Access to these data may be requested via the Office of the VA General Counsel. In recent years, VA has paid some $63 million annual in claims and settlements (Table 9.1). This amount is a relative small fraction of the $18 billion VA healthcare cost.

The amount of these claims does not include the cost incurred by the VA General Counsel and the Justice Department in defending the agency from malpractice claims. This amount may be estimated using the following logic. Individuals who file malpractice claims are represented by attorneys working on a contingency basis. The average malpractice award includes 30-35 percent for the claimant's attorney's fees. As these attorneys are paid entirely from these

Table 9.1 Amount Paid in VA Medical Malpractice Cases, Fiscal Years 1996-2001

Year	Administrative Settlements	Litigation Settlements	Judgments	Total
1996	$ 20,492,247	$ 27,830,873	$ 5,152,155	$ 53,448,275
1997	$ 21,129,995	$ 27,062,891	$ 13,834,638	$ 62,027,524
1998	$ 18,249,971	$ 36,170,116	$ 5,785,281	$ 60,205,368
1999	$ 24,816,612	$ 29,039,319	$ 9,161,221	$ 63,017,152
2000	$ 21,200,448	$ 38,217,368	$ 4,133,004	$ 63,550,820

Source: VA General Counsel

contingencies, these fees are sufficient to pay for attorney cost for both successful and unsuccessful claimants. If an equivalent amount is spent defending malpractice suits as is spent in filing them, then this suggests that the federal government spent $22.3 million (35% of $63.6 million) defending VA from malpractice claims in FY2000.

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