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A Small Area Approach to the Analysis of Health Systems Performance

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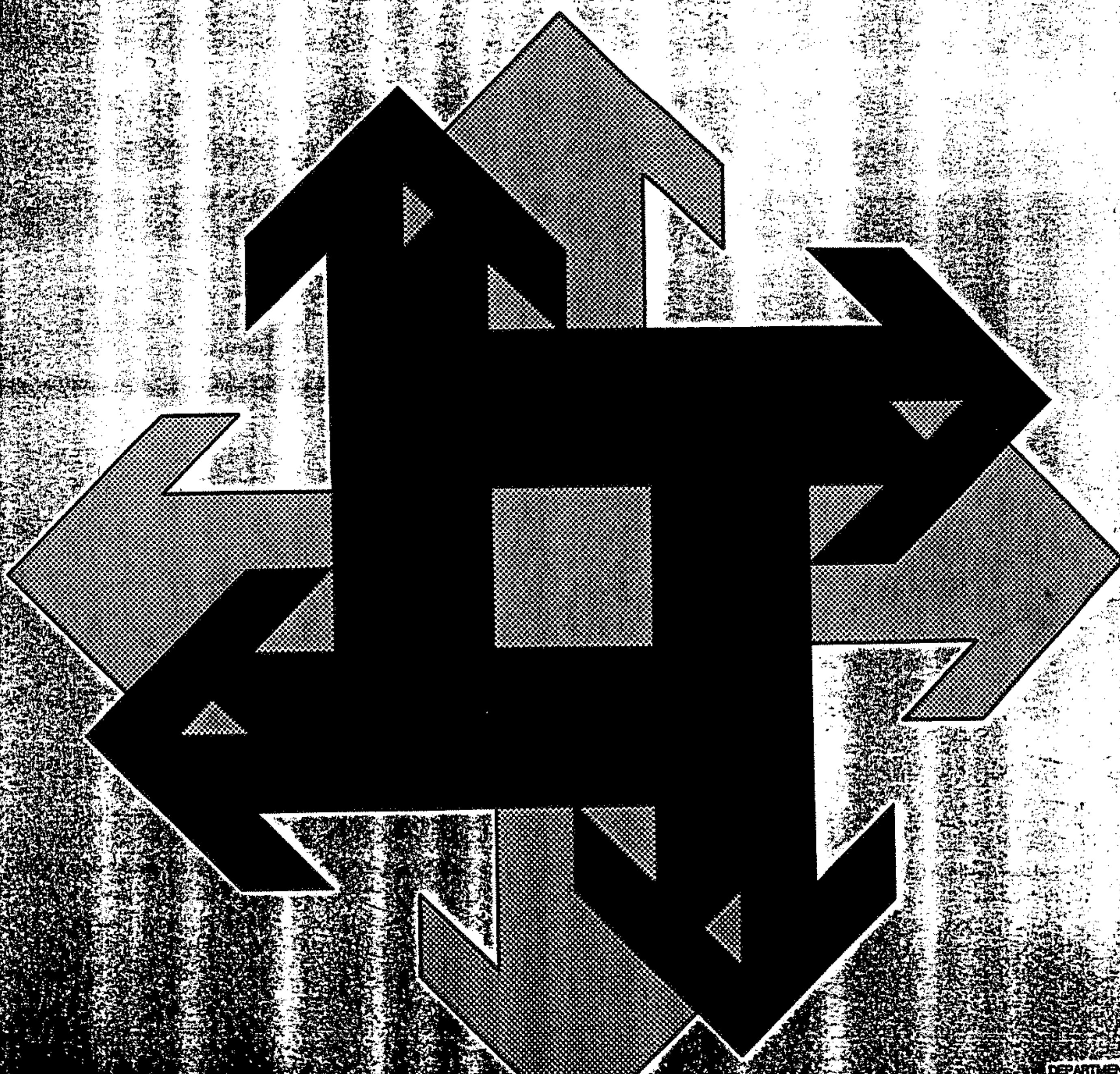
A Small Area Approach to the Analysis of Health System Performance



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A Small Area Approach to the Analysis of Health System Performance

By
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and
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under Contract No. 291-76-0003

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FOREWORD

Methods and techniques for acquiring and analyzing data have been an area of primary concern for State and local health planning agencies since their initial designation. As their responsibilities have developed and the factors become more complex, the agencies have realized an even greater need for analytic processes for evaluating the performance of their health care systems and determining future directions of their programs.

In performing the analyses with data collected in the small, rural areas of New England, this study may provide alternative procedures for data development which are appropriate for use in other small area studies throughout the Nation, including assessments in PSRO settings and health service areas. Yet, many items of consideration in this report need not be confined to small areas; the use of Medicare data for assessment of medical care outcomes, trends in rates of use of hospital services, variations in resource allocations, all have important implications for the health planning agencies.

We hope you find the study useful to your health planning efforts.

Colin C. Rorrie, Jr., Ph.D.
Director
Bureau of Health Planning

PREFACE

This report is Volume II of a two-volume final report by the Codman Research Group, prepared for the Health Resources Administration under Contract #291-76-0003, to assess the usefulness of small area data to evaluate the health planning program in New England.

Volume I, Health Planning and Regulation: The New England Experience, describes health planning and regulation in New England from 1976 through 1979. Part One includes chapters on the setting, the roles of key actors in health planning, planning methods, policies over time, and conclusions. It is based on several hundred interviews and selected case studies concerning Certificate of Need and 1122 applications, development of resource standards, and inter-institutional competition. Part Two of Volume I consists of nine case studies developed to illustrate how the health planning requirements were being implemented by the health systems agencies.

Volume II deals with cross-sectional differences and changes over time in the amount, kind, and costs of hospital services in New England communities. It also addresses the problem of ascribing an observed change in the local pattern of hospital use to a specific Federal or State program.

Both of these volumes will be made available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161, Area Code 703 487-4650.

ACKNOWLEDGMENTS

This report has been prepared by the Codman Research Group under a contract from the Health Resource Administration (Contract 291-76-0003) to evaluate the process of health planning and regulation in the New England States. In addition to this research, the report summarizes a number of studies based on hospital discharge data which the authors have conducted with the support of a number of Federal agencies.

The list of acknowledged grants and contracts attests to the continuity of support by the Federal Government for efforts to develop new methods for the analysis of health systems performance. The earliest studies reported here were performed under grants awarded to the Northern New England Regional Medical Program (NNE/RMP), Public Health Service Grants PHS-RM0303 and HS01197. The NNE/RMP was fortunate to inherit the hospital discharge data collection system which was organized by Dr. Kerr White during his time of tenure as Chairman of the Department of Community Medicine at the University of Vermont. Under RMP auspices the system was expanded to cover all hospitals which routinely serve Vermonters. Much of the developmental work for defining hospital areas, for estimating resource allocations and measuring utilization were performed when the authors were associated with the NNE/RMP.

In 1973 the RMP data system was administratively re-organized to become the Cooperative Health Information Center of Vermont (CHICV). The major support for CHICV came from three grants from the National Center for Health Services Research (HRA 230-75-0163, 230-75-0142 and 230-75-0129.) A subsequent contract from the National Center for Health Statistics (230-75-0192), and, more recently, from a grant from the Health Care Financing Administration (18-P-97520/1-01).

Since September, 1978, a systematic study of the nature, extent, causes, and cost implications of small area variations in the hospital and ambulatory care setting has been underway at the Department of Community & Family Medicine at the Dartmouth Medical School. The authors of this report and Michael Zubkoff, Ph.D. serve as Principal Investigators on this work, which is supported by the Health Care Financing Administration (Grant Number 18P97192/1-02).

This book also summarizes a number of studies which the Codman Research Group has undertaken to demonstrate the use of Medicare data for health planning and outcome assessment of medical care. These studies have been funded by a contract from the Health Care Financing Administration (Contract 600-77-0039).

It is impossible to adequately acknowledge by name the people who have contributed in one way or another to the work presented in this book. Without the cooperation of the physicians, hospital administrators and State agencies who contributed data to CHICV--and to similar organizations in Maine and Rhode Island--the studies could never have been done. And without the interest of the same physicians, hospital administrators and agencies in learning about the patterns of medical practice and principles, the use of epidemiologic data for feedback to improve decision-making would not have occurred. Nor could it have occurred without the active support of the State Medical Societies or Hospital Associations which we gratefully acknowledge.

We also acknowledge the advice and help of a number of colleagues who have contributed to our work over the years. Mention must be made of the special contribution of three physicians--two anesthesiologists and a surgeon--who have been particularly helpful. John Bunker has encouraged and advised

us for a very long time; John Mazuzan provided the key to keep things from falling apart in the early days; Benjamin Barnes continues to help in the interpretation of the epidemiology of surgical practices.

The studies presented in this book happened because of the strength and loyalty of a number of co-workers. To the "original four"--Roger Gillim, Pat Hickcox, Karen Provost and John Senning--goes a lion's share of the credit for the continuity of this research over more than ten years. To John Putnam and David Soule goes the credit for the development of the Maine Data Service; without their long-range commitment to the prospect of data feedback, the current advantages for Maine made possible by the Maine Data Service would not have occurred. Dr. Dan Hanley, the editor of the Maine Medical Journal, was supportive in our efforts to disseminate some of the early results of our work, and Maine's Medical Care Development, directed by Manu Chatterjee helped support our studies in Maine. We also thank the former Governor of Vermont, The Honorable Deane C. Davis, for State Senator Douglas Kitchel, and Jennifer Robbins, whose efforts were instrumental in establishing CHICV as a viable organization.

Our colleague Floyd J. Fowler, who organized two household interview surveys, has made a major contribution to our understanding of the role consumers play in the causes of geographic variation. Michael Zubkoff has also helped with the interpretation of economic behavior.

Special thanks are in order to Anne Bouchard, who managed the difficult task of getting this manuscript in order, to Linda Aldrich and Jill Michalenoick for skillful typing and to Jay Tuck for his editorial advice. Thanks are also due to Lynn Anderholm, Ross Jaffe, Patty Hale, Steve Marion and David Herr for their contributions and comments.

We also appreciate the assistance of Frank Dorsey and Jonathan Stevens of CHICV; and the staff of SEARCH, particularly Jim Cooney, Jr., Ann Walker and Alan Humphrey.

We are particularly appreciative to our Project Officer for this contract, Anabel Crane, who together with Milt Schoeman of the Health Resources Administration, provided invaluable guidance in the completion of this project. They have been particularly helpful in the completion of the final book, and it is largely due to their urging that we have expanded the book to its present scope.

We also want to thank Doug Williams of the National Center for Health Statistics who, as Project Officer for the contract with CHICV, has for a long time, supported the development of many of the small area analyses presented in this book.

As Project Officers for several studies reported in this book, which were supported by HCFA, Peter McMenamin, George Chulis, Marion Gornick and Penny Pine have encouraged the development of studies of the use of Medicare data for health planning. We appreciate their long term interest in this effort. Peter also helped by reading the manuscript and obtaining HCFA permission for the publication of the studies performed under contract 600-77-0039.

Finally, we would like to thank Dan Zwick, formerly of HRA and now with the American Hospital Association. Dan, more than anyone else, made it possible for the Codman Research Group to study the process and outcome of health planning and regulation in New England.

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CHAPTER I

INTRODUCTION

It is increasingly apparent that hospital performance, measured in terms of per-capita rates of use of resources and services, varies significantly among apparently comparable populations living in neighboring communities. The classic description of small-area variations is Glover's pre-World War II study which showed that British school children experienced ten-fold differences in per-capita rates of tonsillectomy between different school districts.[1] These variations in utilization persisted long after the National Health service removed any possible economic motives for tonsillectomy. Thus, in 1959 the Chief Medical Officer noted in his annual report that "the tonsillectomy rate ranges from 0.5% in Merthyr Tydfil to 16.3% in Chester; in those aged 15 years, it ranges from 1.3% in Swansea to 36.5% in Kingston-upon-Hull."[2] In more recent years extensive variations for total surgery and for specific procedures have been documented for neighboring communities within the United States,[3-5] Canadian Provinces,[6] geographically separated but apparently homogeneous members of insurance plans,[7] and for enrollees in prepaid group practices.[8] While the rates are generally lower in the United Kingdom than in North America, the range of variation among neighboring health districts in the United Kingdom appears to be of the same order of magnitude as seen among North American communities of similar size.[9]

The per-capita rates of use of hospital beds and expenditures also show extensive variations.[10] The studies presented in this report show extensive variations among neighboring communities within each of the six New England States: per-capita expenditures for hospital in-patient services and per enrollee reimbursements under the Medicare

Program vary by more than two-fold between highest and lowest hospital areas in all states except Vermont; the use of hospital beds varies by nearly as much, with some communities having bed-per-capita ratios that are similar to those seen in the Kaiser Permanente Plan--and others having ratios that exceed the pattern seen in Western Canada where the number of beds is greater than 6 per 1,000.

The idea that hospital performance should be measured through the routine recording of information on each patient is not a new one. It was first advanced more than 100 years ago by Florence Nightingale, who proposed that information on patients admitted to London hospitals should be collected so that the impact of hospitalization on health status could be compared among patients and hospitals.[11] At the beginning of this century, the same concept was advanced by Ernest A. Codman, a Boston surgeon interested in improving clinical performance through the feedback of information on outcomes, who was able to establish and maintain a data system for a short period of time.[12] In more recent years, with the introduction of electronic data processing, interest in the establishment of routine data systems has grown. In the United States, routine data collection procedures have been established in several States, with Rhode Island and Vermont having the longest experience. Since 1969, information on each admission has been maintained under the auspices of a regional data organization. In Rhode Island, the organization is Rhode Island Health Services Research, Inc. In Vermont, the responsible agency is the Cooperative Health Information Center of Vermont. These agencies are responsible for data confidentiality and for making the data available for use by hospitals, public agencies, physicians and other members of the health care sector. Since 1973, data have been collected in Maine and, more recently, a regional organization, the Maine

Health Information Center, has been formed to take responsibility for collection, confidentiality and release of the data.

In each State, essentially the same information is available for each admission. The information does not identify individuals, recording only age, sex, residence, diagnoses, operations, hospital of occurrence, date of admission, date of discharge and discharge status; although the data base appears to contain a minimal amount of information, it supports a number of studies of the use of health care among New England communities. We are fortunate to have been long associated with the developments in these States and, as health researchers, have had unique opportunities to explore some of the uses that could be made of large data banks for the analysis of hospital performance.

This report summarizes a number of studies which describe hospital performance in New England. Part One is devoted to methodologic issues. Chapter II describes how a small-area analysis is undertaken; how the demography of hospitalizations within a region can be described so that larger geographic regions can be subdivided into local hospital market areas; how indicators of performance describing per-capita resource allocations are developed; and how utilization of services is measured. The chapter also deals with several statistical issues which are important in the interpretation of the data.

Chapter III deals with problems of the quality of data available in the hospital discharge abstract. Studies on the consistency of recording practices are reviewed to give the reader an understanding of the limits on the interpretation of hospital utilization data. We conclude that while demographic data, such as age, sex, place of residence and surgical procedure codes are reasonably accurate, the

coding of the cause of admission is extremely variable and cannot be relied upon at a level of detail beyond major disease classification.

Although the basic approach to small-area, epidemiologic analysis was initially developed using the hospital discharge data systems available in Maine, Rhode Island and Vermont, the research described in Chapter IV extends the basic methodology to the data maintained by the national Medicare Program. These data can be used to describe the health-care system and yield much of the same results as are obtained with total discharge data. The data files we use for this purpose are the MEDPAR (Medicare Provider Analysis and Review) file, a 20% sample of all inpatient stay records paid for under the Medicare program. The MEDPAR files contain utilization information from bills, demographic information about enrollees and provider information. Data from the Medicare Part B Program, which have the virtue of being potentially available throughout the United States, are also used in Chapter IV. They also have some important advantages over the Main, Rhode Island and Vermont hospital data in that information on charges and reimbursements is available. More importantly, the Medicare data include data of death after discharge from hospital, so that survival can be measured. Thus, this source of data can be used to accomplish some aspects of the goals of Nightingale and Codman--to connect medical care events to their outcomes.

Part Two of the book is a description of the epidemiology of medical services in New England. Chapter V shows how the data have been used to systematically measure the distribution of hospital resources across the six New England States. It also describes the cross-sectional pattern of variation in rates of use of services to show that some

surgical procedures or hospitalizations have relatively little variation while others have a great deal. Chapter VI investigates the consistency of the differences in rates of use of services over time, as well as the long-range trends in expenditures for particular surgical procedures, such as tonsillectomies or cesarean sections.

A picture of the health care system emerges in which the constituent hospitals have strikingly different performance records with regard to impact on population rates of use of medical technology and expenditures.

In Part Three, we give examples of a number of different applications of the data. Chapter VII explores how epidemiologic information can be used for the planning, management or regulation of the hospital system. Theoretical and actual applications of data in facility planning, in Certificate of Need decisions and in the development of State health plans are discussed and examples given. Applications in insurance or price regulation are also presented, including the use of data to develop "parity" prospective budgeting: Based on either Medicare data or the hospital discharge data, budget estimates can be developed for each hospital in a region such that if these budgets were realized, the variations in hospital expenditures or Medicare reimbursements per capita would be substantially reduced. The importance of using these methods to achieve a more equitable distribution of resources is highlighted by the use of the data to describe the cross-subsidizations between communities that result from insurance or taxation policies that do not take historical patterns of per-capita expenditures into account. A final section discusses how hospital administration may use the data for planning of physician staffing and for cost-containment through review of employment practices.

Chapter VIII shows some uses that can be made of the data for measuring clinical practice and suggests strategies and a case example for use of the data in the PSRO setting. With the small-area approach, PSROs can focus their review on the specific cases (in specific hospitals) that contribute substantially to rates higher than the regional average, leading more directly to review of controversial uses of care than do current approaches to utilization review. We also show how the outcome of care--with regard to mortality following surgery--can be more accurately and extensively assessed with Medicare data than with any other existing data source.

Chapter IX summarizes some uses of the data for the evaluation of the impact of public programs. We review the relationship between regulatory and planning decision-making and the performance of the health care system: Over time, can connections be made between planning and regulation and their end result as indicated by changes in rates of use of services or expenditures? A study concerning the impact of PSRO concurrent review on rates of hospitalizations and patterns of variation is included. Using the small-area approach, we demonstrate that no changes in utilization or expenditure rates were clearly related to program impact. We also examine the impact of rate-setting and the Medicaid Program with regard to the equitable distribution of resources among community populations.

In the final chapter of the book we discuss strategies for improving the feedback of data on performance of the hospital sector. While the variations in performance raise a number of policy dilemmas that are not easily resolved, we suggest that the first step to resolving the dilemmas is more widely shared and used information about their nature.

PART ONE

Measuring Health Systems Performance Using Small-Area, Epidemiologic Techniques

CHAPTER II

HOW TO UNDERTAKE A SMALL-AREA ANALYSIS

There are four steps in doing the small-area analysis of hospital performance:

- Step One: acquiring the necessary data
- Step Two: defining areas and populations
- Step Three: estimating the quantity of health resources allocated to populations
- Step Four: measuring the utilization of hospital services by populations

This chapter describes each of these steps. It also reviews some commonly used statistics and discusses the limits of the data for describing case mix.

ACQUIRING THE NECESSARY DATA

The appropriate base for defining areas and populations, for estimating resource allocation and for measuring the utilization of hospital services is a population-based data set covering the use of hospitals by the full population living within the geographic areas of interest. The data should include:

--hospital discharge data

--population counts, and

--information describing the resources and expenditures of hospitals

These data can be acquired from a number of resources. Hospital discharge data are the most difficult to obtain. In a few States, all hospitals are enrolled in a cooperative system which provides information corresponding to the Uniform Hospital Discharge Data Set (UHDDS), recommended by the National Center for Health Statistics.

Analysis of insurance claims provides another source of utilization data. The following section describes elements of these data sets and tells how they may be obtained.

Hospital Discharge Data (for a defined population)

This data set, the backbone of small-area analysis, consists of a unit record of discharge from hospitals over a defined period of time, preferably for at least one year. The records may be for all discharges or for a sample of discharges. However, if the records are sampled, problems of sampling variation may hinder interpretation of variations in rates, particularly those involving the estimates of resources allocated to populations. In order to generate unbiased population-based rates, it is important that discharge data be acquired from all of the hospitals that routinely serve residents of the pertinent areas. This will usually mean that hospital use must be investigated across the boundaries of geopolitical areas, such as States or health service areas.

For example, in the Vermont studies, we investigated the use by Vermont residents of hospitals located in all of the neighboring areas along the New York, New Hampshire and Massachusetts borders. The use of referral hospitals in Boston, Montreal, Hanover, New Hampshire, and in Albany, New York, was also investigated. When significant numbers of Vermont residents were found to be using an out-of-state facility, the hospital was requested to provide discharge records for Vermont residents, so that any hospital which contributed more than 5% of the hospitalizations of any Vermont town's residents were included.

The items contained in the discharge record vary according to the nature of the data system from which they are derived. The simplest and most commonly encountered record is that collected as part of an *ad hoc patient origin study*.

This record will often consist only of a code for the hospital and a code for the location of the patient's home for all discharges occurring during a specific period of time. This minimal information is all that is needed to investigate geographic patterns of hospitalization and to define populations with reference to the hospitals they use. In more extensive patient origin studies, the data may include data of admission and service (e.g., maternity) from which the discharge occurred. Furthermore, (as described in the next section) when used in conjunction with information describing resources and expenditures of hospitals, the patient origin data is sufficient to use in estimating the allocation of beds and expenditures per-capita. Because of their simplicity and low cost, many planning agencies and hospital associations have undertaken their own patient origin studies. In the studies presented in Part Two of this book, the hospital discharge data in three States--New Hampshire, Massachusetts and Connecticut--are based on patient origin data. In New Hampshire and Connecticut the data were collected by health planning agencies and in Massachusetts the data were collected by the Massachusetts Hospital Association.

Hospital Discharge Data Sets Containing the UHDDS Elements

Table 2.1 lists the UHDDS data items. These data items supply numerator data for determining age-adjusted utilization rates and for analyzing hospitalization experience related to case mix.

In Maine, Rhode Island and Vermont, the discharge sets contain the items recommended by the National Center for Health Statistics for inclusion in the UHDDS.[13] In each of these three States, the major source of the discharge data is a discharge abstract service: in Vermont, 14 of the 16 hospitals currently supply discharge abstracts to

the Commission on Professional and Hospital Activities, Professional Activities Study (CPHA/PAS). One of the hospitals that does not participate in CPHA/PAS contributes UHDDS compatible data from its own computer system and the other submits abstracts of records directly to the agency responsible for merging the data into a common format.

TABLE 2.1

ITEMS INCLUDED IN UNIFORM HOSPITAL DISCHARGE DATA SET

Hospital	
Date of Discharge	
Length of Stay	
Patient	- Age Sex Town of Residence
Discharge Status	
Diagnosis	- Final Diagnosis Explaining Admission Secondary Diagnosis
Procedures	- Principal Procedure Secondary Procedures

Maine data is derived from three sources. Most of the hospitals are registered in the Maine Data Service, an abstract service administered by the Maine Blue Cross organization; five hospitals participate in the CPHA/PAS system; and one Maine hospital records its discharges with a commercial discharge service. All Rhode Island data is acquired through CPHA/PAS.

Each of the three States maintaining the UHDDS does so through a single agency that is responsible for merging the data from the hospitals into a single uniform file. In Maine, the responsibility is with the Maine Data Service; in Rhode Island, the Rhode Island Health Services Research, Inc. (SEARCH) is the responsible agency; in Vermont, the Cooperative Health Information Center of Vermont, Inc. (CHICV) serves this function.

Since full coverage, population-based data sets containing the UHDDS elements are available only in a few States, information based on claims data can provide a useful alternative. Chapter IV summarizes studies which show how the MEDPAR data file and Medicare Part B claims data can be useful surrogates for patient origin data and can measure utilization.

Population Data

To generate population-based rates of use of service, a denominator, the number of persons-at-risk, is needed. One source of population data is the dicennial census which provides population counts for minor civil divisions or for zip codes in five year-age groupings. In the intercensal years, estimates can usually be obtained from a State agency, such as a planning office or health department, but the age breakdowns are not always convenient. For our studies in the six New England States, we made estimates for the years before and after the intercensal using a straight line interpolation and extrapolation based on 1970 census and year of estimate. For studies based on Medicare claims data (including MEDPAR), we used the Medicare enrollee file as the source of the denominator.

An important caveat concerns the geo-code. For constructing per-capita rates, the geo-codes used in the numerator (for example, the UHDDS) and in the denominator (the population file) must match. Since the numerator geo-code can be either a zip or a minor civil division, we have found it convenient to organize the data so that the basic geo-unit is a "zip-minor civil division unit"--a "ziptown"--identified by: (1) investigating the boundaries of zip codes and of minor civil divisions, and (2) grouping each so that the resulting aggregates under both code conventions relate as nearly as possible to the same geo-

graphic area. This strategy also reduces the importance of a possible source of confusion in recording place of residence in numerator data: place of residence is sometimes reported in the UHDDS in terms of location of post office rather than patient residence.

Resource and Expenditure Data

As will become apparent in the discussion below, the strategy for estimating hospital resource allocations to populations can be applied to any fixed resource or expenditure associated with a hospital. Thus, if there is interest in the distribution of coronary care units among community populations, a count of the number of such beds in each hospital is needed. Or, if the objective is to estimate the per-capita annual expenditures for inpatient services among the various populations of a region, a valid estimate of the annual inpatient expenditures of each hospital is needed. Similarly, if the employment practices of hospitals are to be investigated in terms of per-capita employment rates, then the number of full time equivalent (FTE) employees in each hospital is needed.

There are various sources for these data, but those who use them must assess their accuracy carefully because the variations demonstrated by the analysis sometimes represent artifacts of the under- or over-counting of resources rather than substantive differences in resource allocation. Fortunately, with the growth of special registries associated with rate setting and other planning or regulatory programs, the opportunities for acquiring accurate descriptive data of the resources and expenditures for hospitals are increasing.

In this report, we have based our estimates of inpatient expenditures on data from Medicare cost reports for Vermont, New Hampshire and Maine. For Rhode Island they are provided

by SEARCH, and are based on American Hospital Association (AHA) data for inpatient costs. The Connecticut data are also from the AHA. The data for Massachusetts have been provided by the Massachusetts Rate Setting Commission.

Data describing hospital beds are based on AHA data, as is the FTE employee rate.

Summary: Types of Data and Their Sources

Table 2.2 summarizes the data used in the various studies reported in this monograph.

TABLE 2.2

DATA USED IN THIS BOOK

POPULATION ESTIMATES	
For 1960 and 1970	United States Census
Interim Estimates	(1977)
Connecticut	Connecticut State Department of Health Division of Health Statistics, Estimated Population 7/1/77
Maine	Maine State Health Department (1975)
Massachusetts	State Census (1975)
New Hampshire	Office of Comprehensive Health Planning (1977)
Rhode Island	Rhode Island State Health Department (1975)
Vermont	Vermont State Health Department (1975)
UTILIZATION DATA	
Paitent Origin Data	
Connecticut	Connecticut Hospital Association (10/76-9/77)
Massachusetts	Massachusetts Hospital Association (3/74-2/75)
New Hampshire	United Health Systems Agency (10/76-9/77)
Uniform Hospital Discharge Abstracts	
Maine	Maine Health Data Service (1973-1977)
Rhode Island	Rhode Island Health Services Research, Inc. (SEARCH) (1974-1977)
Vermont	Cooperative Health Statistics Center of Vermont (1969-1977)
Medpar (1975)	Health Care Financing Administration
All New England states except Connecticut	
Medicare Part B	
Vermont	Carrier (1972)
RESOURCE ALLOCATION DATA	
Expenditures	
Connecticut	Commission on Hospital and Health Care, Finance Div.
Maine	Maine Health Data Service (from Medicare Cost Rept.)
Massachusetts	Massachusetts Hospital Association
New Hampshire	Based on Medicare Cost Reports
Rhode Island	SEARCH - Based on American Hospital Association
Vermont	Based on Medicare Cost Reports
Hospital Beds and Personnel For All States - American Hospital Association	

DEFINING AREAS AND POPULATIONS

The Per Capita Rate

The analyses in this monograph are examples of the use of epidemiology as applied to health services. Perhaps

the most fundamental epidemiologic concept is that of a population-based or per-capita rate, which is used in many contexts. Most people are familiar with the concept of per-capita income, which is often used as an indicator of relative prosperity among states or among the various communities within a state. To compute this per-capita rate, the analyst must first define the areas that he or she is interested in comparing. The rates for comparison are then constructed by counting the total number of residents in each area (i.e., the "population-at-risk" in epidemiologic terms) and then determining the total income of each area which is the sum of all income received by the resident population. Note that income is counted by place of residence and not by place of employment, so that the income of a resident who works out of the area is counted for the area where the worker lives. The per-capita rate is obtained by dividing the denominator for the number of residents (whether they are workers or not)--into the numerator--the total income.

In the health field, the death rate, based on place of residence, is often used in population-based analysis. Here, once again, the analyst must specify the geographic areas for comparison, count the population and count the number of deaths (regardless of place of death). He/she then constructs the rates by dividing, on an area-specific basis, the number of events (the deaths) by the number of people living in the area (the population-at-risk).

Establishing the Population at Risk

In working out population-based rates, the choice of criteria for defining the areas for study is a key decision. The criteria used can be based on public policy. Area comparisons on per-capita income and other indicators of prosperity are sometimes made to determine eligibility for

welfare benefits: In this case, areas usually correspond to the boundaries of local government. An example that is particularly important for the administration of national health manpower programs is the designation of "medically underserved areas" -- geopolitical units declared to have "need" based on their ranking on several indicators thought to relate to the relative consumption of health services.

The selection of areas can be based on some characteristic that is thought to be associated with mortality. The relationship between per-capita income and death rates can be studied by ranking communities according to their per-capita income, combining small communities into larger areas (to develop a population-at-risk that is sufficiently large to generate "statistically significant" rates, see page 28),and counting the number of events (deaths).

In this case, the definition of the area is based on criteria derived from a hypothesis concerning causality; the application of the criteria is to an indicator of the independent variable, per-capita income. An example of this approach is the stratification of populations on the basis of their rates of surgery to investigate the association between exposure to surgery and surgery-associated deaths per capita (see page 181).

In the small-area analysis of hospital performance, population-based rates can be defined by policy or by empirical criteria. The approach will depend on the objectives of the analysis. In our experience, the more common approach to defining the population-at-risk is according to <u>geographic patterns of use of hospital service</u>. This approach involves some measure of the relative frequency of use of hospitals by residents living in each of the most detailed geo-code units available. In this study,

this unit is the "ziptown." as described above. Ziptowns may then be clustered or aggregated to form hospital areas.

<u>Using Patient Origin Data to Define Hospital Areas</u>

Table 2.3 illustrates the procedure. Step one involves a count of the number of cases by geographic area for each hospital with a unique geographic code and for groups of hospitals when hospitals are in the same location. In the table, Hospital I and II are in different locations; Hospitals III and IV are in the same community. The strategy for aggregating the basic geographic units into the areas to be used for a comparative study will vary according to the purpose of the analysis. In the analyses presented in this report, the demographic units used most often are "hospital areas." each made up from the basic geographic units (the ziptowns, whose residents tend to use the same local hospital(s)). To define the "hospital area." we investigate the relative frequencies of use of hospitals in each ziptown and assign each unit to "membership" in the area served by the hospital(s) with the plurality of (or most) discharges from the unit. For example, using the so-called "plurality rule" in Table 2.3, zip-units 1 through 4 are assigned to the area of Hospital I; zip-unit 5 and 6 to Hospital II's area; and zip-units 7 through 9 to Hospital III and IV's area.

In the rural sectors of New England, the analysis portrayed in Table 2.3 will occasionally lead to the definition of areas that are not completely contiguous. For example, in Vermont certain ziptowns that are located at some distance from the nearest hospital will divide nearly equally among hospitals located in two or more different areas. Occasionally, a town within the outer boundary of towns assigned to one hospital area will qualify for in-

clusion in an area of another hospital. To promote the development of areas made up of contiguous ziptowns which

TABLE 2.3

USING PATIENT ORIGIN DATA TO DEFINE HOSPITAL AREAS

PART I: NUMBER OF ADMISSIONS TO FOUR HOSPITALS BY THE ZIPTOWN OF THE PATIENTS' RESIDENCE

Hospital Code	Ziptown Location	Ziptowns 1	2	3	4	5	6	7	8	9	All Other Ziptowns
I	2	55	1,236	200	19	76	4	8	18	49	97
II	5	0	82	0	16	35	826	10	7	18	130
III[o] > IV[o]	8, 8	3	37	4	18	0	82	1,421	831	2,332	275
All Others		6	104	129	10	32	92	386	72	230	35,670
Total		64	1,459	333	63	459	1,004	1,825	928	2,629	36,172

PART II: PERCENT OF ADMISSIONS TO FOUR HOSPITALS BY THE ZIPTOWN OF THE PATIENTS' RESIDENCE

Hospital Code	Ziptown Location	Ziptowns 1	2	3	4	5	6	7	8	9
I	2	85.9	84.7	60.6	30.2	16.6	0.3	0.4	1.9	1.8
II	5	--	5.6	--	25.4	76.5	82.3	0.5	0.8	0.7
III > IV	8, 8	4.7	2.5	1.2	28.6	--	8.2	77.9	89.5	88.7
All Others		9.4	7.1	38.7	15.9	7.0	9.2	21.6	24.8	8.7
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[o]Hospitals locatèd in same ziptown are combined when hospital areas are defined.

are more useful to planners and providers we have included some small ziptowns that did not meet the plurality criterion.

New England's 193 Hospital Areas

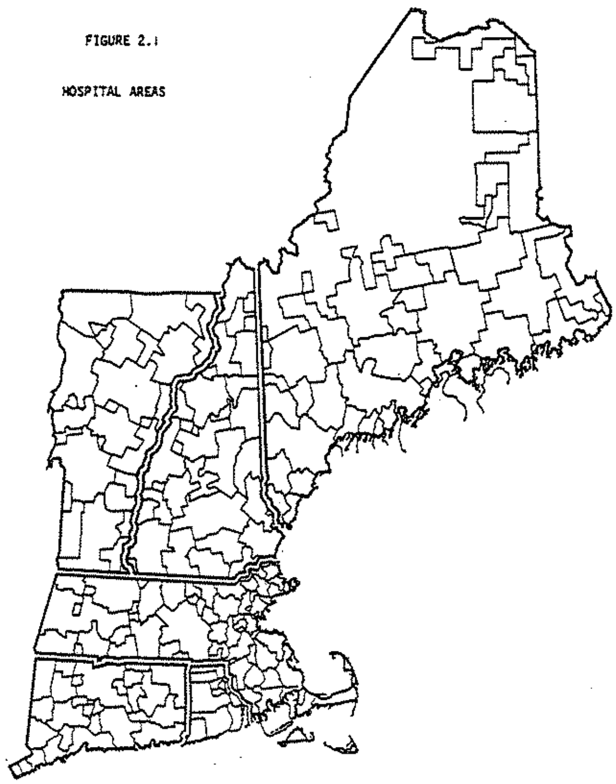
The term "hospital service area" has been used in a variety of ways. We have found it convenient to refer to the areas defined by the plurality rule simply as (local) "hospital areas" and to refer to the resident population of the area as the "principal population of the local hospital(s)."

Patient origin studies undertaken in each of the six New England States result in the division of New England into 193 geographically distinct hospital areas. There are 26 areas in Connecticut, 41 in Maine, 79 in Massachu-

setts, 24 in New Hampshire, seven in Rhode Island and 16 in Vermont. (See Figure 2.1) The procedure usually results in areas where the majority of residents are discharged from the local hospital(s).

FIGURE 2.1

HOSPITAL AREAS



The method for defining areas is similar to that proposed for "hospital service areas" by Poland and Lembke,[14] except that we do not investigate patient origins below the minor civil division or ziptown level.

The approach differs from that proposed by Griffith.[15] Under his method, the population resident in each geographic unit is "assigned" to a specific hospital, according to the hospital's percentage share of the discharges from the geographic unit. Thus, in Table 2.3 Hospital I would be assigned 85.9% of the population from Area 1, 84.7% from Area 2, etc. The population served by the hospital is thus the sum of its allocated population, as

determined by the relative frequency of discharge and the population of each ziptown. These synthetic populations sometimes yield results with similar trends as the method based on area-specific populations. However, the denominator that is used to generate the rates by Griffith's method is a function of the numerator and, for any single geographic unit, the utilization rate calculated for each hospital will be identical. However, as the studies in Part Two clearly show, hospitals are not the same with regard to the probability that a member of a "population-at-risk" will be admitted. In some cases, populations of similar size will experience two-fold differences in the number of discharges. The allocation of populations to hospitals on the basis of relative frequencies of discharges thus means that hospitals with higher than average probabilities for admitting patients will be assigned larger populations than the actual "population-at-risk" for their services. A further problem with synthetic populations is that standard statistical techniques for testing significance of rate variations, which require that the numerator be a proper subset of the denominator, cannot be applied to synthetic populations.

Identifying Service Areas in Urban Areas

In the urban setting, use of the plurality rule to define hospital areas leads to the aggregation of many minor civil divisions into areas with large populations. In Providence, this resulted in an area with five local hospitals and a population of 480,000. Hospital areas were also defined in Providence by excluding its largest hospital (which obtained a plurality in nearly every census tract). The method was not satisfactory because it resulted in the assignment of many non-contiguous census tracts to membership in an area, violating the concept of geographically contiguous "medical market areas" comprised

of neighboring communities. An alternative approach was adopted which aggregates neighborhoods in the urban setting into administratively defined health service regions. The health service regions are then aggregated into hospital service areas defined by patient origin studies. The method thus involves three levels of aggregation:

Level One: Urban Neighborhoods: in which census tracts in urban areas are grouped into neighborhoods (as defined by the Rhode Island Health Department). There are 38 neighborhoods containing one-half of the State's population in Providence.

Level Two: Health Service Regions: in which neighborhoods (and non-Providence census tracts) are grouped into Health Service Regions. The boundaries of these regions were previously determined by SEARCH or the Rhode Island Health Department. In the urban areas, the criteria for defining the region include social class of neighborhood, geographic contiguity, and shopping pattern for medical care. In the non-urban areas the regions fit existing patient flow patterns concerning hospital use Outside the Providence area, the Rhode Island Health Department and SEARCH areas diverge. We have selected the areas which correspond most closely to the boundaries of our original hospital service areas which were based solely on patient origin criteria.

There are 18 health service regions which contain the entire population of Rhode Island.

Level Three: Major Hospital Service Areas: in which the individual health service regions are grouped into major hospital service areas so that in each area the majority of hospitalizations occur at the local hospital(s). There are seven such areas in Rhode Island.

ESTIMATING RESOURCE ALLOCATION

After the medical care demography of a region has been defined on a small-area basis, estimates can be made of the quantities of health care resources (e.g., beds, dollars or personnel) that are allocated to the populations living within these areas. This step in the analysis requires three data sets: patient origin data, data on the resources to be allocated, and a population count. Patient origin and population data were described in the preceding section. The allocation of resources requires the identification of an indicator for each facility or place of service of the quantity of manpower or facilities available or expenditures incurred. For example, the indicator may be the total number of beds in each of the hospitals or the number of employees working in each hospital. These resources are then allocated back to the geographic areas from which the patients come on a hospital-by-hospital basis according to the frequency of use of the resource by the residents of the areas. The sum of the allocated resources from all hospitals contributing to an area's consumption is obtained and, for comparative purposes, divided by the area's population to obtain a per-capita rate.

Examples of the Allocation Methodology

Table 2.4 illustrates the method for estimating the allocation of hospital resources to a Maine Hospital Area. The table shows the contributions of all the hospitals that served the area in 1975 and 1976. Most of the service was contributed by a local 71-bed community hospital (Hospital A). Of its 6,605 discharges (Column 5), 4,925 (Column 6) or 74.6% (Column 7) were to local residents. Thus, under the allocation procedure we estimate that 52.9 (74.6%) of its 71 beds were used locally. (Column 4 x

Column 7 in Table 2.4 = Column 8.) The contributions of other hospitals used by the population are also included:

Table 2.4

Hospital Resource Allocation Method Based on Distribution of Discharges Illustrated for a Maine Hospital Area with Estimated Population of 10,649 1975-76

Hospital Code (1)	Location (2)	Type of Hospital (3)	% of Beds (4)	Total Discharges (5)	Discharges From Area (6)	% of Dis-charges From Area (7)	Beds Allocated to Area (8)	Per Capita Beds* (9)
A	Within area	Community	71	6,605	4,925	74.6	52.9	4.97
B	Within region	Referral	578	25,005	531	2.1	6.7	0.63
C	Remote	Referral	536	38,479	40	0.1	0.6	0.05
D	Neighboring area	Community	130	10,612	120	1.1	1.5	0.14
E	Neighboring area	Community	38	3,381	136	4.0	1.5	0.14
F	Neighboring area	Community	14	558	64	11.5	1.6	0.15
All Others	Remote	Community	---	------	180	----	2.3	0.22
TOTAL	--------	--------	---	------	5,996	----	67.1	6.30

*Beds per 1,000 population

one referral hospital (Hospital B) contributed 531 discharges; we estimate that 6.7 of its beds are allocated to the area's residents. Community hospitals located in neighboring outside areas contributed 4.6 beds (Hospitals D, E and F). Twenty-eight other community hospitals located in other parts of the State contributed 180 discharges. Allocations to the area for these hospitals sum to an additional 2.3 beds (Column 8). Taken together, 67.1 hospital beds were allocated in the area: 78.8% by the local community hospital, 10.9% by the referral hospital and 10.3% by out-of-area community hospitals. Column 9 in the table gives the per-capita rate of bed allocation. The per-capita rates are obtained by dividing the allocated number of beds (Column 8) by the population of the area in 1975 (10,649).

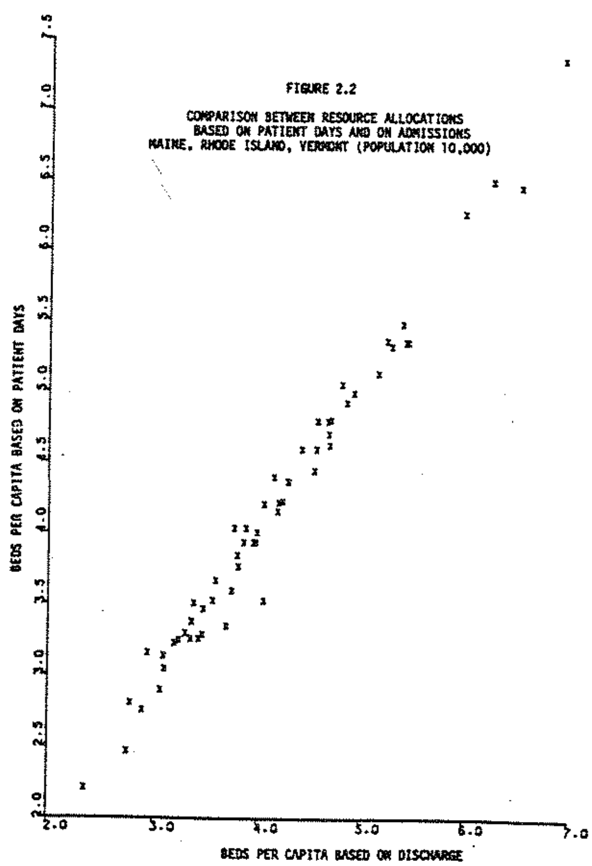
This hospital area, with 6.3 beds per 1,000 people, was involved in an 1122 review. We will return to consider the case later in this chapter and again in Chapter VIII.

The value of the information about the allocation of resources to the health planner is that it reveals the distribution of each hospital's resources and the total distribution of resources throughout various communities of the region. As we show in Chapter VI, they can and have been used in decisions concerning bed need. Tables can be generated for specialty bed distribution (such as CCU beds or maternity beds). In some cases, patient-origin data allocated specifically to a department or service may be more appropriate than total discharges or patient days. The number of maternity discharges is more appropriate than that of total discharges or patient beds for studying the use of maternity beds, and the number of cardiac patients (or medical service patients) is more appropriate for determining CCU bed needs. When UHDDS data are used, service-specific data is readily available and in some patient-origin studies the data are service-specific. Other data not ordinarily thought of as discharge data can also sometimes be used for specialized patient origins. For example, birth records provide a readily available source of data for maternity patient origin and allocation studies.

Allocation can also be done to estimate manpower. As we show in later chapters, there are marked differences in per-capita FTE hospital employees among areas, and these differences are associated with differences in per-capita hospital expenditure and reimbursements under Medicare. Since employment practices are within the domain of hospital administration, an indicator of variation in personnel employment practices that is strongly associated with variations in per-capita expenditures is of potential value in choosing cost-containment strategies. This concept is discussed further in Chapter VII.

Allocating Resources on the Basis of Total Patient Days or Admissions

Allocations can be done on the basis of admissions or patient days. Among community hospitals, length of stay does not appear to vary much by distance of patient origin; allocations by numbers of admissions and patient days yield similar results. For referral hospitals, out-of-area admissions have slightly longer lengths of stay, resulting in proportionately greater out-of-area allocation when patient days are used. When contrasted to the overall per-capita differences in resource allocation, however, the difference between the two methods is not important. This can be seen from Figure 2.2 which relates beds per-capita for hospitals among the hospital areas of the three New England States with uniform hospital discharge abstracts. The correlation coefficient between the results



of the two methods is r = .99. Because allocations based on discharges can be done with simple patient-origin studies, we prefer to use discharges so that the methods are strictly comparable between areas with and areas without UHDDS. However, when UHDDS data are available, some resources may be more accurately reflected in the patient day allocation than in the discharge allocation. For example, estimates of FTE hospital employee per-capita may be more reasonably associated with patient days than admissions.

MEASURING THE UTILIZATION OF HOSPITALS

As already stated, the measurement of the number of services provided to a population-at-risk requires some form of uniform registration of medical care events. The patient-origin study (or record of hospital discharges during a defined period), can be used to obtain a discharge rate by counting the number of discharges occurring to the residents of an area and dividing that count by the total number of residents. The resulting rate is a crude discharge rate, that is, it has not been adjusted to reflect differences in age groupings as they may exist between communities. Further, since information on length of stay is not recorded in the registration, patient-day rates cannot be calculated.

To interpret utilization rates, it is important to understand the principles of age-adjustment and other statistical tools used to describe variations in rates, as well as some of the issues involved in the interpretation of statistical significance. It is also important to understand the concept and limitations of case mix measurement.

In the studies presented in this monograph, age-adjusted and case-mix specific rates have been developed for the populations of Maine, Rhode Island, and Vermont, using the UHDDS.

The MEDPAR file--the 20% sample of discharges occurring among the Medicare population--has also been used to develop age-adjusted rates for the 65-year old and other population, in five New England states. The rates are also case-mix specific. The remaining section of this chapter deals with age-adjustment and case-mix.

Age Adjustment

Many rates used in epidemiologic investigation are strongly influenced by the age structure of the population-at-risk, the most obvious example being the death rate. For example, if the proportion of persons over 65 years of age was 5% in one population and 10% in the second, one would expect that the death rate in the second population would be higher than in the first on that basis alone. Since the purpose of many inquiries into population death rates is to find out what factors other than age may be responsible for differences in death rates among areas, it is important first to "factor out" that portion of the differences that can be related to age structure. This is done by age-adjustment.

There are two traditional methods of age adjustment, the direct and indirect method. In this report, the indirect method is used, principally because of the ease with which it can be calculated. In calculating an age adjusted death rate with the indirect method:

1) The number of deaths that occur to each of the study populations is counted; this number becomes known as the "observed" number of cases.
2) The adjustment occurs through the process of estimating the "expected" number of cases that would have occurred in each study population if the age-specific rates that are observed for all areas taken together had been the rates that occurred in each area. This is done by:

a) defining age-groups of interest,
b) calculating the rate for all areas together and then
c) multiplying that rate by the number of residents in each study area. This gives the expected number of cases on an age-specific basis.
d) The expected number of cases for all ages for a given population is the arithmetical sum of the expected number of cases for each age-specific group.

3) To obtain the rate, the ratio of the observed to the expected number of cases is calculated and then multiplied by the rate for all areas together. The result of this multiplication is the age-adjusted rate.

Statistical Issues

The standard statistical test we have used to interpret the significance of a departure from the expected rate is a one-degree of freedom chi-square test. This test asks the question: What is the probability that the rate observed in a particular study population is different from the rate for all areas on the basis of chance alone? The probability is expressed as a "p" value. For example, when p = .05, the chance is 5%, or one in 20. An important issue related to the interpretation of p values is the "problem of multiple comparisons." In the formal testing of an experimental hypothesis, it is customary to establish in advance a p value that one is willing to accept as an indication that the experimental group is "statistically significant" on some variable when compared to a control group. For example, p = .05 or less may be chosen. But if an experimentor chooses this value, he runs a risk of drawing the wrong conclusion one time out of 20. In that one instance a difference will be interpreted as "being significant" when in fact it would be expected on the basis of chance alone. And if he does 20 experiments, he should expect to be wrong once on the basis of chance alone.

The multiple comparison problem comes about when many tests are run and is particularly severe when data are generated for surveillance to detect "statistical outliers." This problem is encountered in the interpretation of chi-square values in area comparisons such as presented in this book. For example, in one analysis of variations in discharge rates among 21 Vermont populations for 373 different conditions, a total of 21 x 373 = 7,833 rates were tested by chi-square. On the basis of chance alone, one would expect 392 of these rates to yield a positive test at the p = .05 level; 78 to be significant at the .01 level; and 8 at the .001 level. The fact that the number of positive tests corresponding to these three levels were 2,354, 1,491 and 929, respectively, indicates that much of the difference in rates observed in the study cannot be explained by chance alone. However, in interpreting any given rate, one would expect that 16.6% of rates with p = .05 or less were so on the basis of chance, for tests using p = .01 and .001, 5.2% and 0.9% of rates with positive tests would be so on the basis of chance.

One strategy for avoiding the pitfalls associated with the multiple comparison problem is to use the observations made on one subset of the data base to formulate hypotheses about the results that will be obtained in the second. We have used this strategy in the studies of variation of surgical and medical case mix by using the Vermont portion of the data base for exploring and characterizing the patterns of variation and then "predicting" that similar results will be found in Maine and Rhode Island. Based on this strategy, and using simple indicators for variations in the distribution of rates within states, we have been able to classify common surgical procedures along a spectrum ranging from low to high variation which is generally consistent among the States (see page 76, Chapter V).

Indicators of Variation Commonly Used in Small Area Analysis

The indicators of variation we commonly use are: (1) the number of statistical outliers (with p values equal to or greater than .01); (2) the coefficient of variation, which is the standard deviation of the distribution of rates divided by its mean; and (3) the range between high and low members of the rate distribution.

Another statistical issue is the correspondence between two ways of viewing hospital performance, from the perspective of the institutions and from the perspective of the populations served by the institutions. The extent of the association between the institutional performance indicator (length of stay) and the populations' use of beds, and the extent to which variation in the use of beds relates to variations in incidence of hospitalization may be characterized with the "explained variance" or "R-squared" statistic, which is the square of the correlation coefficient. The correlation coefficient itself ranges from -1.0 to +1.0; the stronger the relationship the nearer the value of the coefficient is to 1.0; weak relationships are near zero. The sign of the coefficient indicates the direction of association, with a negative sign meaning the value of one indicator increases as the other decreases. The squared correlation coefficient is usually expressed as a percent and represents an estimate of the variance or difference among the values of one variable which is explained by difference among the value of a second. Because the relationships are usually multiplicative, we use the logarithmic form of the regression coefficient.

Case Mix and its Measurement

One important application of the UHDDS or MEDPAR data is for the measurement of the types of cases that are admitted to hospitals. Interest in the measurement of case mix

stems from a number of needs, many of which relate to the obvious fact that not all hospitals are the same: some serve as regional referral centers and others as community hospitals. For a number of planning and regulatory functions, it would be useful if the types of cases processed by hospitals could be classified according to condition and severity, as well as to type of treatment. This would be valuable both for resource allocation decisions and for testing the relative efficiency with which cases are handled in the individual hospital. And, if comparisons could be made between the ways similar cases are handled in different hospitals, hospitals that deliver care more efficiently could be rewarded and those that are inefficient could be penalized.

One way by which conditions may be classified is by use of the primary and secondary diagnoses listed in the UHDDS. The primary diagnosis is defined as "the condition, determined after study, that occasioned the patient's admission to hospital" (CPHA/PAS definition). The coding of this condition (sometimes as it is associated with relevant secondary diagnoses) is used for specification of case mix. The value of the approach, therefore, depends on the degree to which the listed diagnoses correspond to the conditions they are presumed to represent. The nature of this correspondence depends on qualities of physicians as observers and recorders of biological events; on the quality of the coding as it takes place in the hospital record room; on the quality of transcription of the information from physician to record room and from record room to computer tape.

In the past, most studies of the quality of reporting have shown major variations in coding practices that result from between-physician differences in use of terminology,

or in diagnostic practices. Koran[16] has reviewed many of these studies. More recently, the Institute of Medicine[17] demonstrated significant variation among hospitals in the practice of recording diagnoses in the UHDDS. Although the coding of surgical procedures was reasonably accurate, there was little uniformity among hospitals in the ordering of diagnoses.

The next chapter reviews several studies which estimate the quality of the UHDDS data for classifying patients according to cause of admission. The evidence cited in the chapter stands as a clear caveat against the naive interpretation of case mix based on UHDDS data.

CHAPTER III

NOTES ON DATA QUALITY

Hendrickson and Myers,[18] in a review of one year of computerized hospital discharge abstract data from a large urban teaching hospital, found a variable but significant error rate in the recording of all entries studied. The extent of the error rates, plus evidence of recording bias, led the authors to conclude that the abstract data were unsuitable for most clinical purposes and, at best, could serve only "as a guide to selecting parameters to study in a chart review." Of particular importance is the recording of diagnoses from the medical record for encoding on the discharge abstract form. The Institute of Medicine[17] study on the "Reliability of Hospital Discharge Abstracts" was based on independent reabstracting of a sample of records in several institutions and developed disturbing evidence of discordancies in diagnostic coding. The issue of reliability must be of central concern to all workers in the field and to all consumers of data derived from the hospital abstracting systems.

In the course of working with health data sets in New England, several opportunities arose to study reliability questions because, in certain circumstances, more than one record with diagnostic information is produced semi-independently for the same hospital episode. An example is the report of Gittelsohn and Senning[19] on in-hospital deaths for which both a hospital abstract and a death certificate are produced. The correspondence between cause of death on the certificate and abstract diagnoses were compared, with the result that 72% of the causes were found to have the same 3-digit diagnosis at some position in the medical record. For all neoplasms as cause of death, discharge

abstract diagnoses agreed on the same site in 77%; 6% agreed only at the organ level; and 17% were either of different organs or, in the case of one record, listed no neoplasm at all. Circulatory system causes of death had the same discharge abstract diagnosis in 71% of the cases. While a stroke was likely to be labeled a stroke in both data sets (81%), there was major disagreement as to type, such as thrombus, embolus, hemorrhage or generalized cerebrovascular disease. The overall rates of agreement varied widely between hospitals, ranging from 45% to 85%. Since no external measure of the validity of a given diagnostic label is available for either data set, high agreement rates provide only a measure of consistency, while low agreement rates provide evidence of potential problems in diagnosis abstracting, recording and encoding.

A specific problem pertains to deaths following elective surgery. In general, the instructions for coding underlying cause of death specify that complications and misadventures in operative procedures are not to be used if the condition for which the treatment was given is indicated. Thus, a person dying of a heart attack or stroke following lens extraction is to be coded to the cataract. A similar problem arises in the assignment of final diagnosis explaining admission on the hospital abstract where the acute infarction rather than the cataract is often assigned.

MEDPAR AND PAS COMPARABILITY

In a study carried out for the Health Care Financing Administration,[20] a 20% sample of Medicare Part A inpatient records was obtained for Vermont residents for the year 1975. This data set, called the MEDPAR file, is described in detail in the next chapter. It contains items which are comparable to the PAS hospital file, including diagnosis and principal procedure.

In order to compare diagnosis codes between PAS and MEDPAR hospital record systems, records from each data set pertaining to the same patient were linked. Because identification is by patient number in PAS and by Social Security number in MEDPAR, it was necessary to link the patients in each hospital on the basis of coded characteristics common to both systems--i.e., admission and discharge dates, status, sex, age and county of residence.

Of the 2,857 patients in the MEDPAR file, 2,305 (81%) were located in the PAS file. The 552 unmatched records are explained by coding errors or differences in the two data sets, particularly regarding residence. There can be reasonable assurance that the matched pairs are the records of the same patient. An analysis of the information content of these items revealed that, for Vermont, the probability of a false positive match was less than one in one million in the worst possible case and an average of less than one in two million overall.

The diagnosis code in the MEDPAR and the PAS data sets are appropriately regarded as independent replications of the same information under two different processing systems. Both data sets use the adapted version of the international classification of disease (ICD-A) convention for coding diagnosis and procedures. A measure of the reliability of final diagnosis is thereby provided by the agreement rate for the 2,305 matched pairs. MEDPAR uses a single diagnosis while PAS records a final diagnosis explaining admission and up to seven secondary diagnoses. Since the definitions of final diagnosis are at variance in the two systems, the MEDPAR diagnosis code was compared with all diagnostic codes present in the PAS record first at 4-digit level, next at the 3-digit level and last at the 2-digit level. The search algorithm ensured that the most

specific agreement would be selected with any PAS diagnosis code, irrespective of its position in the record.

There were a number of occurrences of non-ICDA codes in the MEDPAR file, the outstanding example being the 101 cases listed as ICD-A 799 which does not exist in the code. None of the '799' MEDPAR agreed with any PAS diagnosis. There were 207 MEDPAR malignant neoplasms, of which 71% had the same site coded as PAS, 14% referred to the same organ and the remaining 15% to a different organ or not to cancer at all. (Table 3.1) The 283 MEDPAR cases with ischemic heart disease had specific 3-digit agreement or better two times out of three. The 130 MEDPAR cases with cerebrovascular disease (CVD) were on target in 58% of the cases, while an additional 24% confused hemorrhage with thrombus and thrombus with ill-defined acute episodes, but remained within the bounds of the cardiovascular disease rubric. Thus, there was 79% agreement for cancer, 80% for ischemic heart disease and 82% for stroke.

TABLE 3.1

AGREEMENT OF MEDPAR AND PAS RECORDED DIAGNOSES
VERMONT, 1975

MEDPAR DX	ICD-A Codes	Total Records	Agreement With Any PAS Diagnosis 4-Digit	3-Digit	2-Digit	None
Total		2,305	1,146	268	258	633
Infective	(000-136)	49	28	3	7	11
Neoplasm	(140-209)	207	129	21	13	44
Other Neoplasms	(210-239)	27	13	1	2	11
Diabetes	(250)	49	31	15	0	3
AMI	(410)	57	42	5	4	6
ISHD	(412)	283	92	93	41	56
Asymptomatic HD	(427)	44	12	9	0	23
CVD	(430-438)	130	75	11	20	24
Pneumonia	(480-486)	51	40	0	4	7
Other Respiratory	(519)	63	9	0	5	49
Hernia	(550-553)	60	51	3	4	2
Gall Bladder	(574-576)	31	11	16	0	4

Perhaps the best that can be expected is a 2-digit diagnostic taxonomy which distinguishes a stroke from pneumonia, a heart attack from an impacted bowel, and an umbilical hernia from lumbago.

QUALITY-ASSURANCE/DISCHARGE ABSTRACT STUDY

In one hospital included in our studies, two hospital discharge abstracting systems were maintained independently for Federal patients. The first system included the medical records for all inpatients for whom diagnoses, procedures, dates and demographic data were abstracted on form for encoding. Under the second system, operated for the PSRO under the Quality Assurance program covering all Medicare and Medicaid patients, abstracts of similar items of information were prepared for each hospital episode by a different group of workers. The comparability of the diagnostic and procedure codes under the two systems provides an indication about the limits of the reliability of the information.

To this end, a sample covering the first six months of 1978 admissions were selected. A total of 3,328 Quality Assurance and Medical Records were linked for each patient in the series and the ICD-A diagnosis and procedure codes compared. The results are presented in the number of digits of code agreement of the first or principal Quality Assurance diagnosis with the first Medical Record diagnosis and with any Medical Record diagnosis. About half of the Medical Records contained a single diagnosis code, 20% contained two and the remaining 30% listed three or more. The importance of the first diagnosis is that it is the basis for most reports on case mix and classification systems, such as Diagnostic Resource Groups (DRG).

Table 3.2 exhibits the percent of first quality assurance (QAI) diagnosis by agreement level with the first (MR1) and with any MR entry. Overall, 58% of the record pairs were in total agreement (4-digits) in the comparison. An additional 6% agreed as to the first 3-digits of the ICD-A code, but differed in the terminal digit. In 19% of the pairs, the closest agreement was in the first two digits of the code. On the principal diagnosis explaining admission, 24% of the pairs were in total disagreement: The two data systems assigned completely different principal diagnoses in nearly one quarter of the cases. Under the DRG system, such cases would end up in entirely different groups.

TABLE 3.2

AGREEMENT OF FIRST QUALITY ASSURANCE DIAGNOSIS
WITH ANY MEDICAL RECORD DIAGNOSIS

		Number of Cases	Percent by Agreement Level 4-Digit	3-Digit	2-Digit	None
Total Cases		3,328	58%	6%	19%	17%
Service	Private, Medicine	479	66%	8%	11%	15%
	Pediatrics	181	67%	4%	11%	17%
	Gynecology	113	77%	6%	6%	11%
	Obstetrics	441	57%	3%	19%	21%
	Fertility	322	0%	0%	99%	1%
	Ophthalmology	273	81%	4%	5%	10%
	General Surgery	273	65%	10%	10%	15%
Dx	Neoplasms	320	72%	7%	7%	16%
	Diseases of Eye	253	85%	4%	5%	6%
	Diseases of Ear	58	71%	17%	10%	2%
	Abortion (641)	322	0%	0%	99%	1%
	Diabetics	36	44%	12%	0%	44%
	ISHD	90	37%	7%	29%	28%

By service (as shown in Table 3.3) the 3-digit agreement rates with any Medical Record diagnosis varied from 85% in opthalmology, 83% in gynecology, 71% in pediatrics, to 0% in the fertility clinic. In the latter case, the discordance arose because the Medical Record used the ICD-A codes 642-644 (codes which include abortion induced for

other reasons, spontaneous abortion and abortion not specified respectively) to describe the same phenomena for which the Quality Assurance utilized ICDA codes 640-641 (codes which include abortion induced for medical or other legal indications). For the 320 QA1 neoplasms, agreement as to the same site was 79%, with an additional 7% classified to the same organ; fully 16% of the MR1 diagnoses were other than neoplasms.

TABLE 3.3

AGREEMENT OF PROCEDURE CODES IN QUALITY ASSURANCE AND ANY MEDICAL RECORD PROCEDURE

	Number of Cases	Percent by Level of Agreement QA1=MR1	Any	None
Total Cases	1,763	71%	7%	22%
D & C (747)	229	98%	1%	1%
Otolaryngology	99	65%	11%	23%
Ophthalmology	253	79%	4%	17%
Lens Extraction (145)	118	100%	0%	0%
Cardiac & Vascular	99	57%	9%	34%
Thoracic Surgery	22	63%	9%	28%

A total of 1,763 of the cases in the series contained one or more procedure codes in both data sets. The first quality assurance procedure (QA1) agreed with the first medical record procedure in 71% of the cases, with additional Medical Record procedures in 7% and totally disagreed in 22%. Agreement by QA1 procedure ranged from 100% for inguinal hernia (ICD-A-382) to 57% for cardiac and vascular procedures and 65% for ENT procedures. The implication is that reliability problems exist in the assignment of procedure codes in the hospital under study.

INTERNAL CONSISTENCY: FINAL DIAGNOSIS EXPLAINING ADMISSION BY TYPE OF SURGERY

An opportunity to investigate the quality of diagnostic coding in the hospital discharge abstract was performed by comparing the diagnoses listed for patients with selected

types of surgical procedures. Only the consistency of the final diagnosis with the procedure is at issue; no external measure of validity of the diagnostic label is available since the UHDDS contains no objective measurements of morbidity, records no signs of symptoms, and contains no pathology reports or other criteria whereby the diagnosis might be validated or a measure of likelihood assigned to the particular diagnostic label. The association of hypertrophy of tonsils and adenoids as cause of admission with adenotonsillectomy as first procedure is merely taken to indicate internal coding consistency on the records, suggestive of accurate coding practice.

Tables 3.4 and 3.5 exhibit the final diagnosis explaining admission for several types of surgery. Appendectomies are classified as either primary or secondary to other procedures, such as hysterectomy. Some 82% of the 2,602 primary appendectomies had a diagnosis of acute and other

TABLE 3.4

APPENDECTOMIES REPORTED ON HOSPITAL DISCHARGE ABSTRACT BY STATUS AND MAJOR DIAGNOSIS

Vermont, 1969-71

Major Diagnosis	H-ICDA Codes		Primary	Secondary
Enteritis, diarrheal disease	(008,009)		27	3
Malignant Ca - digestive organs	(150-159)		1	61
Malignant Ca - GU organs	(180-189)		0	144
Uterine fibroma	(218)		1	285
Other benign neoplasms of uterus	(219)		1	20
Benign neoplasm of ovary	(220)		6	178
Other diseases of spleen	(289)		116	17
Acute appendicitis	(540)		2011	72
Other appendicitis	(542-543)		112	17
Hernia of abdominal cavity	(550-553)		2	79
Other diseases of intestine	(560-569)		33	107
Cholelithiasis	(574)		0	546
Diseases of ovary	(612-616)		37	210
Diseases of uterus	(620-629)		12	326
Delivery	(650-661)		102	200
Symptoms referable to abdomen	(785)		60	30
All other diagnoses	*********		81	392
Total Appendectomies			2602	2687
		Males	1391	399
		Females	1211	2288

forms of appendicitis. An additional 16% of the cases were associated with diseases of the spleen, intestine, ovary or uterus, with delivery, or with symptoms referable to the abdomen. Most of the secondary appendectomies were performed in conjunction with female surgery, i.e., surgery for neoplasms of the digestive or genitourinary organs or cholecystectomy. More than 80% of these cases were associated with diseases of the digestive and GU systems and delivery.

For the 6,356 adenotonsillectomies, 90% of the cases had final diagnoses of hypertrophy of the tonsils and adenoids to explain admission, while 5% cited chronic otitis media (Table 3.5). Ligation of varicose veins was

TABLE 3.5

CONSISTENCY OF SURGICAL PROCEDURE AND MAJOR DIAGNOSIS

Vermont, 1969-71

SURGERY Major Diagnosis	H-ICDA Code	Number of Cases
Tonsillectomy		6356
Hypertrophy of tonsils	(500)	5731
Otitis media	(381)	340
All other diagnoses	***	285
Ligation of varicose veins		1358
Varicose veins, lower extremities	(454)	1214
Diseases of veins & lymphatics	(450-8)	71
Cholecystectomy		2620
Cholelithiasis	(574)	2215
Cholecystitis	(575)	268
Other diseases of gall bladder	(576)	17
Prostatectomy		1859
Malignant neoplasm - prostate	(185)	239
Malignant neoplasm - bladder	(188)	30
Diseases of prostate	(600-2)	1295
Lens extraction		1675
Diabetes (diabetic retinopathy)	(250)	16
Cataract	(374)	1588
Glaucoma	(375)	19
Congenital anomalies of eye	(744)	12
Repair of inguinal hernia (non-recurrent)		3513
Hernia of abdominal cavity	(550-3)	3353
Hydrocele	(603)	35
Hemorrhoidectomy		867
Hemorrhoids	(455)	754
Anal fissure, fistula, abscess	(565-6)	51

associated with final diagnoses pertaining to diseases of the veins in 95% of the cases. Cholecystectomy was per-

formed in conjunction with cholelithiasis, cholecystitis and other gall bladder diseases in 96% of the cases. A similar circumstance pertains to prostatectomy and diseases of the prostate, lens extraction and cataract, herniorraphy, and abdominal hernia, and hemorrhoidectomy and hemorrhoids. Such consistency between surgery and indications suggests that a high level of diagnostic coding accuracy exists in the data system.

The internal consistency, however, is considerably less for cases of surgery that end in death. In a study[21] of 11 common surgical procedures with discharge status of dead (N = 269), only 53% of cases had a cause of admission diagnosis that corresponded to the organ for which the surgery was performed, 22% were for cardiovascular disease and 25% for unrelated diagnosis. In general, there is a strong tendency to confuse the immediate cause of death with the reason for admission. Further, the confusion carries over to the death record where only 32% of the 269 cases were found to have the underlying cause of death attributed to a disease affecting the organ for which surgery was performed.

SUMMARY AND CONCLUSION

The problem of data quality in hospital discharge abstract systems is central in developing reliable information concerning hospital utilization. Our own observations suggest acute problems exist in the ordering of diagnoses, defining cause of admission in transcription from medical record to face sheet and in encoding to the discharge abstract. The quality of the information is limited by the current state of medical knowledge and the manner in which it is applied by practitioners working in particular institutions. Wagner[22] refers to "formal errors" as contrasted with "factual errors." By this he means errors detectable

without any further knowledge, such as a gynecologic procedure in a male. Such formal errors exist in the hospital data sets under study and their occurrences have been tabulated by institution; the results indicate that certain hospitals should be selected for review of medical coding practices. Linkage and internal consistency studies of the type explored here provide the opportunity for targeting potential problems and for establishing the dialogue between data producer and data analyst required for continuing improvement of information flow.

For present purposes, issues of reliability are discussed in order to establish caveats for the interpretation of hospital utilization data on both an institutional and a population-geographic basis. In general, the basic facts of a hospital episode appear to be complete and reasonably reliable. These include the fact of hospitalization itself, patient characteristics, dates and discharge status. Thus, measures such as total hospital utilization rates, patient day rates, occupancy and length of stay can be regarded with a high degree of certainty. Next in quality are procedure data which provide the basis for patient billing. While problems may exist in certain hospitals, internal consistency studies and reabstracting studies of the type carried out by the Institute of Medicine suggest that surgical information is ascertained with a high degree of accuracy and that statistical indices developed therefrom can be viewed with reasonable confidence. The major difficulty evidently is with diagnosis codes, where the resolution appears to be, at best, at the level of two digits. Thus, a patient may be reliably classified as being admitted for a chronic respiratory disease while some doubts must be entertained as to the subclassification of bronchitis, emphysema or chronic obstructive pulmonary disease.

The importance of this observation for the use of nomenclatures such as Diagnostic Research Groups should be underscored.

CHAPTER IV

THE USE OF MEDICARE DATA FOR ANALYSIS OF THE PERFORMANCE OF THE MEDICAL CARE SYSTEM

The data most often recommended for the analyses of health care services are population-based data which record medical care events uniformly for the total population of a region. The Uniform Hospital Discharge Data Set (UHDDS) is an example of this type of data. But total population data are not easily obtained because all hospitals that serve the region's population on more than an occasional basis must agree to pool discharge abstracts containing agreed upon data elements so that a masterfile of all hospitalizations for the region can be prepared. For ambulatory care, all physicians' offices and out-patient clinics need to agree to a similar procedure. For a number of reasons, such agreements are difficult to obtain and maintain. There are only a few examples of successful population-based hospital discharge data systems and no examples of ambulatory data systems. For these reasons, it is very unlikely that data systems will be developed in most States soon enough to be useful to current planning and regulatory legislation.

There are, however, alternate data sources that can be used to generate valid indicators of population use rates and that also have distinct advantages over the uniform hospital discharge or ambulatory data sets. Data obtained from health insurance claims can be used. The value of claims data for describing small-area variations has been demonstrated in studies by Lembke[23] and Lewis.[7] Lembke's pioneering studies in the 1950's demonstrated the importance of routine data sets collected from insurance programs for describing geographic variations. His efforts to feed back

the data indicated the potential value of the information for altering clinical practices. In the late 1960's, Lewis demonstrated how Blue Cross claims data could be used for describing variations in practice patterns among counties in Kansas.

The national Medicare program is a rich source of data for the analysis and evaluation of the medical care system. The value of the data for describing health service areawide utilization rates has already been demonstrated by the Health Care Financing Administration. This and subsequent chapters demonstrate potential uses for two national Medicare data sets for small area analysis. The first is the MEDPAR data set, a 20% sample of all hospitalizations under Medicare. The demonstration in this chapter is MEDPAR's value for defining hospital areas, estimating the allocation of resources and measuring utilization. The second national data set is the Medicare Part B file; this chapter shows how the information can be used to define physician service areas and to measure aspects of ambulatory and inpatient care. The Medicare Part B data set can be used with the national Medicare enrollment file (the HISKEW file) to obtain valuable information on survival after medical intervention. This latter application, together with illustrations of how the MEDPAR data set may be used in planning, are discussed in subsequent chapters.

THE NATIONAL MEDPAR DATA SET AS A SURROGATE FOR FULL COVERAGE POPULATION-BASED DATA SETS IN SMALL AREA ANALYSIS

The following section summarize the principal findings of a study of the feasibility of using MEDPAR data as a surrogate for total coverage data files.[24] This data set is maintained by the Health Care Financing Administration (HCFA); its contents are given in Table 4.1.

The investigation involves (1) comparing hospital areas defined by patient origin studies based on MEDPAR with areas using patient origin studies based on full coverage data; (2) comparing the results of resource allocation studies based on MEDPAR data with those based on full coverage data; and (3) comparing variations in utilization

and reimbursement rates from MEDPAR with utilization and hospital expenditure rates based on full coverage data.

TABLE 4.1

MEDPAR RECORD CONTENTS

1. Claim Number	25. PRSO State Code
2. Hospital Number	26. Type of Hospital
3. State and County of Residence	27. Total Charges
4. Professional Standard Review Organization (PSRO) Service Area Number	28. Coinsurance Days
5. Discharge Date	29. ZIP Code of Beneficiary Residence
6. Primary Discharge Diagnosis	30. Number of Facilities and Services
7. Length of Stay	31. Medical School Affiliation
8. Age	32. Bed Capacity (Adult)
9. Sex	33. Covered Days
10. Race	34. Lifetime Reserve Days
11. Additional Diagnosis	34a. Type of Control
12. Surgical Indication	35. Periodical Interim Payment
13. Discharge Status	36. Date of Admission
14. Day of Admission	37. Date of Surgery
15. Additional Surgery	38. Surgery Code
16. Amount Reimbursed	39. Blood Furnished (pints)
17. Intensive Care Charges	40. Intensive Care Days
18. Operating Room Charges	41. Total Accommodation Charges
19. Pharmacy Charges	42. Type of Entitlement (Medicare Status Code)
20. Laboratory Charges	43. Total Departmental (Ancillary) Charges
21. Radiology Charges	44. Covered Charges
22. Supplies Charges	
23. Anesthesia Charges	
24. Inhalation Therapy Charges	

MEDPAR as a Proxy for Defining Hospital Service Areas

Two independent origin studies were performed; one used the 100% patient origin data, the second, the MEDPAR file, obtained from HCFA. Studies were performed for Maine, Massachusetts and Vermont. Results in Vermont and an urban portion of Massachusetts typify the findings.

Vermont: MEDPAR in the Rural Environment Because the Vermont data file is geocoded using town of residence rather than zip code, the two data sets were made compatible by reducing the towns and zip codes into 167 units (ziptowns) with common boundaries. The number of Medicare enrollees who live in these 167 ziptowns ranges from 9 to 5,187; of the 167 population units, 47 have fewer than 100 Medicare enrollees; 48 have between 100 and 199; 22 have between 200 and 299; 37 have between 300 and 999; and 11

ziptowns have more than 1,000. We investigated the use of each Vermont hospital by residents (or enrollees) of each ziptown; the geographic units were then assigned to hospitals according to the plurality rule. (See page 17 for definition of plurality rule.) The correspondence between the two methods is shown in Table 4.2: 50,020 or 95.6% of all enrollees were assigned to the same hospital service area under either method. These enrollees live in 115 ziptowns.

TABLE 4.2

RELATIONSHIP BETWEEN NUMBER OF RESIDENT ENROLLEES AND HOSPITAL AREA ASSIGNMENT OF ZIPTOWNS - Vermont, 1975

Ziptowns Grouped by # of Enrollees	Total # of Zip-towns	Total # of Enrollees	Assigned to Same Hospital Area by Both Methods		Different Area or No Assignment Possible by Plurality Rule		Percent Enrollees Assigned to the Same
			# of Ziptowns	# of Enrollees	# of Ziptowns	# of Enrollees	
300+	41	39921	41	39921	---	---	100.0
200-299	17	4123	14	3375	3	748	81.8
100-199	39	5435	35	4958	4	477	91.2
9-99	42	2813	25	1766	17	1047	62.8
Total	139	52292	115	50020	24	2272	95.6

However, 24 ziptowns containing 4.5% of enrollees were assigned to different areas or were not assigned at all, either because of a tie or because there were no recorded admissions in the sample. These areas each have fewer than 300 enrollees.

When a ziptown has less than 300 Medicare enrollees (or less than an annual expected number of admissions of about 15), one can anticipate some difficulty in assigning ziptowns to hospital areas. Although the discrepancies are in fact low (only 4.4% of the population was not assigned the same way), 23.5% of Vermont Medicare enrollees live in zip-

towns that have an enrollee population of less than 300 where there is some uncertainty about hospital area assignment. If the sample size were 100% rather than 20% of the over 65-population, the uncertainty would be reduced substantially. Indeed, beginning in fiscal year 1978, a 100% Medicare hospitalization file exists which could be used for patient origin studies. The UHDDS maintained by PSRO is also a 100% Medicare hospitalization file.

Massachusetts: MEDPAR in an Urban Area To investigate the utility of the MEDPAR file for urban and suburban patient origin studies, hospital use of Medicare enrollees living within local zones of the Boston Post Office was investigated. The territory includes the Boston hospital area and 15 suburban hospital areas as defined by the Massachusetts Hospital Association's patient origin study (MHPOS) which is based on complete recording of all admissions for one year. In contrast to Vermont, most of the zip codes in the Boston postage zone have more than 1,000 enrollees (60 out of 99) and sample size is not a problem. The patient origin study using the MEDPAR file resulted in hospital areas that were the same as those defined by the MHPOS.

In urban areas, the zip code geocoding convention of MEDPAR makes it neighborhood-specific. Urban areas can thus be subdivided in a fashion which is not possible using the MHPOS where population estimates at the zip level are not available for 1975. With the MEDPAR data, Boston can be divided into 19 neighborhoods, each with a relatively large population and with different patterns of hospital shopping. The neighborhood data for Boston are given in Table 4.3.

TABLE 4.3

NUMBER OF ENROLLEES, ADMISSIONS TO HOSPITAL AND PERCENT OF ADMISSION TO TEACHING HOSPITALS BY BOSTON NEIGHBORHOODS MEDPAR FILE 1975

Boston Neighborhoods	Number of Enrollees[a] Age 65 and Over	Total Number of Admissions[a]	Percent to Teaching Hospitals
Boston-D	1029	227	63.0
Back-Bay	847	210	78.1
Stationa	406	105	87.6
Roxbury	986	217	80.2
Dorchest	728	173	33.5
Dor-Ctr	1025	242	39.2
Upham	586	172	48.8
Mattapan	462	132	40.1
S-Boston	1020	262	55.3
E-Boston	909	290	65.5
Charlest	329	80	53.7
Jamaicap	1119	299	47.1
Roslinda	1139	277	39.7
W-Roxbury	1016	228	28.5
Allston	397	114	35.1
Brighton	1227	307	33.2
Hydepark	775	200	37.5
Brookline	2017	482	69.9
Chestnut	552	129	48.8

Number in the 20% sample[a]

The table shows for each neighborhood the proportion of patients using teaching hospitals; finer breakdowns, not presented here, show the considerable localization of the markets of the teaching hospitals. For example, in Neighborhood 1, 36% of all admissions and 57% of all teaching hospital admissions are to the Massachusetts General Hospital. By contrast, in Neighborhood 3 most admissions were to teaching hospitals, but Massachusetts General admitted only 8% of all hospitalized enrollees and 10% of teaching hospital cases. In this area, the dominant teaching hospitals are Boston City Hospital and University Hospital (Boston University). There is also localization with regard to non-teaching hospitals. For example, in Neighborhood 14, 72% of admissions are to community hospitals; and 45% are to a single community institution (Faulkner). The level of specificity at the neighborhood level indicates that the Medicare data can be used in urban

areas to support a neighborhood-based small-area analysis, such as those performed in Providence, Rhode Island, using census tracts and the total hospital file.

Use of MEDPAR Patient Origin Data for Resource Allocation Studies

Chapter II describes a simple method for estimating the use of hospital resources by geographically defined populations based on the allocation of resources to populations according to the relative frequency of use of services. This method provides indicators of per-capita beds, expenditures and manpower which can serve as a measure of the inequality of resource allocation throughout the communities of a region. To be of maximum use to planning agencies, the indicators should provide an estimate of the total consumption of resources for the entire population at risk. If patient origin data based on national Medicare hospitalization are to be used, it is important to determine their compatibility with allocations based on a hospital file containing the total population.

To study this comparability we have made allocations of hospital beds among hospital service areas in Vermont, Maine and Massachusetts using all 1975 discharges from hospitals (Method A) and compared it to a similar estimate based on allocations using only discharges to persons 65 years of age and older (Method B). The correspondence between Method A and Method B is shown in Figure 4.1 which gives the relationships between allocated expenditures for the 66 hospital areas with populations greater than 11,000 based on allocations using the patient origin study (Method A) and allocations using the MEDPAR data. The results in these three States indicate that the national MEDPAR data set would be useful for estimating per-capita hospital expenditures, per-capita personnel or per-capita beds for most hospital

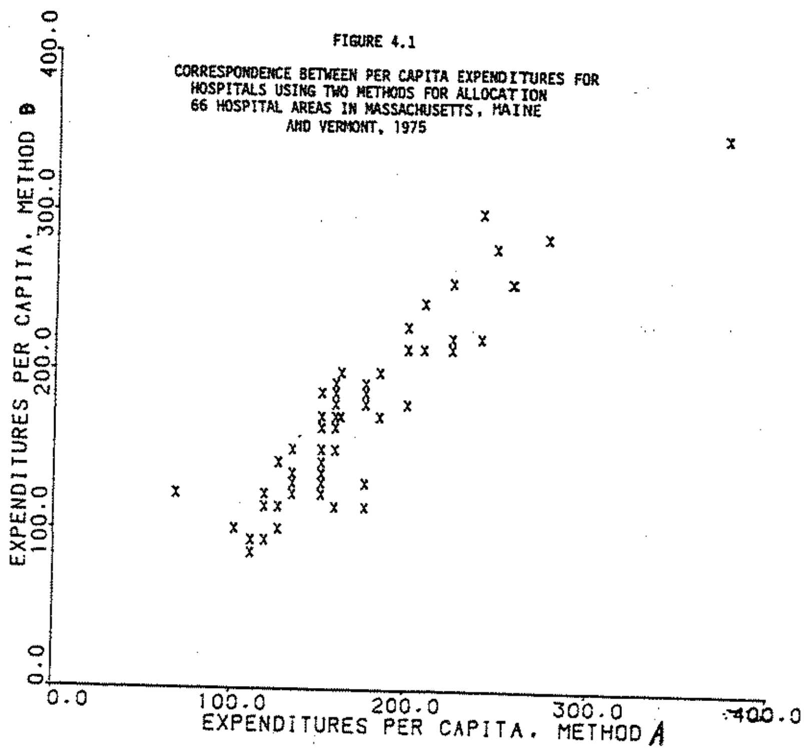


FIGURE 4.1

CORRESPONDENCE BETWEEN PER CAPITA EXPENDITURES FOR HOSPITALS USING TWO METHODS FOR ALLOCATION 66 HOSPITAL AREAS IN MASSACHUSETTS, MAINE AND VERMONT, 1975

areas in the United States. With the use of multiple year data or the 100% samples referred to above, useful indicators should be available for virtually all areas. Some examples of how the allocation strategy could be used in planning are given in Chapter VII.

Comparisons Between Utilization Rates and Reimbursement-Expenditure Rates

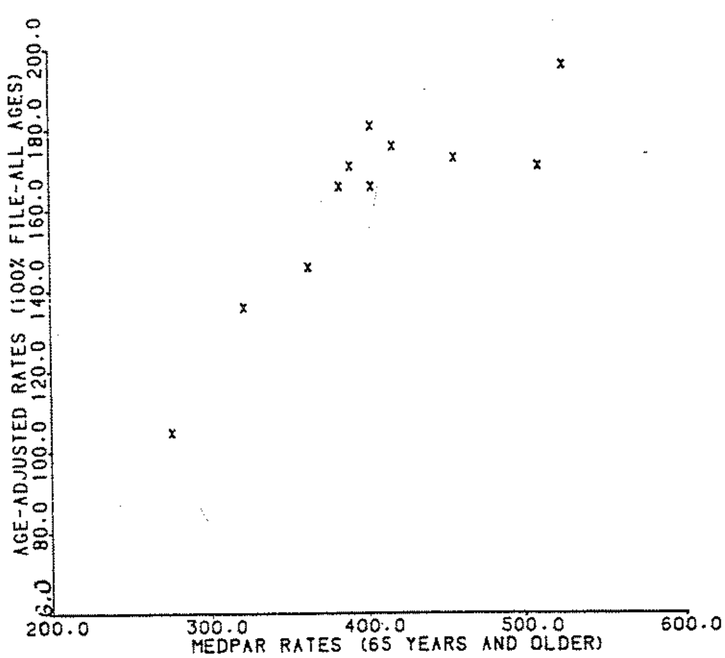
Using the MEDPAR file we have measured rates of hospital admission, the number of patient days and total reimbursements for hospital care on a per enrollee basis for hospital areas in each New England State except Connecticut. The results are in Chapter V. The following compares MEDPAR results for utilization and reimbursements with utilization and allocated expenditure results based on full-coverage data sets.

The rates of admission observed using the MEDPAR file and those observed using the 100% Vermont data file are highly

correlated. Figure 4.2 shows the relationship between the overall age-adjusted admission rates and the age-specific rates obtained from the MEDPAR file (r = .91). Variation in the rate of admission among hospital services areas for the over-65 population (about 18% of all hospitalizations) appears to be indicative of variations in total rate of use of the population-at-risk.

FIGURE 4.2

CORRESPONDENCE BETWEEN MEDPAR AGE-SPECIFIC RATES (65 YEARS AND OLDER) AND AGE-ADJUSTED RATES FOR ALL AGES OBTAINED BY USING 100% VERMONT HOSPITAL FILE 1975

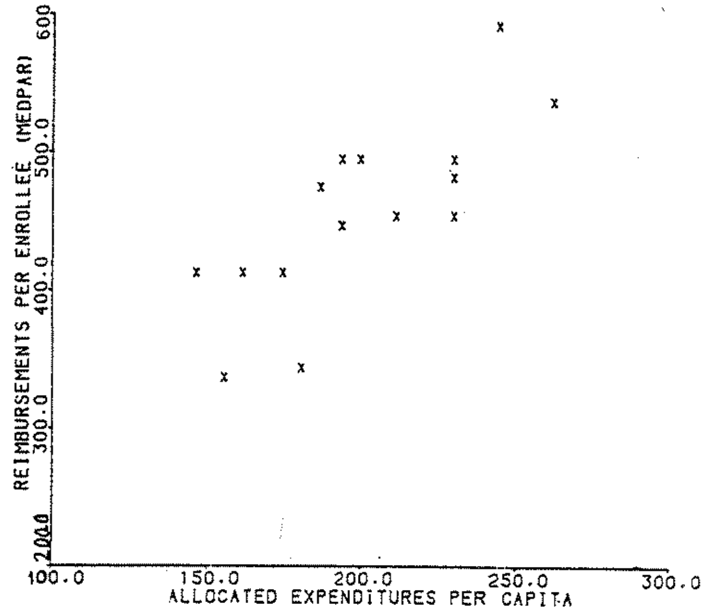


Reimbursements per enrollee obtained from the MEDPAR file were correlated with expenditures per capita as obtained by allocation according to patient town of residence. This compares cost data obtained from two independent sources. The areas for comparison are the 15 hospital areas in Vermont and 14 suburban hospital areas in the Boston area. One Boston area with uncertain population estimates was excluded. The correlation coefficient is .79. The

relationship for Vermont is shown in Figure 4.3.

FIGURE 4.3

CORRELATION BETWEEN REIMBURSEMENTS PER ENROLLEE (MEDPAR)
AND ALLOCATED EXPENDITURES PER CAPITA (100% FILE)
BOSTON HOSPITAL AREAS



<u>Summary</u>

The above demonstrates that the MEDPAR file can provide a useful substitute for UHDDS data for patient origin and allocation studies. For annual estimates, the 100% sample Medicare file may be required in zip codes with fewer than 300 enrollees. The study also demonstrates a unique advantage of the Medicare data set. The Social Security agency keeps account of the enrollees (the HISKEW file), which can serve as a moving census (geocoded at the zip code level) with current data on age, sex and racial composition of the population-at-risk. Since the geocoding conventions for the numerator data also include zip code, accurate rates can be generated in the intercensal years without concern about the accuracy of small-area population projections. Further, a source of confusion between mailing address (zip code) and place of residence, which sometimes hampers small-area analysis, is effectively removed.

USE OF MEDICARE PART B DATA

General Background

The data files established to administer the Medicare Part B program are an important and under-used source of information about the medical care system. Their richness derives from the level of detail necessary to administer the policies of the program. Payment to physicians is on a fee-for-service basis and a complete record of services must be kept. Enrolled persons are entitled to be reimbursed for a portion of the costs they incur in purchasing care, but only after they have met an initial out-of-pocket deductible. The amount reimbursed for a specific service is not fixed on a national basis, but rather is determined by local market circumstances: the amount "allowed" for a specific service is determined by statistical profiles of charges for the specific service by similarly trained physicians living in the same locality.

To make the necessary administrative decisions on the structure of benefits and payments, the records of Medicare transactions include information on:

- --who is enrolled in the program (and who terminates enrollment through withdrawal or death)
- --who receives services (including a record of all services received)
- --who provides services (and a record of all services provided)
- --mailing address of each member of the enrolled population and each provider of service.

These data can be a useful surrogate for certain of the "general purpose" data components proposed under the Cooperative Health Statistics System (CHSS). These include each of the utilization components: acute care, long term care and ambulatory care and the Medicare data possess some features not available under the CHSS.

First, the records are of individuals and, unlike the CHSS utilization data, are not restricted to episodes of care; this makes it possible to obtain the accumulated experience of an individual across a given time interval. Because individuals are removed from enrollment at the time of death (regardless of where they die), follow-up studies concerning the association between medical care use and mortality are possible. An example of this use is presented in Chapter VIII.

Second, since the count of the enrolled population is kept current, the enrollment file provides a moving census at the small-area level.

Third, the Medicare transaction records contain much more detail on the services provided than do the abstracts proposed under CHSS. Therefore, some aspects of the small-area epidemiology of medical care practices can be studied in greater detail.

Fourth, the presence of charge data and of "allowed dollars" (the amount actually reimbursed by Medicare) permits a range of economic and social policy analyses that cannot be done with the CHSS components.

Fifth, the data support detailed patient origin studies which can be used to define certain types of medical care service areas (such as physicians' service areas) and to estimate the resources allocated to populations living in the defined areas.

The Medicare Part B program generates three data files which are used in the daily transactions of the program. These are the patient history or claims files, the enrollee file, and the provider file. These files can be organized into a unit record covering each transaction. Table 4.4 lists the data items we have found useful for small-area analysis.

TABLE 4.4

DATA AVAILABLE FOR ANALYSIS
MEDICARE PART B

Physician Board Certification
Specialty Code
Physician Number
State Code
Procedure Code
Place of Service
Type of Service
Service Count
Reported Dollars
Allowed Dollars
Incurred Data
(Patient age, sex, race, zip code)
Date of Death

The data items correspond closely to those called for in the UHDDS, with the exception that diagnosis is usually not available. The coding convention used for surgical and diagnostic procedures is considerably more detailed: it is designed primarily for billing purposes and therefore distinguishes precisely among procedures so that the relative value of a particular procedure may be determined. For example, there are several code designations for hysterectomy, each indicating a different operative technique. There are extensive codes for diagnostic procedures. For example, the data show whether one or two chest X-ray films were taken. There are also other significant items: each patient is distinguished by his/her Social Security number; the provider of service is also identifed; the charge for the service and the amount actually reimbursed (the "allowed dollars") are listed; and the place and type of service are noted.

In sections of this and the next chapter, we demonstrate uses of Medicare Part B data for each of the three major steps in a small-area analysis:

1. Identify Medical Care Service Areas The example chosen is the Primary Physician Service Area. Based on patient origin data, we define geographically distinct areas in Vermont; in these areas, the majority of Medicare patients use local physicians for most of their primary physician visits.

2. Allocate Resources to Populations Using these primary physician service areas, we show how the Medicare data can be used to estimate the per-capita number of primary care physicians (both in and out of the area) who provide care to the residents.

3. Measure the Services Utilized by Populations In the next chapter, using selected hospital areas (including their sub-areas as defined by rural-urban dichotomy) we show variations in per-capita use of diagnostic and therapeutic procedures among the resident Medicare enrollees. The procedures examined include chest films, sigmoidoscopies, urinalyses, electrocardiograms and blood sugar tests. We also examine the use of vitamin B-12 injections. For certain hospital service areas, we study intra-area variations, using the constituent primary physician service areas to define the study population.

Use of Medicare Data to Identify Medical Care Service Areas: The Primary Physician Service Area

We have investigated the use of the data for defining physician service areas. The example given here is the service area of the primary physician. These areas have been defined by investigating the patient's geographic origin for each ambulatory visit. The data used in this study are based on claims processed over a five-month period (February 1 - June 30, 1972).

The physicians classified as "primary" include all general practitioners, osteopaths and general internists. Active physicians in these categories were identified through the appropriate code in the claims form (see Table 4.4). Zip codes identifying the physicians' places of practice were obtained from the provider file.

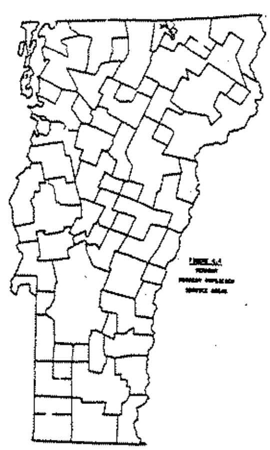
The patient origin study was performed in several steps:

1) The zip codes for all primary physicians whose place of practice had the same zip code were grouped.

2) A count of visits made by residents of each zip unit to each primary physician group was made, using the entire five-month billing file.

3) A plurality rule for assigning zip units to primary physician service areas was adopted.

This process led to the definition of 61 areas in Vermont that range in population according to the 1970 census of less than 500 to about 35,000. Figure 4.4 maps these units.



In 48 of the 61 areas, most primary care is obtained locally. The percent of localization ranges from a low of 20.4% of patients to a high of 90.5%. The median value is 62%. These results are quite comparable to those seen for hospital areas and suggest that these primary physician service areas can be used for the study of the epidemiology of common medical care practices.

Use of Medicare Claims Data to Estimate Resources Allocated to Defined Populations: The Primary Physician

The Medicare Part B claims data can be used to estimate the numbers of primary physicians who, on a per-capita basis, serve the enrolled Medicare population. Under the assumption that patient origins for the under-65 and the over-65 populations are similar, the results can be generalized to estimate the full-time equivalent number of primary physicians who provide service to the entire population. This assumption is currently being tested by comparing patient origin studies for physician claims data under the Medicaid and Blue Shield programs to the Medicare Part B results. Since pediatrician and obstetrician services are not described in Medicare Part B data, more complete analysis would include Medicaid data.

To estimate physician manpower input to a given area the place of residence of all the patients seen by a particular physician was investigated. A decimal fraction of each physician (the percent of all his or her patients who reside in the area) was assigned to the area. For example, if physician A saw 100 patients and 10 of them were from primary physician service area W, then area W gets .1 of a full-time equivalent. The activities of all primary physicians were investigated and the number of equivalents assigned to primary physician service area W was added to obtain an area total.

This estimate, strictly speaking, is an estimate of the labor input by primary physicians to the area. The technique is analogous to the methods used for allocation of expenditures and beds, except that physicians are allocated and patients, not visits of admissions, are used for allocation.

The accuracy of generalizing the estimate to the total population depends on several factors. First, as mentioned above, it depends on the assumption that patient origins for under- and over-65 groups are similar; second it depends on knowing when a physician who is allocated is a single full-time physician. There are several problems related to this issue. Medicare physician codes sometimes represent more than one physician, partners often bill under a single number for services rendered by any or all, and some physicians have more than one code number. In performing this analysis, special attention must be given to an investigation of physician codes so that corrections can be made. We have resolved the problems by use of the manpower file available from the Cooperative Health Information Center of Vermont in Burlington that is analogous to the CHSS manpower file.

A second problem is to know when a physician is engaged in less than full-time practice. This is not revealed by the Medicare file and must be determined independently. We resolved this problem through special inquiries undertaken in conjunction with the maintenance of the CHICV manpower file.

Tables 4.5 through 4.7 illustrate the process of allocating primary care physicians to populations. We selected eight primary physician service areas that are within the geographic boundary of two hospital areas. Table 4.5 shows for each primary physician, the number of

his or her patients that came from each of the areas. For example, physician 1 saw a total of 52 patients during the five-month billing sample, 40, or 77% were from the area in which his practice is located; physician 20 saw 462, 395 of whom were from his immediate area. In total, there were 29 primary physicians who saw a significant portion of patients in these areas. The mean number of patients seen per physician is 112; the range is from a low 6 to a high of 462.

TABLE 4.5

NUMBER OF PATIENTS BY AREA BY PHYSICIAN

Vermont Medicare Claims File, February–June 1972

Physician by Specialty Type	Primary Physician Service Areas 1 A	2 B	3 C	4 D	5 E	6 F	7 G	8 H	All Other	Total
GP - NON SURG										
1	40*	3	0	0	3	0	1	0	5	52
2	31*	0	0	0	3	0	0	0	1	35
3	37*	0	0	0	0	1	2	0	8	48
4	15	56*	1	10	6	2	0	3	10	103
5	1	34*	1	0	3	0	0	0	0	39
6	8	115*	0	2	2	0	0	1	6	134
7	0	0	19*	2	0	0	0	0	11	32
8	0	0	0	78*	0	0	0	1	5	84
9°	7	5	0	1	183*	0	0	1	12	209
10	21	0	0	0	0	87*	3	0	11	122
11	0	0	0	0	0	46*	1	0	17	64
12	4	1	0	0	0	3	64*	0	30	102
13	12	14	1	17	2	0	0	40*	29	115
OST										
14	98*	5	1	0	0	0	1	3	1	109
15	5	19*	2	2	3	0	0	1	0	32
16	0	6*	0	0	0	0	0	0	0	6
17	0	3	68*	6	0	0	0	0	44	121
18	1	0	0	0	0	5*	0	0	11	17
19	5	0	0	0	0	0	0	0	30	35
GP- SURG										
20	395*	20	2	1	9	0	4	0	31	462
21°	358*	21	2	8	24	0	10	0	30	453
22	1	19*	0	0	0	0	0	0	3	23
23	0	0	67*	3	0	0	0	0	27	107
INT MED										
24+	244*	5	0	2	3	0	2	0	10	266
25	15*	0	0	0	6	0	0	0	3	24
26	17	35*	0	31	7	0	1	4	21	116
27	20	113*	5	15	4	0	1	1	15	174
28	0	0	49*	2	0	0	0	0	40	91
29	0	1	48*	3	1	0	0	0	15	68
TOTALS	1335	475	266	183	259	144	90	55	101	3243

*Local physician
°Two physicians use same code
+Three physicians use same code

Table 4.6 shows the proportion of patients seen by these physicians in each of the areas; the sums of the columns represent the estimate for the total amount of full-time equivalent physician effort expended in the area during the five-month billing period.

TABLE 4.6

PROPORTION OF PATIENTS SEEN BY AREA BY PHYSICIAN CODE

Vermont Medicare Claims File, February-June 1972

Physician by Specialty Type	Primary Physician Service Areas 1 A	2 B	3 C	4 D	5 E	6 F	7 G	8 H	All Other	Total
GP - NON SURG										
1	.769*	.058	0	0	.058	0	.019	0	.096	1.0
2	.886*	0	0	0	.086	0	0	0	.028	1.0
3	.771*	0	0	0	0	.021	.042	0	.166	1.0
4	.146	.544*	.010	.097	.058	.019	0	.029	.097	1.0
5	.025	.872*	.025	0	.077	0	0	0	.000	1.0
6	.060	.858*	0	.015	.015	0	0	.007	.045	1.0
7	0	0	.594*	.062	0	0	0	0	.344	1.0
8	0	0	0	.929*	0	0	0	.012	.059	1.0
9°	.034	.048	0	.010	1.751*	0	0	.010	.147	2.0
10	.172	0	0	0	0	.713*	.025	0	.090	1.0
11	0	0	0	0	0	.719*	.016	0	.265	1.0
12	.039	.010	0	0	0	.029	.627*	0	.295	1.0
13	.104	.122	.009	.148	.017	0	0	.348*	.252	1.0
OST										
14	.899*	.046	.009	0	0	0	.009	.028	.009	1.0
15	.156	.594*	.062	.062	.094	0	0	.031	.000	1.0
16	0	1.000*	0	0	0	0	0	0	.000	1.0
17	0	.025	.562*	.050	0	0	0	0	.364	1.0
18	.059	0	0	0	0	.294*	0	0	.647	1.0
19	.143	0	0	0	0	0	0	0	.857	1.0
GP - SURG										
20	.840*	.043	.004	.002	.020	0	.009	0	.082	1.0
21°	1.581*	.093	.009	.035	.106	0	.044	0	.132	2.0
22	.043	.826*	0	0	0	0	0	0	.131	1.0
23	0	0	.626*	.028	0	0	0	0	.346	1.0
INT MED										
24⁺	2.752*	.056	0	.022	.034	0	.022	0	.114	3.0
25	.625*	0	0	0	.250	0	0	0	.125	1.0
26	.116	.302*	0	.267	.060	0	.009	.034	.182	1.0
27	.115	.649*	.029	.086	.023	0	.006	.006	.086	1.0
28	0	0	.538*	.022	0	0	0	0	.440	1.0
29	0	.015	.706*	.044	.015	0	0	0	.220	1.0
TOTALS	10.365	6.161	3.183	1.879	2.664	1.795	.828	.505	5.620	33.0

*Local physician
°Two physicians use the same code
⁺Three physicians use the same code

The data from Tables 4.5 and 4.6 have been summarized in Table 4.7. For each area, the table gives the number of physicians who are active in the area by the location of their practices. It also gives the man-years of primary physician effort invested within the area by the location of the physician providing the service. Note that in all but one area most physician effort is from physicians who practice there. The table gives the full-time equivalent number of physicians serving the area as a per-capita rate. The rate is based on the full population and is obtained by dividing the man-years of primary physician effort invested in the area by the 1970 census population.

TABLE 4.7

CHARACTERISTICS OF PRIMARY PHYSICIANS SERVICING VERMONT PRIMARY PHYSICIAN SERVICE AREAS LOCATED WITHIN TWO VERMONT HOSPITAL AREAS, 1972

Numbers, Man-Years of Effort and Equivalent Numbers of Primary Physicians Per 10,000 Population

	Primary Physician Service Areas							
	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H
Number of Physicians Active in Area								
Practicing in Area	11	8	5	1	2	3	1	1
Practicing Out of Area	14	13	9	19	17	3	13	9
Man-Years of Primary Physician Effort Within Area								
Local Physicians	9.1	5.6	3.0	0.9	1.8	1.7	0.6	.35
All Physicians	10.4	6.2	3.2	1.9	2.7	1.8	0.8	.51
% of Effort from Local MDs	88.0	90.0	94.0	49.0	66.0	96.0	76.0	69.0
FTE MDs per 10,000								
Local Physicians	3.7	4.9	4.5	1.6	4.2	7.5	2.6	1.7
All Physicians	4.2	5.3	4.7	3.3	6.3	7.8	3.4	2.5

This general approach can be modified to meet a number of specific purposes. One example derives from our interest in relating physician characteristics to variations in use of services. Table 4.8 shows one such analysis which looks at the primary physician supply according to specialty and activity characteristics. There are considerable differences among the areas in the numbers of FTE physicians per 10,000 and in the percent of effort that comes from each of the three designated classes of primary physicians. Some areas receive most of their primary care from general practitioners who do not do surgery; others receive most from internists. The range of FTE general practitioners who do surgery is from zero to 1.0 physicians per 10,000.

These subclassifications of physicians into specialty and activity class are only one example of the ways in which physician manpower can be analyzed on a small-area basis; others of policy and planning value include age of physician, educational background and subspecialty. An example of this use of data is in Chapter VII, page 172.

TABLE 4.8

CHARACTERISTICS OF PHYSICIANS SERVICING THE RESIDENTS OF PRIMARY PHYSICIAN SERVICE AREAS LOCATED WITHIN A SINGLE VERMONT HOSPITAL AREA

Full-Time Equivalent Physicians Per 10,000 Population and % of Effort by Specialty Characteristics of Primary Physicians

	Primary Physician Service Areas							
	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H
Full-Time Equivalents								
Characteristic of Primary Physicians:								
General Practitioners Who do not do Surgery	1.7	3.6	1.8	2.4	5.1	7.8	3.0	2.3
General Practitioners Who do Surgery	1.0	0.8	0.9	0.1	0.3	0.0	0.2	0.0
Internists	3.6	1.0	1.3	0.4	0.4	0.0	0.05	0.05
Percent of Effort by:								
General Practitioners Who do not do Surgery	27.0	67.0	45.0	83.0	88.0	100.0	93.0	98.0
General Practitioners Who do Surgery	16.0	15.0	23.0	3.0	5.0	---	6.0	0.0
Internists	57.0	18.0	33.0	14.0	7.0	---	1.0	2.0

Use of Medicare Claims Data to Measure Utilization

In defining medical service areas and in estimating the allocation of resources, Medicare data can be used to estimate the experience of the entire population. But the data's uses for measuring the utilization of specific services, such as an appendectomy, a diagnostic X-ray or an electrocardiogram, are restricted more narrowly to the specific population-at-risk, namely, Medicare patients. While preliminary studies show that within a particular area the utilization experience of the over-65 population is commonly similar to that of the population under 65, the value of claims data for demonstrating differences in utilization experience among areas does not depend on this. Lewis' demonstration of variations among subscribers of the Blue Cross program in use of surgery was a valuable contribution to our understanding of the epidemiology of medical care practices and this contribution was independent of the question of what was happening to the remaining portion of the population at risk. The demonstration of variations in use of services among Medicare enrollees makes a contribution to an understanding of the nature of local

medical care markets. Further, the over-65 population is the target of a major federal utilization review program (PSRO), and the Medicare claims data can provide indicators specific for that program.

By virtue of the benefit structure of the Medicare program, costs incurred during a patient's hospitalization exceed the deductible, and, thus, the events become recorded in the Medicare claims files. For this reason, the Medicare data is a sufficient source of data for measuring the hospitalization experience of nearly every American citizen who is over 65 years of age. The Part A file provides data for generating discharge rates, patient day rates, average lengths of stay and costs which can be measured for all causes and for selected causes of admission. The Medicare Part B file can be used to measure the rates of use of in-hospital services among defined populations, particularly their rate of use of surgery.

SUMMARY AND CONCLUSIONS

This chapter demonstrates the use of claims data based on the Medicare program for small-area analysis. In jurisdictions that do not have uniform hospital discharge data sets (UHDDS) covering the full population, claims data can serve as a useful substitute and we recommend its adoption. Because more extensive information is available in the claims data set, unique analysis not possible with the UHDDS can be undertaken. These include economic and other policy analyses using reimbursements and survival after medical or surgical interventions, some of which are illustrated in subsequent chapters. In the next chapter, we demonstrate the use of both the MEDPAR data set and the Medicare Part B data for measuring small-area variations in use of services among hospital and primary physician service areas.

PART TWO

An Epidemiology of Medical Care in New England

CHAPTER V

ON THE NATURE AND SOURCES OF VARIATIONS IN USE OF MEDICAL SERVICES

This chapter describes the pattern of variation in rates of use of medical services among small areas and discusses the probable causes. The focus is on variations as they occur among three levels of geographic aggregation:

(1) between the New England States;

(2) among hospital areas within States; and

(3) among primary physician areas within hospital areas.

Among the States and hospital areas, we describe variations in resource allocations (beds, hospital employment and expenditures per capita), in aggregate use of hospital for all and for medical and surgical cases and in a specific surgical and medical case mix. For selected Vermont hospital and primary physician service areas, variations in use of diagnostic and therapeutic procedures are presented.

This chapter contains two important observations that are relevant for public policy. First, it demonstrates that micro-level (small-area) analyses of market performance are important for health planning and regulation because the rates that apply to larger political aggregates do not describe the behavior in the individual markets for which plans and regulation are targeted. Second, it develops strong evidence <u>against</u> the existence of an operationally useful professional consensus on how medical need is defined and how medical services should be allocated. An important contributing factor to the variations, it is shown, is differences among physicians in their opinions concerning the nature of medical need or the value of specific diagnostic or therapeutic procedures. This has important implications for public policy because many current planning and regu-

latory strategies are based on the assumptions that medical need can be objectively defined and that consensual standards and guidelines can be developed by the profession to regulate the distribution of resources and services among populations.

VARIATIONS IN RESOURCE ALLOCATION AND AGGREGATE UTILIZATION

For 1975, we have made estimates of the hospital resources allocated to each of the 193 hospital areas in the six New England States. (The areas were defined on page Chapter II.) For each of the 193 hospital areas, we have estimated the relative contribution to resource allocation made by each hospital that had one or more recorded admissions during 1975. For Connecticut, Massachusetts and New Hampshire, which do not have uniform hospital discharge data sets maintained by health statistics centers, detailed tables have been assembled in a separate volume.

In this section, we summarize the patterns of per-capita variations for hospital expenditures, beds and hospital employment among the tates and, within each State, among the 11 most populated hospital areas. The 11 largest areas were selected so that the minimum population in any one area was 12,000 or more. We summarize the aggregate rates of use of hospitals for all conditions and for medical and surgical cases: in Maine, Rhode Island and Vermont, (States with the UHDDS), rates are given for the total populations. Using MEDPAR data, we are able to report on aggregate utilization and reimbursement rates for the over-65-years population for all States except Connecticut.

We review the evidence concerning the relative importance of consumer and supplier factors as a cause of variation in aggregate use of resources and services. We then examine variations in the rates of use of specific types of services--surgical procedures classified by type of surgery

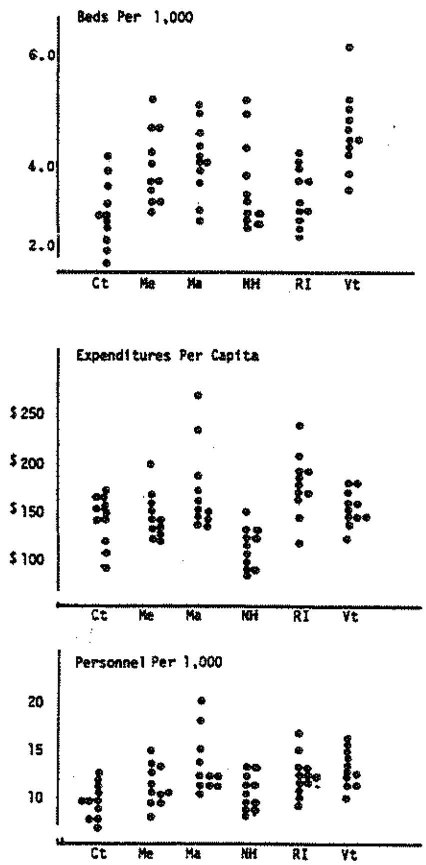
and medical admissions classified by cause of admission--and conclude the section with a discussion of the importance of physician decisionmaking as a cause of variation.

Certain tables from which text figures, summary tables, and figures in this chapter are abstracted are presented at the end of this chapter. Such tables are labeled with a letter suffix. Appendix I tables give information on the number of cases observed in each of the 11 areas, on population size and on the conventions adopted for grouping cases by cause of admission and by surgical procedure.

Between-State Variation

The estimates for allocated resources for each of the New England States in 1975 are given in Table 5.1 and are shown diagrammatically in Figure 5.1. When the States are taken as the geographic units for investigation, there are substantial differences between them. On a statewide basis, Connecticut has the lowest ratio of beds to population (3.2 per 1,000). Vermont, the highest State, with 4.6 beds per 1,000, is 35% higher than Rhode Island or New Hampshire. The low number of beds per 1,000 in Rhode Island probably reflects the stringent application of Certificate of Need statutes which have existed in that State since 1969. However, while ranking low in a ratio of beds, Rhode Island ranks second highest (after Massachusetts) in per-capita expenditures for inpatient services. New Hampshire, a State which has resisted public regulation, has as few beds per 1,000 as Rhode Island, and is also the lowest in per-capita expenditures ($109 per capita). Massachusetts, with $177 per capita, is 1.6 times higher than New Hampshire. Inpatient expenditures for Rhode Island are 1.5 times the New Hampshire rate, while expenditures in Connecticut, Maine and Vermont are about 1.3 times greater. For personnel, Massachusetts is highest and New Hampshire the lowest.

FIGURE 5.1
DISTRIBUTION IN ALLOCATED HOSPITAL RESOURCES
AMONG HOSPITAL AREAS IN EACH NEW ENGLAND STATE WITH GREATEST POPULATION



Wide variations exist, both between the states and within each state

TABLE 5.1

ALLOCATED HOSPITAL EXPENDITURES, BEDS, HOSPITAL PERSONNEL:
HOSPITAL AREAS IN NEW ENGLAND STATES WITH GREATEST POPULATION, 1975

State	State Total	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Area 11
Beds*												
Connecticut	3.2	3.2	2.9	3.2	3.8	2.1	2.7	2.5	4.4	3.4	3.1	4.1
Maine	4.2	3.7	3.4	4.5	4.3	5.6	3.4	3.9	3.5	5.1	3.9	5.0
Massachusetts	4.3	4.6	5.3	3.3	4.3	4.4	3.8	4.1	3.9	3.0	4.3	5.5
New Hampshire	3.4	3.2	3.5	3.6	3.2	3.6	4.6	3.1	5.6	4.7	4.0	2.9
Rhode Island	3.4	3.9	4.3	3.1	4.3	3.3	3.9	3.4	2.9	2.8	3.2	4.5
Vermont	4.6	3.7	4.1	5.2	4.8	5.6	4.6	4.8	5.5	5.0	6.8	4.5
Expenditures+												
Connecticut	$144	$158	$153	$147	$171	$ 90	$114	$106	$163	$153	$141	$163
Maine	$142	$165	$129	$138	$129	$200	$119	$119	$131	$157	$135	$152
Massachusetts	$177	$270	$170	$147	$151	$146	$161	$185	$134	$137	$139	$234
New Hampshire	$109	$111	$112	$ 97	$120	$ 85	$127	$ 89	$146	$113	$104	$ 89
Rhode Island	$168	$240	$183	$160	$166	$177	$210	$175	$144	$114	$185	$176
Vermont	$147	$143	$120	$142	$152	$182	$155	$144	$169	$157	$183	$141
Personnel*												
Connecticut	11.2	10.3	9.5	9.7	12.4	6.6	7.5	7.5	9.5	10.6	9.2	11.6
Maine	13.0	10.4	7.8	12.5	9.1	11.0	13.2	10.1	13.0	14.8	10.2	10.2
Massachusetts	13.5	19.9	13.7	11.2	12.0	12.1	11.2	14.7	10.8	10.1	12.2	17.7
New Hampshire	9.4	9.7	9.7	9.1	12.3	9.1	12.8	8.6	14.0	9.2	11.4	8.8
Rhode Island	12.7	12.8	12.6	14.8	16.7	12.4	12.7	12.5	11.0	11.7	8.5	12.9
Vermont	11.9	16.1	10.8	14.4	14.6	12.7	13.2	11.6	15.9	10.8	9.7	11.5

+Per Capita
*Per 1,000 Population

Reimbursements under the Medicare program show similar per-capita variations as do allocated expenditures. The lowest State is New Hampshire with $323 per enrollee and the highest is Massachusetts with $564 per enrollee, 75% more. Reimbursements in Maine, Vermont and Rhode Island are respectively 1.12, 1.31 and 1.44 times greater than those in New Hampshire.

Based on the UHDDS, the 1975 discharge rate measured for hospitals in Rhode Island is substantially lower than in Vermont or Maine: 129 per 1,000 versus 162 per 1,000 and 158 per 1,000 respectively (Table 5.2). The differences in overall rates are largely because of differences in non-surgical discharges: for this category of discharge, the rates in Maine and Vermont are 33% and 51% higher respectively than Rhode Island. By contrast, surgical discharges in Vermont and in Rhode Island are about the same; in Maine they are about 10% higher. The implication is that when bed supply is restricted, it is the medical and not the surgical cases which are excluded.

TABLE 5.2

USE OF HOSPITALS FOR ALL AND FOR SURGICAL AND NON-SURGICAL DISCHARGES: MAINE, RHODE ISLAND AND VERMONT, 1975
DISCHARGES PER 1,000 POPULATION

Discharges	Maine	Rhode Island	Vermont
All Cases	158	129	162
Surgical Cases	66	60	58
Non-Surgical Cases	92	69	104

A similar pattern emerges for utilization rates for the Medicare population. Table 5.3 shows that Rhode Island has the lowest rate of admission among the New England States and that the admission rate is low because of a relative

deficit in medical, not surgical admissions. For non-surgical cases, Vermont exceeds Rhode Island by 90% and Maine exceeds Rhode Island by 85%. By contrast, for surgical cases, the Rhode Island rate is 5% higher than average and exceeds the surgery rate in Massachusetts, New Hampshire and Vermont. New Hampshire is lowest.

TABLE 5.3

USE OF HOSPITALS FOR ALL AND FOR SURGICAL AND NON-SURGICAL DISCHARGES: FIVE NEW ENGLAND STATES MEDICARE ENROLLEES, 1975 PER 1,000 ENROLLEES

Discharges	Maine	Massachusetts	New Hampshire	Rhode Island	Vermont
All Cases	269 (1.4)	245 (1.3)	284 (1.5)	185 (1.0)	272 (1.4)
Surgical Cases	88 (1.1)	83 (1.1)	75 (1.0)	87 (1.1)	86 (1.1)
Non-Surgical Cases	181 (1.8)	162 (1.7)	159 (1.6)	98 (1.0)	186 (1.9)

Figures in parentheses are ratios to the lowest figure in each category.

Variation Among Hospital Areas

The average rates for the States as a whole do not give a clear picture of the quantities of resources that are allocated to their constituent hospital areas.* The intrastate variations are considerable. In Maine, the highest hospital areas are allocated 65%, 68% and 90% more than the lowest hospital service areas for hospital beds, expenditures and employees respectively; similar patterns exist for the other States. For allocated beds, the greatest intrastate variations are in Vermont and Massachusetts with a 1.8 range of variation between the highest and lowest areas; in Rhode Island the range is 2.1 for expenditures; and for personnel, Rhode Island and Massachusetts exhibit almost a two-fold range of variation between their highest and lowest areas.

*Remember that the Rhode Island areas are health service regions, not hospital areas. See Chapter II.

Within the States, the typical pattern of variation is seen: in two States, Maine and New Hampshire, the per enrollee reimbursement varies by more than two-fold (Table 5.A). Among the hospital areas, the highest is in Massachusetts (Boston area) with $640 per enrollee; the lowest is in New Hampshire (Manchester area) with $176 per enrollee. It appears that in 1975 the average Medicare enrollee who lived in Boston received 3.6 times as many Federal dollars for hospital care as did the enrollee who lived in Manchester.

Such diversity is revealed only by small-area analysis. A comparison of Figure 5.1 and Table 5.1 shows that the rate of services measured at the State level does not reveal the behavior of the individual markets. While on the average, Rhode Island and New Hampshire have kept their number of beds per capita at a relatively low rate when compared to most other New England states, the range of variation among the constituent communities of Rhode Island and New Hampshire appears to be as striking as in any of the other States. Some Rhode Island areas have resource allocation rates higher than the average of other New England States; and some areas in each of the other States (which by 1975 had not put Certificate of Need laws into effect) have allocated bed rates lower than the average rate for Rhode Island. Planners, regulators and managers of health resources commonly make decisions which affect the distribution of resources among communities. Unless detailed information is available at the micro-level, their decisions can result in increased rates of use in high-rate areas while constraints are placed on growth in low-use rate areas. The equity implications of decision-making without knowledge of existing market conditions are discussed in subsequent chapters, particularly in Chapter IX in conjunction with the review of rate setting programs.

Medical, surgical and total discharges for Medicare enrollees

among the 11 largest hospital areas in five New England States show the same general patterns and are summarized in Table 5.B at the end of this chapter.

VARIATIONS IN SURGICAL AND MEDICAL CASE MIX

Between-State Variations

We have examined the rates for the nine most commonly performed surgical procedures (excluding cesarean sections, circumcisions and mastectomies) in Table 5.4.

TABLE 5.4

RATES FOR COMMON PROCEDURES IN MAINE, RHODE ISLAND AND VERMONT, 1975

PER 10,000 POPULATION

PROCEDURE	MAINE	RHODE ISLAND	VERMONT
Tonsillectomy	39	37	23
Dilation and Curretage	95	81	84
Hysterectomy	55	58	43
Prostatectomy	26	25	23
Cholecystectomy	21	22	20
Appendectomy	15	11	16
Inguinal Hernia	26	26	28
Hemorrhoidectomy	6	7	5
Varicose Vein	5	5	6

Between the States, the rates are highest in Rhode Island for three of the procedures: hysterectomies, which exceed the low State, Vermont by 35%; hemorrhoidectomies, which exceed Vermont by 40%; and cholecystectomy. Rhode Island has the lowest rate in two of the nine procedures, and is tied for lowest in two others.

This is in marked contrast to non-surgical admissions classified by cause of admission, where the Rhode Island experience is lowest in all the examined categories. As noted above, Rhode Island has fewer beds per capita than do the other New England States and the impact of the lower bed rate appears to be entirely in the rate of admission for

non-surgical cases.

Admissions for the following conditions exceed Rhode Island rates by at least 50% in one or both of the other States: mental conditions, diseases of nerves and sensory organs; respiratory illness, genital or urinary tract conditions, diseases of skin and musculoskeletal system, injuries and digestive diseases. Non-surgical admissions for malignant neoplasms and for cardiovascular diseases are the only two cause groups in which the Rhode Island rate is more than two-thirds the rate in either Vermont or Maine.

Variations Among Hospital Areas

In Figure 5.2, we selected surgical procedures in each of 11 largest hospital areas in Maine, Rhode Island and Vermont, to illustrate an important characteristic of the pattern of variation of surgical services: some procedures are much more varied in their rates than others.

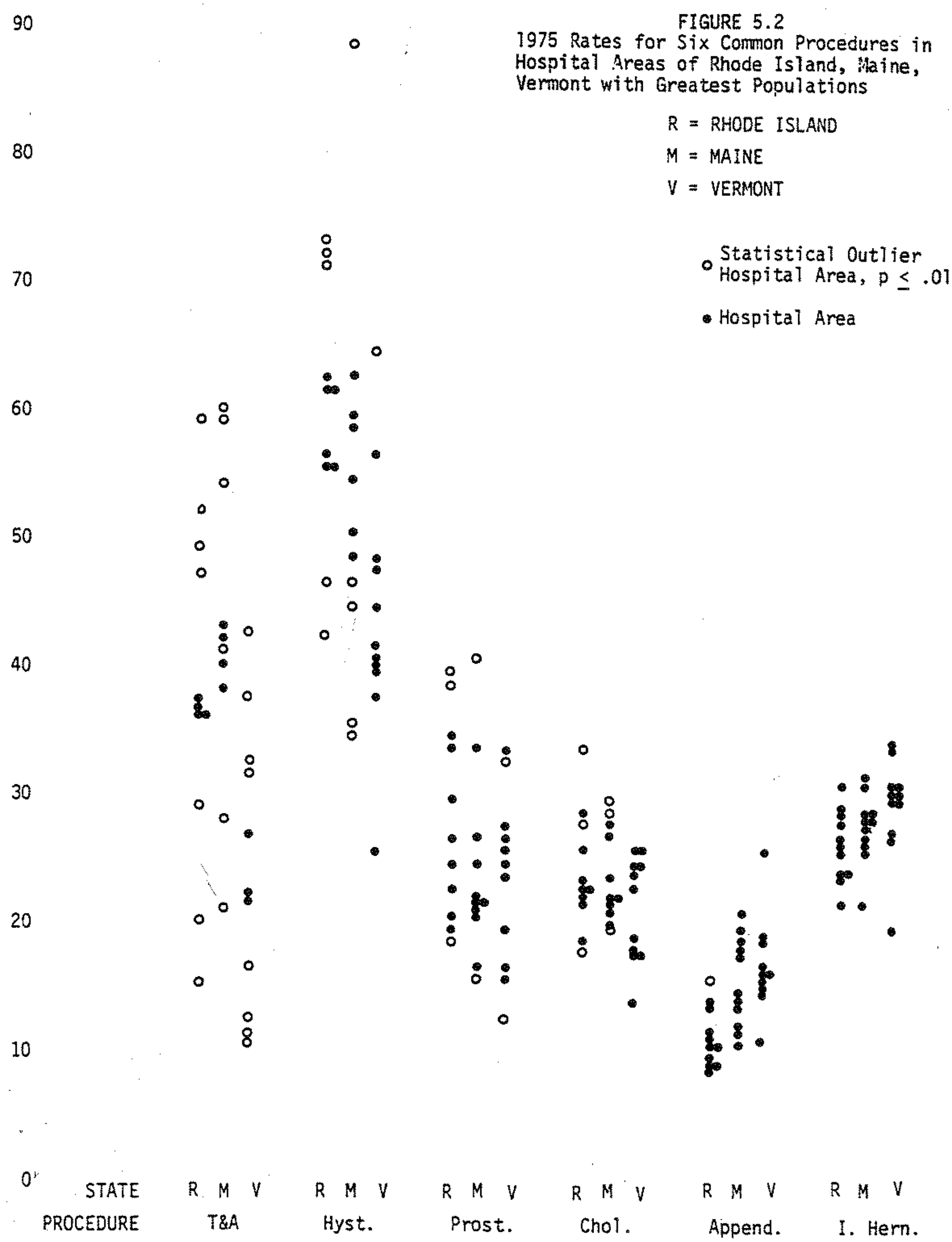
CAPTION FOR FIGURE 5.2

Procedures can be classified according to their relative variation.

	Relative Variation	Chi-Square with $p < .01$° #Areas	Chi-Square with $p < .01$° %Tests	Average Coefficient Variation	Average Ratio H/L
Tonsillectomy	High	21	64	36	3.5
Hysterectomy	Inter. High	11	33	23	2.0
Prostatectomy	Inter. High	7	21	30	2.5
Cholecystectomy	Inter. Low	6	18	18	1.8
Appendectomy	Inter. Low	1	3	21	2.0
I. Herniorrhaphy	Low	0	0	12	1.5

°Based one degree Freedom chi-square with expected number of cases (age-adjusted) predicted by state average rate. Total number of tests equals 33.

The Figure also illustrates that the pattern of variation along with the hospital areas within each of the states tends to be consistent from state-to-state. For example, for inguinal hernia procedures, the coefficient of variation is low in each state and there are no areas in any state where the one degree of Freedom chi-square test was significant at the p = .01 level. By contrast, for tonsillectomy, the distribution of rates in each of the three states yields a relatively high coefficient of variation, a comparatively wide range between low and high rates, and 21 of the 33 areas have rates that are significantly different by the chi-square test.



(FOR CAPTION SEE NEXT PAGE)

The rates for tonsillectomy, hysterectomy, prostatectomy and dilation and curretage are much more widely scattered than are the rates for appendectomy, cholecystectomy, and particularly, inguinal hernia.

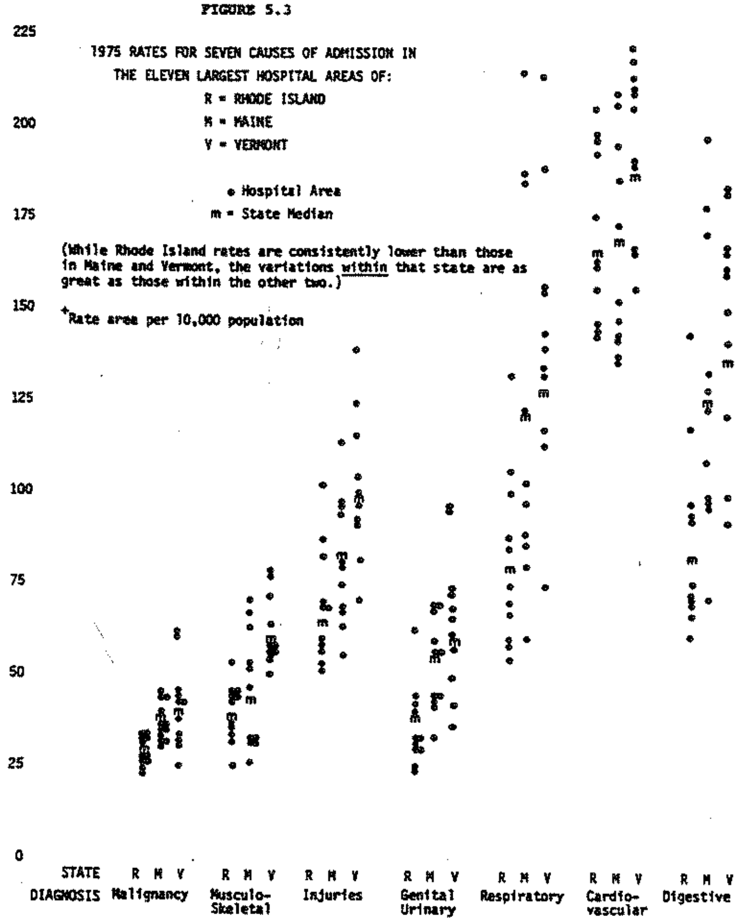
Besides indicating variations in the frequency of different procedures, the interesting fact emerges that these variations are consistent between different groups of people. While supporting arguments are more fully developed below, the consistency in the pattern of specific procedures between areas suggests a continuum of discretion in clinical decision-making; i.e., the greater the discretion, the greater the variation in use of the operation. Along the continuum, high variation (high discretion) procedures are (1) those in which "need" is less clear, certainly not a yes-or-no situation, and/or (2) those about which physicians do not agree concerning their efficacy. By contrast, low variation (low discretion) procedures are those for which (1) the condition to be treated is rather clearly defined as to its presence or non-presence; and (2) there is professional consensus concerning the value of the procedure (as opposed to an alternative approach) in treating the condition.

The low variation pattern among hospital areas in rate of use of surgery for inguinal hernia suggests that the incidence of the condition does not vary greatly among areas and that the medical profession from area to area diagnoses and treats the condition about the same. Other procedure and condition rates which one might expect to fit this pattern are surgical procedures for common cancers, such as cancer of the bowel or lung, and hospitalizations for serious fractures, such as hip fractures among the elderly. The rates for these condition-procedure combinations for which, under current practice standards, there

is little professional discretion. By contrast, the high variation condition-procedures are highly discretionary in the sense that practical alternatives are often employed for treating the condition in question.

Figure 5.3 shows the distribution of the rates among the 11 largest hospital areas in Maine, Rhode Island and Vermont for the seven most frequent medical conditions. While the

FIGURE 5.3



average State rate for Rhode Island is considerably lower for most conditions, the rates within Rhode Island tend to demonstrate as much variation as do the distributions in Vermont and Maine. In other words, although the rates are generally lower in this State with the earlier Certificate

of Need legislation, there is no evidence that there is greater homogeneity among the Rhode Island areas in pattern of use of hospitals for non-surgical conditions. And the statistical indicators are such that the distributions for most of the conditions would be classified as high variation patterns, suggesting that, even in Rhode Island, a large number of cases are discretionary; that is, in some places patients are admitted to the hospital and in other areas they are treated in an ambulatory setting or in a nursing home. The most common condition, cardiovascular disease, shows little difference between the States, suggesting that the availability of long term care beds is not an important reason for the difference.

Two conditions, malignant neoplasms and diseases of the skin and musculoskeletal system, tend to demonstrate low variation patterns in some States. In Rhode Island and Maine, medical admissions for malignancy demonstrate much less variation than admissions for most other conditions; and for skin and musculoskeletal conditions, the rates are relatively homogenous within Rhode Island and Vermont.

In contrast to low variation surgical procedures where the average rates between the states are similar, the average rate for Rhode Island is appreciably lower than the rate for Maine for malignant diseases and the rate for skin and musculoskeletal conditions for Vermont. Thus, although patterns may suggest similar professional decision-making with regard to admission to hospital within the States, there is no indication for similar behavior between the States.

VARIATIONS IN USE OF DIAGNOSTIC TESTS AND INJECTIONS

The Medicare Part B data are particularly useful for describing the patterns of use of diagnostic and therapeutic procedures, including many that are not coded in the ICDA convention. The populations-at-risk are defined at two

levels of market aggregation. The first is the hospital area, defined according to the strategies outlined in Chapter II. The data are for five months in 1972 in Vermont in the six areas with largest populations. And for the three largest hospital areas, we examine geographic sub-areas according to rural/urban dichotomies. The least aggregated market area is the primary physician area as defined in the previous chapter. We examine seven such areas that lie completely within the boundaries of one of the largest hospital areas.

The examples of utilization selected include chest films, electrocardiograms, sigmoidoscopies, blood sugar tests, urinalyses and pulmonary function tests. We also look at one therapeutic procedure, the injection of Vitamin B-12, an agent that is specific for a relatively uncommon medical condition - pernicious anemia - but which is used rather commonly, perhaps as a placebo for non-specific complaints.

<u>Variations Among Hospital Areas</u>

Table 5.C summarizes the variations observed among the areas, presenting the standard utilization ratio for the two highest and the two lowest areas as they rank on each individual procedure. For chest films, electrocardiograms, sigmoidoscopies and blood sugar tests, the area using the greatest per-capita number of tests exceeded the least by a factor of more than 10; for urinalysis, pulmonary function tests and for Vitamin B-12 injections, the range of variation was less, but still of a marked degree.

<u>Intra-Hospital Service Area Variation</u>

For service areas 1, 2 and 3, Table 5.D shows the per-capita rate of reimbursement for the six diagnostic procedures and for Vitamin B-12 injection. For each procedure there are striking differences among the sub-areas of at least one hospital service area.

For electrocardiograms (EKG), there are major differences among the three sub-areas of Area 1. The city Area (1) has the greatest reimbursement rate, nearly $1,000 per 1,000 enrollees more than city-rural areas (2). These differences are entirely due to differences in the number of electrocardiograms performed per 1,000 enrollees: the "allowed dollars" per electrocardiogram in these areas are nearly identical.

For sigmoidoscopies, again, the greatest differences are among the sub-areas of Area 1, where reimbursements in the city area exceed those in the other areas by more than three-fold. Although the rate in the area as a whole was about equal to Area 3, when the areas are disaggregated it becomes apparent that reimbursements per capita in parts of Area 1 exceed those in Area 3; and those in other parts; namely, the city-rural and rural areas are lower than in all other hospital areas.

For blood sugar tests each of the three areas demonstrate considerable intra-area variation. In Area 1, the rural area shows a rate that is less than one-fifth that of the city-rural area. In Area 2 and 3, the situation is the reverse; the city areas are less than one-third those of the small-town rural areas.

For urinalysis and pulmonary tests there are some differences, but they are small when compared to the other procedures.

For Vitamin B-12 injections, the variations are striking in Area 1, where the city-rural area 2 reimbursements exceed by nearly three-fold those in small-town-rural area 3; the city-rural area of hospital service Area 1 exceeds that in the next highest hospital service area by nearly 25%.

These intra-service-area variations demonstrate an important principle of small-area analyses: the rates in any geographic area reflect a weighted average of the clinical opinion of the local physicians concerning the value of a particular procedure; the weights are a function of the probability of being treated by a physician who subscribes to a particular school of thought. When the population of an area visits a small cohort of physicians, then the aggregate rates in an area will reflect more directly one school of thought; namely, the opinion of the dominant physicians in the area. By disaggregating hospital areas into smaller geographic areas, the natural variation in workloads among physicians becomes more apparent.

This suggests that the more natural demographic unit for studying small-area behavior of the health care system is the physician, rather than the hospital, area.

Variations Among Primary Physician Service Areas

Table 5.5 examines variations among primary physician service areas (defined above), which are located in hospital Area 2. Primary Physician Service Area B is located within

TABLE 5.5

STANDARDIZED UTILIZATION RATIOS FOR SELECTED DIAGNOSTIC AND THERAPEUTIC PROCEDURES AMONG SEVEN PRIMARY PHYSICIAN SERVICE AREAS, LOCATED IN HOSPITAL AREA 2

(Based on the Number of Procedures During a Five Month Billing Period, 1972)

Primary Physician Service Area	X-Rays	EKGs	Blood Sugar Test	Urinalysis	Vitamin B-12 Injection
A	1.09	0.68^x	0.84	0.83^x	1.45^x
B	0.97	0.81	0.26^x	0.90	0.69^x
C	1.38^x	1.94^x	0.43^x	0.58^x	0.16^x
D	0.88^x	1.85^x	1.53^x	2.34^x	0.89
E	0.58^x	0.98	4.24^x	1.54^x	0.32^x
F	0.63	1.91^x	3.67^x	1.37	1.60
G					

X $P \leq .001$

the city sub-area; Area A crosses both sub-areas; the remaining areas are each located in the small-town-rural area.

Table 5.5 gives the ratios of utilization in each area to the average of all areas for five procedures. Note that for each procedure there are substantial differences among the primary physician service areas.

For chest films there are considerable differences among the more rural-small-town practices. These differences were not observed when the population at risk was defined according to city/rural dichotomy.

For electrocardiograms it can be seen that the relatively greater utilization seen in rural-small-town areas is localized in three of the five primary physician service areas that lie within that larger area. In these areas (D, E and G) the rates are nearly double the expected. By contrast, one of the two areas within the city area (Physician Service Area B) has a rate significantly lower than the average.

For blood sugar tests, Area B is very low, as are two of the areas in the rural-small city sector. But in three of the areas the rates are strikingly high; it is these three areas that account for the relatively high rate of reimbursement seen in the rural portion of Hospital Area 2 (Table 5.D).

For urinalysis the pattern of variation is similar to that seen for blood sugar tests, except the rate in Area B is not as low.

For Vitamin B-12 injection, the hospital service sub-area analysis revealed relatively high expenditures in both the city and in the rural-small town sectors. This can be localized to Primary Physician Service Area A (which crosses both sectors) and to Primary Physician Service Area G, which is the small-town-rural hospital service sector. By contrast, the rates are low in Area D, E and F.

ON THE CAUSES OF VARIATION

Among large geo-politically defined regions, such as countries, States or provinces, rates of use of services will depend on the aggregate supply of resources invested in health and the productivity of the medical care system. Variations in rates of use of specific services, such as hysterectomies, appendectomies or hernia procedures, will depend on the incidence of the condition as well as upon the conventions adopted within the medical profession (whether in response to professional standards or to consumer demand) concerning how conditions of the uterus, appendicies or a hernia should be treated. They will also depend on less tangible factors, such as national or regional differences in attitudes toward medical care. Among small areas, similar factors may operate to determine variation. However, there is an added dimension that can affect small-area variations, but be unobservable in the larger aggregation. This is the impact of between-physician variations in diagnostic or prescribing practices. Thus, at the small-area level the importance of both aggregate supply and individual physician decision-making can be studied as a cause of variation. And because, commonly, small neighboring populations defined by patterns of use of hospital or primary physician are quite homogeneous in demographic characteristics that determine individual consumer behavior, small area analysis reveals the impact of physician and other supply variables on utilization. Indeed, as we show below, the method of defining local populations according to patterns of care (which is almost always determined by proximity to source of care) creates a "case control" circumstance in which the populations are quite similar but in which, (for historical reasons unrelated to medical need), the supply of medical providers varies considerably with regard to professional and, probably, personal characteristics.

The discussion of the causes of variation is first devoted to the topic of aggregate use of services (e.g., total expenditures or aggregated rates of use of surgical or medical services), and is concerned with the impact of supply and consumer differences among areas on the observed variations in aggregate consumption rates. The second part is concerned with the variations in rates of specific therapeutic or diagnostic procedures and how they should be interpreted. The focus is on the impact of clinical decision-making under uncertainty.

Differences in Aggregate Utilization

This section reviews accumulated evidence concerning the reasons for cross-sectional differences in aggregated rates of use of service and expenditures. Given the current distribution of physicians and populations, to what extent can the differences in rates of use of services be attributed to differences among the populations with regard to their perceived need for care or their behavior in seeking care? To what extent can the differences be attributed to the distribution of physicians? (The issue of the contribution of facilities is taken up in the next chapter.)

Consumer contribution to market variations in demand rests with factors that determine the disease incidence in populations and those which affect the behavior of individuals in making choices to seek and to consume care, given that a particular disease has occurred or is thought to have occurred. Extensive literature exists on the determinants of demand for medical services which demonstrates the importance of illness (or perceived illness or morbidity) as an initiating episode in a chain of events that may lead to a first contact with the health care system. Other factors are important in determining whether or not contact is actually made. Some relate to the avail-

ability of resources that affect the individual's status in the market: personal income and, most important, privately financed health insurance or the availability of public programs such as Medicaid or Medicare.

To investigate consumer contribution to variations, we have asked if, among the populations of the communities, net differences exist in factors known to affect an individual's decision to seek care. Evidence to answer the question has been obtained for selected Vermont hospital areas through a special-purpose household interview study.[25] Individuals in at least 245 households were interviewed in each of six hospital areas which vary considerably in their rates of use of hospitals. (Table 5.E) These areas have a range in utilization that is nearly two-fold for surgery rates and per-capita expenditures for hospital care. The household survey could detect few differences among the populations in the distribution of consumer attributes that are usually thought to predict the use of health services (Tables 5.F and 5.G). The differences which were detected could not be related to differences in the use of care in any consistent way to explain variations. No differences were seen in the distribution among areas for such important predictors as the proportion of consumers with health insurance (cross-classified by type of insurance coverage), reported episodes of acute and chronic illness, poverty level or availability of physician care. Further, residents of the surveyed areas visited their physicians in approximately equal proportions (75%) on an annual basis. The results indicate that these populations, while differing with regard to exposure to medical services and rates of utilization, are essentially similar with regard to age-standardized illness rates (as these can be measured by interview survey) and behavior of consumers in seeking care.

Physician Contribution to market variation in demand is suggested by several studies which show that the composition and overall cost of health services vary depending upon the number, type of specialty and other characteristics of physicians serving the populations. Feldstein[26] has shown an inverse correlation between numbers of general practitioners and use of hospitals; Bunker's[27] studies show that the difference in rate of use of surgery between the United Kingdom and the United States is associated with a difference in per-capita numbers of surgeons; a similar (direct) relationship has been shown by Vayda[6] for Canadian Provinces and by Lewis[7] for counties in Kansas. The SOSSUS[28] studies show a similar relationship. Our own studies[3] among Vermont hospital areas show that populations served by more general practitioners who do not do surgery have lower per-capita costs for hospitalizations and fewer surgical admissions than areas served by general practitioners who perform surgery. This finding is consistent with that of Feldstein cited above. Further, areas served by general practitioners who do not do surgery have lower expenditures for diagnostic services. Areas with more internists incur greater costs for hospitalizations and receive more diagnostic tests; areas with more surgeons receive more surgery. (For example of correlations, see Table 5.H).

The correlations between physician supply and expenditures and service rates derive, of course, from differences in workload undertaken by the individual physicians who make up the different specialties.

Generally, this workload cannot be related to indicators of the relative need of one population when compared to another. For example, among 13 Vermont hospital areas, the multiple correlations between allocated full-time physician equivalents per capita and population size, per-capita

income and age structure was r = .90. The simple correlations were .51, .60 and -.64 respectively, suggesting a poor correspondence between physician impact and population need. Further, differences in total expenditures tend to relate to volume rather than pricing differences. For example, in the case of relative supply of internists, the positive correlation between laboratory and electrocardiogram expenditures stems from the internists' inclination to perform the tests rather than from greater charges or reimbursements.[21] The reverse situation pertains to general practitioners.[o]

In summary, at least for Vermont, differences in consumption between hospital areas do not bear a strong relationship with variations in consumer factors which can be quite constant among areas which have two-fold differences in consumption rates. The distribution of physicians is not related to need in such a way that areas with older populations would have more physicians. In the aggregate, the professional workloads undertaken in a community relate to the specialty interests of physicians serving the community; variations in per-capita input of full-time equivalent physicians, classified by specialty, correlate with specialty-specific per-capita rates of service. While this association would be expected in situations where needs were not met (or where excess demand exists), we show in the next section the peculiar patterns of variation of specific services or procedures which indicate that differences exist in professional decision-making with regard to the indications for many common surgical and medical treatments. We will argue that the variation of acceptable practice is such as to negate regulatory or planning strategies that assume the existence of professional consensus that can ration health services within acceptable expenditure or use-rate limits.

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[o]For example, in 1972 the average Medicare reimbursement for an EKG performed by an Internist was $13.96; for General Practitioner it was $13.88. The volume of EKGs per 100 encounters varied strikingly: 38 for Internists and 16 for General Practitioners.[21]

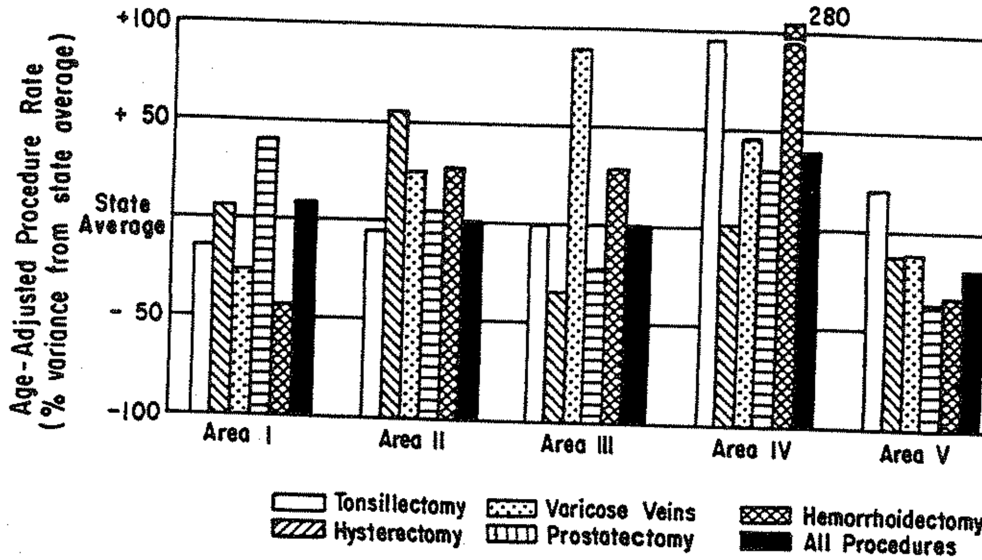
The Professional Contribution to Variations in Surgical and Medical Case Mix

Investigation of the epidemiology of specific procedures at the small-area level of population aggregation provides insight into the nature and importance of professional influence on utilization. While in a typical small-area analysis the numbers of common procedures occurring in the study populations are sufficiently large to obtain statistically "stable" rates, the number of physicians whose workloads contribute to each area rate is small; the aggregate rate of an area is thus the weighted average of the decisions made by a small number of physicians regarding indications for the procedure. When communities with similar populations (similar in the sense discussed above) are compared, the patterns of variation will reflect the range of physician choice concerning the labeling of disease and belief concerning the value of treatment. While the pattern is inevitably an understatement of the true range of professional differences (because the rates are weighted averages), comparisons of the patterns of variation can yield insights into the nature and consequences of differences among physicians in clinical decision-making.

An important piece of evidence showing that physicians differ substantially in their thinking about when operations ought to be undertaken is the repeated observations in Vermont, Maine and Rhode Island of the phenomena depicted in Figure 5.4. Figure 5.4 is derived from studies of rates of surgery in hospital areas in Maine.[4] The numbers on the vertical axis are the ratio in that area to the State rate. The figure gives data for the five most populous hospital areas in Maine. The expected number is the age-corrected number of cases that would occur in each area if the state average rate applied. The figure shows that the rates at which specific procedures are performed within an area vary markedly and to a large degree independently of the

VARIETIES OF SURGICAL EXPERIENCE IN FIVE MAINE HOSPITAL AREAS WITH GREATEST POPULATIONS

FIGURE 5.4



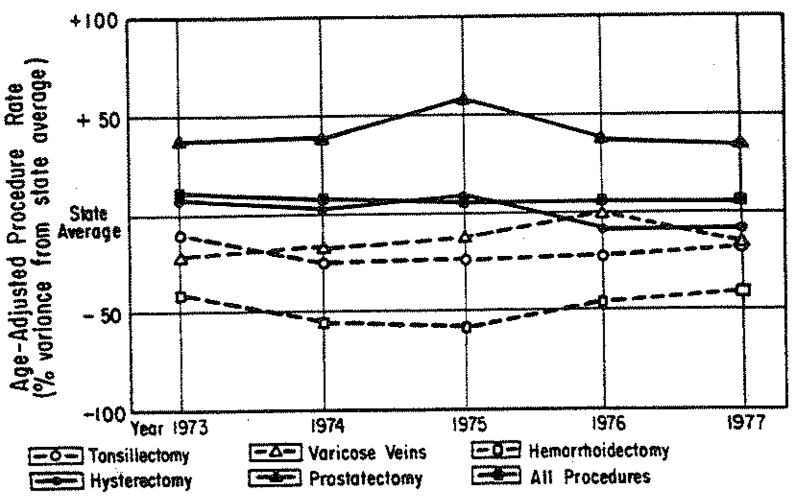
The age-adjusted rates of five common surgical procedures varied widely among five largest Maine HSAs, despite similar total rates in three. In each area, the most common procedure was different - prostatectomy in Area I, hysterectomy in Area II, varicose vein procedures in Area III, hemorrhoidectomy in Area IV, and tonsillectomy in Area V. There were also four different "least common" procedures in the five areas.

total operation rate. For example, while Area II and Area III have the same total operation rate, Area II exceeds in hysterectomies (doing 56% more than the State average) and Area III exceeds in varicose veins (doing 89% more than the State average). In contrast, in Area III, the hysterectomy rate is well below the State average and approximately one-third the rate in Area II. In each of the five areas a different one of the five procedures is performed most often; in four of the five areas, the least-performed procedure is different. The number of surgeons and their specialty distribution do not vary to the same degree as the population-based rates for these operations. Also, the number of hospital beds per capita does not vary in a pattern to account for the variation in rates. It appears that variations in physician and resource supply represent a less important contribution to small area variations in rates of discretionary services than differences in the

opinions of physicians about the proper indications for surgery.

The individual clinical decision-making implied in Figure 5.4 tends to persist over time, and it is possible to identify epidemiological "signatures" for the medical care consumed by a community which tend to be constant from year to year. Figure 5.5 illustrates such a "signature," giving the ratio of the observed to the expected number of cases for each of the five illustrated procedures in Area I. Note that the ratios

FIGURE 5.5



Surgical profile tend to be consistent over time, as shown for Area I, yielding a characteristic "surgical signature" for each area. Other areas showed similar consistency in procedure rates.

remain nearly constant from year to year. For example, in 1973 prostatectomies exceeded the State average in that area by a factor of about 1.4; over the next three years, the same pattern of excess for this procedure is observed; on the other hand, hemorrhoidectomy, a procedure that was done at a rate of only about 50% of the state average in 1973, continues through 1977 at about the same relative (low) rate. The other procedures maintain their characteristic places.

It should be remembered that the small-area technique displays the population impact of the clinical decisions made by

a small number of physicians. For example, the hysterectomy profile in Area II is generated largely by six physicians who, from year to year, do about the same number of hysterectomies. Similar patterns of behavior exist for other physician-procedure combinations. Although not without clear exceptions, a constancy rule applies to workload decisions by physicians; these decisions appear to be insensitive to the prior treatment history of the population. (Further examples of these "epidemiologic profiles" are given in the next chapter.)

Professional Uncertainty is One Important Source of Variation

The interpretation that variations reflect differences in professional judgments made under uncertainty concerning the existence of disease or the value of specific treatments is supported by the medical literature. The extensive literature concerning the variability of physicians as observer and interpreter of medical evidence has been reviewed by Koran.[16] The ambiguous nature of much of the evidence purported to connect many commonly used medical and surgical practices has also been extensively reviewed.

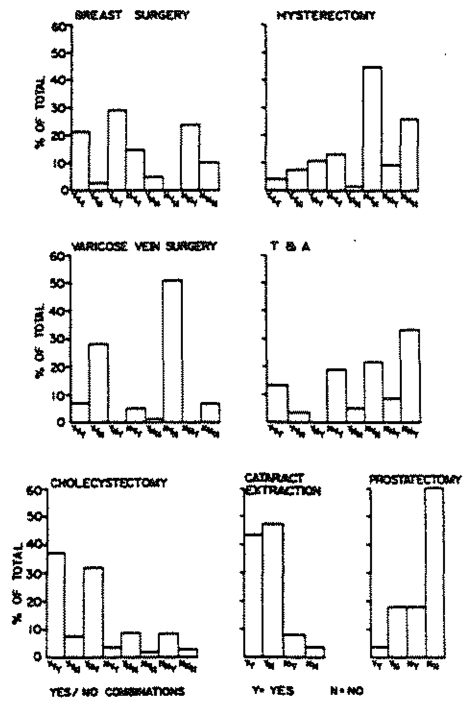
The lack of uncertainty (or the controversy) concerning diagnostic or therapeutic decisions that exists in the medical literature is reflected in the decisions that are measured by the small-area techniques. For example, inguinal hernias are a low-variation procedure performed more or less at the same rate in all areas. The condition for which this procedure is used is generally noted for its transparency; the observation is usually made by the patient or a family member; the subsequent professional diagnosis presents no great difficulty. And the treatment of choice, by consensus, is surgical repair. Under modern conventions in the United States (not in the United Kingdom), only in cases of severe co-morbidity is an alternative treatment--use of a truss--recommended. Appendicitis, a condition for which the moderate variation

procedure appendectomy is the treatment of choice, illustrates how the problem of recognizing the existence of disease influences variation. The problem duly recorded in surgical literature is to know when the condition which brings the patient to the physician is truly appendicitis, not a mimic for which appendectomy is of no value. The data suggest that physician judgments to distinguish false positive and false negative situations are made differently from area to area. Tonsillectomy represents a procedure where there is uncertainty concerning the presence of the condition(s) for which it is the treatment, and intense differences in opinion among physicians concerning the value of the procedure for the condition, given its presence.

Recently, Rutkow and his colleagues[29] have studied agreement-disagreement patterns in surgical decision-making by conducting a randomized and controlled survey of surgical specialists' opinion on the use of seven elective procedures. The study consisted of hypothetical cases for each procedure which described patients who were seeking professional consultation. The case summaries were mailed to board-certified surgeons who were asked to indicate whether they would or would not perform the operation in question. The results indicated marked divergence in professional opinion. The spread of opinion is summarized in Figure 5.6 which shows, for each procedure, the distribution of responses to the case histories. For the three case summaries related to hysterectomy, 25% of specialists indicated that none of the submitted case summaries warranted an operation while 5% thought all three should have the procedure. Among the remaining 70% of surgeons, various combinations of opinions favored one or more examples of operative intervention. Similar disparate patterns of surgical opinions were seen for breast surgery, varicose vein surgery, tonsillectomy and adenoidectomy,

FIGURE 5.6

PATTERNS OF DECISION-MAKING AMONG SURGEONS CONCERNING THE NEED FOR SURGERY IN HYPOTHETICAL CASE HISTORIES



The yes/no combinations to the case histories reveal marked patterns of disagreement for all seven surgical procedures.

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cholecystectomy, cataract surgery and prostatectomy. The authors conclude that "the significant point of this study is that surgical judgment differs to a major degree from one surgeon to another."

In the discussion following the presentation of the above paper, the criticism was raised that the fictional case history approach to evaluating professional disagreement was artificial and could not be relied upon to indicate the extent of professional disagreement. Another study conducted by the American Child Health Association avoids this criticism. In a sample of 1,000 New York school children, 60% had already been tonsillectomized. The remaining 40% were re-examined by school physicians, who selected 45% of them

for tonsillectomy; the children without recommendation were then examined yet again by a second group of physicians who recommended that 45% more undergo the procedure. The third re-examination of twice-rejected children led to tonsillectomy recommendations in 44%. After three successive "second opinions" only 67 out of the original cohort of 1,000 were spared a recommendation for tonsillectomy. The authors concluded that the process of recommendation depended principally on the physician, rather than on the child's health status.

The Flawed Agency Role is also a Source of Variation

The importance of physician choice in influencing utilization is not restricted to cases of uncertainty about diagnosis or long-range benefits. It involves the values he or she assumes to be those of the patient.

The divergence between physician values and patient values--and the fact that the former can dominate decision-making-- is shown by examining the choices patients would make if they were better informed about alternatives when the outcomes are known and the risk of death has different implications for different choices. Here the choice is not made under uncertainty, but rather, given the existence of the objective information, it becomes a question of whose utilities (e.g., values), are being expressed by the decision. A particularly impressive example of the fact that the choices physicians make as agents for their patients can be radically different from the choices patients themselves would have made had they been given more information is provided by McNeil and her colleagues.[31] When they asked patients who had already undergone an operation to remove a cancerous lung whether they preferred greater certainty for short term survival or greater probability for survival at five years, most patients preferred greater immediate certainty. Consequently, these patients would have been better served by radiation therapy than by surgery. The results thus indicate

that patients' preferences for treatment modalities can be more conservative than those of their physicians, and McNeil concludes that patients appear to be more adverse to risk than their physicians. The study illustrates the differences that can exist between physician and patient utilities and how, with more information, patients may make choices more consistent with their own values and more divergent from those of their physician-agents.

SUMMARY AND CONCLUSION

In this chapter we examined the distribution of hospital resources among hospital areas in the New England States. In each State, we found extensive differences in expenditures and in allocated hospital beds and personnel. Similar differences were demonstrated in hospital reimbursements under the Medicare program. These differences in local hospital market use rates can only be revealed through small-area analyses in which areas are empirically defined, based on analysis of patient origins (as defined in Chapter II). Health planners, regulators or managers who do not use these indicators cannot know the distribution of resources throughout the communities of their concern. As we show through several examples in subsequent chapters, decisions made without these indicators further increase variations by awarding more resources to hospitals serving high-use rate areas or constraining growth in low-use rate areas.

We also examined the causes of cross-sectional variations in aggregate use of services among neighboring communities. Relying largely on Vermont studies, we presented evidence that the major factors contributing to variations relate to the supply, rather than the consumer, side of the utilization equation. In each of six hospital areas with extensive differences in consumption rates, we conducted household interviews to characterize the distribution of factors related to

consumer demand among the communities. No important differences were found between the communities, and we concluded that the variations must relate largely to decisions made after the moment of entry into the medical care system. Correlations between type of physician input and type of services produced were found that were consistent with previously reported studies of the association between per-capita physician manpower and rates of service. Areas with more surgeons experienced more surgery; areas with more general practitioners (who do not do surgery) had less surgery; areas with more internists had more diagnostic tests, such as electrocardiograms.

We also examined the use of specific surgical procedures among hospital areas and of diagnostic and therapeutic services among primary physician service areas. The pattern of use of most procedures, we concluded, is incompatible with variations in medical need and for the large part, must be attributed to differences in clinical decisions made by local physicians. The small-area technique, because it concentrates on a relatively small cohort of physicians, is particularly suited for examining the population impact of decision-making differences among physicians. The use of this technique for improving the specificity of utilization review under PSRO is discussed in some detail in Chapter VIII. In this chapter we emphasized the importance of the uncertainty that physicians face in making diagnoses and in making choices among alternative treatments. To a large degree, this uncertainty stems from the lack of convincing studies concerning the expected outcomes of common medical and surgical treatments. But part of the uncertainty derives from differences among physicians in diagnostic or disease-labeling practices. A final probably contributing factor to small-area variations is differences among physicians with regard to the value or utility they ascribe to certain types of outcomes.

The small-area data thus indicate extensive practical differences among physicians that affect the use of resources. In Chapter VIII we discuss some practical ways of using data for improving information on outcome, including a suggestion for obtaining more direct information on how patients' needs are met by current practice patterns. The next chapter deals further with the issue of supply impact on utilization as we examine longer-range trends in use of services among three New England States. Some equity issues are also introduced by examining the implications of long-term, stable differences in per-capita expenditures among communities.

TABLE 5.A

SUMMARY OF PER CAPITA REIMBURSEMENTS AMONG MEDICARE ENROLLEES:
HOSPITAL AREAS IN FIVE NEW ENGLAND STATES WITH GREATEST POPULATION

State	Highest	2° Highest	2° Lowest	Lowest	Ratio H/L	Ratio 2°H/2°L
Maine	$395	$381	$295	$184	2.15	1.29
Massachusetts	640	545	426	354	1.81	1.28
New Hampshire	432	369	202	176	2.45	1.82
Rhode Island	474	439	294	290	1.63	1.50
Vermont	$429	$420	$298	$275	1.57	1.45

TABLE 5.B

VARIATIONS IN DISCHARGES FOR ALL CONDITIONS AND FOR SURGICAL AND NON-SURGICAL CASES AMONG FIVE NEW ENGLAND STATES WITH GREATEST POPULATION

Medicare Enrollees 65 Years of Age and Older, 1975
Rates per 1,000 Enrollees

DISCHARGES	Highest Area	2° Highest Area	2° Lowest Area	Lowest Area	Ratio H/L	Ratio #2H/#2L
All Conditions						
Maine	391	377	266	182	2.1	1.4
Massachusetts	322	301	268	240	1.3	1.2
New Hampshire	464	317	204	145	3.1	2.2
Rhode Island	310	262	206	183	1.7	1.4
Vermont	538	438	299	268	2.0	1.6
Surgical Cases						
Maine	161	120	80	78	2.0	1.5
Massachusetts	106	98	84	76	1.3	1.1
New Hampshire	135	114	80	50	2.7	1.4
Rhode Island	130	122	95	93	1.4	1.3
Vermont	153	152	84	78	2.0	1.8
Non-Surgical Cases						
Maine	281	238	127	105	2.7	1.9
Massachusetts	216	204	164	142	1.5	1.2
New Hampshire	329	229	96	90	3.7	2.4
Rhode Island	188	146	110	90	2.0	1.3
Vermont	385	356	196	172	2.2	1.8

TABLE 5.C

SUMMARY: VARIATIONS IN USE OF SELECTED DIAGNOSTIC AND THERAPEUTIC PROCEDURES AMONG SIX VERMONT HOSPITAL AREAS

Standardized Utilization Ratio°

Procedure	High Area	2° High	2° Low	Low Area	H/L	2H/2L	Number of Statistical Outliers (p .05)
Chest Film	1.33	1.32	.28	.13	10.2	4.7	5
Electrocardiogram	2.07	1.47	.25	.18	11.5	5.9	6
Sigmoidoscopy	1.39	1.36	.60	.07	19.8	2.3	5
Blood Sugar Test	1.64	1.20	.25	.09	18.2	4.8	5
Urinalysis	1.67	1.18	.41	.25	6.7	2.9	6
Pulmonary Function	1.65	.53	.42	.42	3.9	3.0	6
Vitamin B-12	1.35	1.29	.58	.36	3.8	2.2	5

°See text

TABLE 5.D

REIMBURSEMENTS AMONG MEDICARE ENROLLEES FOR SELECTED DIAGNOSTIC AND THERAPEUTIC PROCEDURES DURING A FIVE MONTH BILLING PERIOD (FEBRUARY-JUNE 1972)

Intra-Hospital Service Area Comparisons: Three Largest Vermont Hospital Areas

Dollars per 1,000 Enrollees

	Chest Films	EKG	Sigmoidoscopy	Blood Sugar Exam	Urinalysis	Pulmonary Test	Vitamin B-12 Injection
Area One							
1. City Area	1053	2224	230	199	294	277	61
2. City-Rural Area	433	1244	74	289	329	202	145
3. Small Town-Rural Area	892	1946	72	52	272	261	51
Area Two							
1. City Area	752	318	79	49	168	107	115
2. Small Town-Rural Area	718	488	96	190	222	146	119
Area Three							
1. City Area	NA	3231	182	75	110	87	27
2. Small Town-Rural Area	NA	3317	183	255	112	53	46

TABLE 5.E

USE OF MEDICAL CARE IN SIX SAMPLED VERMONT HOSPITAL AREAS

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Patient Hospitalized in:						
Community Hospital < 100 Beds	3.9	31.8	3.6	3.3	75.4	66.3
Community Hospital > 100 Beds	18.2	4.4	80.0	90.3	8.5	3.8
University Hospitals	77.9	63.8	16.4	6.4	16.1	29.9
Hospitalization Rate (Discharges per 1,000, 1973)*	145	127	160	173	220	132
Surgery Rate (Discharges per 1,000, 1973)*	58	54	58	66	80	49
Medicare Part B ($ Reimbursement Per Enrolled, 1972)	$162	116	141	121	141	92
Number of Local Hospitals	2	2	1	1	1	1

*Age-adjusted to Vermont population

CHARACTERISTICS OF SAMPLED VERMONT HOSPITAL AREAS

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	State-Wide
Interviews Completed	326	258	283	262	280	245	2,190
Number of Adults in Interviewed Households	649	474	551	525	541	478	4,292
Number of Individuals in Interviewed Households	986	704	807	853	858	765	6,681

TABLE 5.F

CHARACTERISTICS OF POPULATIONS LIVING IN SIX SAMPLED VERMONT HOSPITAL AREAS

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Statistical Comparison Among Areas
Socio-demographic Characteristics of Adults:							
Percent with One or More Years of College	35	35	31	21	26	33	.05
Percent White	98	99	99	99	97	98	N.S.
Percent Raised on Farm	31	33	35	34	50	42	.001[2]
Percent Vermont or New Hampshire Born	66	60	68	64	61	59	.05[2]
Percent Living in Area More Than 20 Years	47	49	47	57	47	47	N.S.
Household Economic Characteristics:							
Percent Below Poverty Level	21	19	20	21	23	20	N.S.
Percent with Health Insurance[1]	83	84	83	82	84	84	N.S.
Percent of Insurance Policies Blue Cross	51	54	47	47	54	50	N.S.
Households with Regular Place of Physician Care	98	99	98	98	99	97	N.S.
Illness Level:							
Percent with Any Restricted Days in Last 2 Weeks for Chronic Condition	5	5	6	7	4	5	N.S.
Percent with Chronic Condition	26	28	29	28	23	23	.05[2]
Percent with More Than 2 Weeks of Bed Days in Last Year	6	6	5	7	5	4	N.S.

[1]Excluding Medicare and Medicaid
[2]Linear Trend Component of Chi-Square Statistics Related to Rank on Expenditures and Utilization of Hospitals not Significant

TABLE 5.G

RESIDENT ACCESS TO PHYSICIANS AND HEALTH SCREENING SERVICES
IN SIX SAMPLED VERMONT HOSPITAL AREAS

Health Services	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Statistical Comparison Among Areas
Percent of Population with Physician Contact Within Year Preceding Interview	77.3	76.1	74.2	70.9	73.4	72.6	.001[2]
Percent of Population with Episode of Illness Contacting Physician Within 2 Weeks of Interview	29.3	29.8	34.1	34.4	26.1	30.2	N.S.
Percent of Females 18 Years or Older Receiving One or More Papanicolou Tests[1] Within Year Preceding Interview	59.5	52.2	56.5	49.8	54.8	63.2	N.S.

[1]Within 1 Year of Interview
[2]Linear Trend Component of Chi-Square Significant $P < .001$ for Hospital Utilization: Non-Significant for Medicare Part B Expenditures

TABLE 5.H

SIMPLE CORRELATION BETWEEN MEDICAL MANPOWER RATES AND RATES FOR SURGICAL AND DIAGNOSTIC PROCEDURES IN 13 VERMONT HOSPITAL AREAS
1969

Procedure	Physicians Performing Surgery: General Surgeon	Physicians Performing Surgery: General Practitioner	Physicians not Performing Surgery
Surgical			
Most Complex	.54	-.25	-.19
Intermediate A	.21	-.21	-.04
Intermediate B	.68	.12	-.42
Intermediate C	.55	.16	-.39
Least Complex	.48	.40	-.27
Mastectomy	.48	-.20	-.24
Hysterectomy	.39	-.21	-.34
Cholecystectomy	.48	.24	-.04
Appendectomy	.31	.14	-.28
Tonsillectomy and Adenoidectomy	.46	.42	-.28
Varicose Veins	.07	.31	-.16
Dilation and Curettage	.08	.38	-.42
Total	.54	.19	-.44
Diagnostic			
Electrocardiogram	-.12	-.36	.41
Laboratory	-.06	-.30	.30
X-Ray	-.10	-.28	.35

CHAPTER VI

TRENDS IN RATES OF USE OF HOSPITAL SERVICES

This chapter continues the investigation into variations in rates of use of services by examining what happens to the differences over time. Do they tend to even out or do areas tend to remain consistently high or low? And when changes in expenditures or in hospital use rates do occur, how do they relate to changes in hospital construction projects, to changes in employment practices or to changes in clinical management practices among physicians? We also characterize an important consequence of differences in per-capita expenditure rates--cross-community subsidizations that occur because community-wide per-capita expenditure rates are not closely associated with the price charged to residents for their insurance premiums.

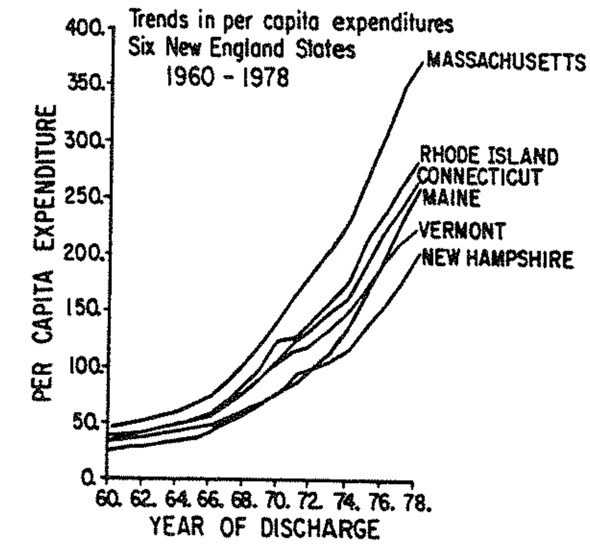
This chapter focuses on the changes that have occurred over time in the per-capita allocation of hospital resources and the use of specific services among New England tates and their hospital areas. For one State, Vermont, specific data for hospital areas are available for as early as 1963 and are consistently available for the years 1969 through 1977. For Maine and Rhode Island the data are generally available for 1974 through 1977. Surgical rates for 1973 are also available for Maine. Because the Vermont data are available for the longest period of time, the experience in that State is emphasized.

TRENDS IN ALLOCATED RESOURCES

Hospital Expenditures Among New England States

Trends in per-capita expenditures for hospital services in each of the six New England States are given in Figure 6.1. Over the 19-year period, per-capita expenditures

FIGURE 6.1



increased about eight-fold in each State. Massachusetts, the most expensive State in 1960, remains highest in expenditures per capita in each year. At the beginning of the study period, expenditures in that State for hospital services were approximately $47 per capita; by 1978, they were nearly $375 per capita. At the beginning of the 1960's, Rhode Island ranked third in per-capita expenditures; by 1968, it ranked second, a position it has held through the 1970's. The least expensive state throughout most of the 1960's is Maine; however, in the 1970's per-capita expenditures in this State increased at a much greater rate than all other States so that, by 1978, it was nearly tied for third. By contrast, Vermont, which began the 1970's ranked about third, demonstrated a relatively low rate of growth in the 1970s, so that by 1976 it ranked fifth. New Hampshire, which ranked fifth in the 1960's also shows relatively low growth rate and in the 1970's becomes, by a substantial amount, the lowest per-capita expenditure State in New England. The association between cross-sectional and time series differences in per-capita expenditures and State regulation of the health care industry is discussed in Chapter IX.

Trends Among Vermont Hospital Areas in Resource Allocation Rates

For Vermont, patient origin data exist as early as 1963 so that hospital area estimates of hospital expenditures, beds and personnel per capita are available for a 15-year period, 1963-1977. This section looks at trends in per-capita expenditures over this period of time and examines the relationship between expenditure trends and trends in numbers of beds and personnel per capita. All Vermont areas with populations greater than 10,000 are included.

A remarkable feature of the distribution of hospital resources among the 13 hospital areas is the constancy of the relative ranking of the areas in per-capita expenditures. This is shown in Table 6.1 which gives the quartile ranking of the areas at three-year intervals and for 1977.

TABLE 6.1

QUARTILE RANK IN PER CAPITA EXPENDITURES FOR HOSPITALS AMONG 13 VERMONT HOSPITAL AREAS BY YEAR

Year	Hospital Area												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1963	1	4	1	3	3	2	m	4	2	2	4	1	4
1966	1	3	1	2	3	2	3	4	2	m	4	1	4
1969	1	3	1	3	2	1	m	4	2	3	4	1	4
1972	1	3	2	m	1	2	3	4	2	3	4	2	4
1975	1	3	1	2	1	m	4	3	2	3	4	3	4
1977	1	4	1	3	1	2	m	3	2	2	4	3	4

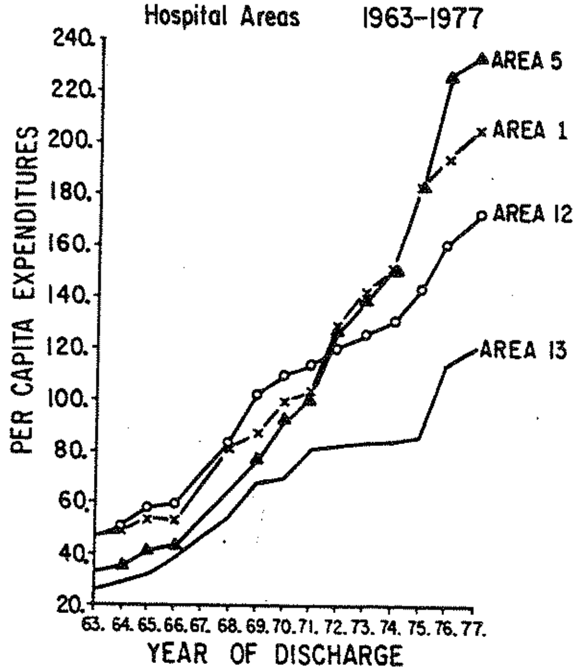
1 = highest quartile   3 = second lowest   m = median
2 = second highest   4 = lowest quartile

Most areas either maintain their quartile rank throughout the 15-year period or show fluctuation across the boundaries of only one quartile range. There are two exceptions. Area 5, which is 1963-1966 period ranked in the third quartile achieved per-capita expenditures such as to place it in the first quartile in the 1970's; by contrast, Area 12 began in the first quartile and dropped in the 1970's to

the third quartile. The per-capita expenditures in Areas 5 and 12 are given in Figure 6.2.

FIGURE 6.2

Per capita expenditure in four Vermont Hospital Areas 1963-1977



We return below to consider the association between per-capita expenditures and hospital employment and hospital bed supply in these two areas. But first we want to emphasize the equity implications of the differences in per-capita expenditures by contrasting the expenditure profiles in Areas 1 and 13, areas which are consistently at opposite ends of the spectrum. These two areas neighbor one another and, as described on page 86 have been shown by household interview studies to have similar populations with regard to factors that predict use of medical care. (Areas 5 and 6 in Tables 5.E, 5.F and 5.G are labeled in this text as Areas 1 and 13 respectively.) The populations also visit their physicians at similar rates, so that the differences in expenditures appear to

relate more to differences in medical decisions made after entry into system than to any other factor. Figure 6.2 contrasts the per-capita expenditures in these two areas. Area 1 per-capita expenditures are consistently high, often by as much as 40% above the median; Area 13 is consistently low.

As we discuss in more depth in Chapter VII, these differences in expenditures are associated with cross-community subsidies: Because of the way most insurance programs in Vermont are designed or regulated, the premiums which consumers pay tend to be equal in both communities. As a result of equal premiums and consistently unequal expenditures, insurance purchasers in Area 13 are paying for a portion of the service received by residents in Area 1. Over time, the expenditure differences accumulate to become large sums. Each area has about equal numbers of persons (11,000) who have similar age and sex structure. Over the 15-year period, we estimate that $3 million more than expected (from the State average) was spent on hospitalizations for Area 1 residents. Most of the excess was local expenditure, benefiting the local economy. For Area 13 residents, $4 million less than expected was actually spent. But, ironically, the savings are not realized by the local economy: much is exported to other areas (including Area 1) to maintain their relatively more expensive hospital care systems.

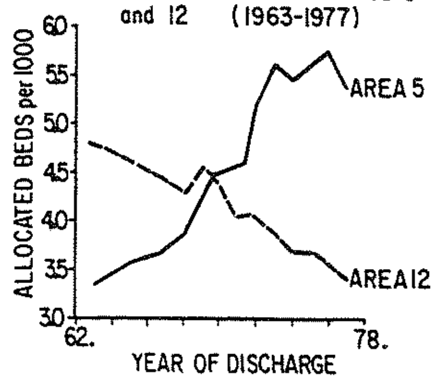
The numbers of allocated beds and personnel per 1,000 bear an association with per-capita expenditures for hospitals. Area 13 has had, over the years, a consistently lower number of allocated beds and personnel; Area 1 by contrast, has had consistently high allocation rates. Over the 15-year period, there were no major construction projects in either area. Very recently, in Area 1, there has been a change in primary physician personnel. (The impact

of this change on hospital admission rates is described below.) Over the last two years of the study, there was a 22% decrease in the number of acute care beds (through closure) and a 14% decline in employment at the local hospital, presumably as a result of the decreased demand for hospitalization associated with the change in physician stock. However, for the population of Area 1 to reach employment or bed allocations equal to the State average, the local hospital would need to reduce beds and employment substantially more than this. In Chapter VII we demonstrate how small-area data may be used to develop an indicator of target employment and beds which, if achieved, would substantially narrow the range of variations in expenditures and reduce cross-area subsidizations.

What factors are associated with the rapid increase in relative per-capita expenditures in area 5? During the initial year of the study period, hospital expenditures were $34 per capita; by 1977 they reached $234 per capita, the highest level in the State. During this period, hospital bed expansion occurred on three occasions, as indicated in Figure 6.3. In 1963, the allocated beds in the

FIGURE 6.3

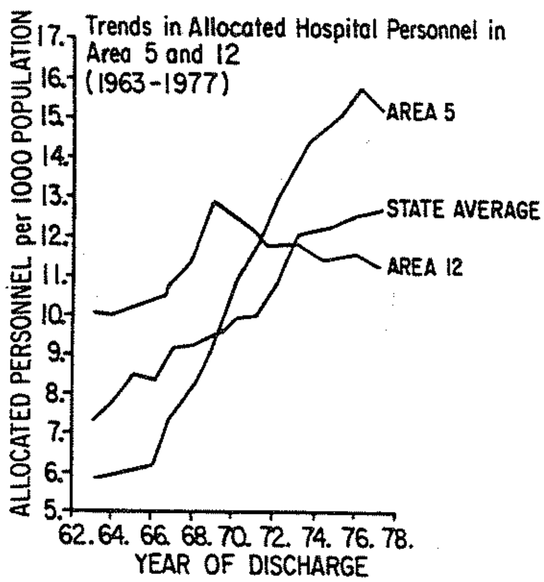
Trends in allocated beds in area 5 and 12 (1963-1977)



area numbered 3.3 per 1,000, among the lowest rates in the

State. By 1977, the allocated beds reached 5.8 per 1000, a rate substantially higher than most areas in the State. This increase in bed capacity was accompanied by rapid growth in employment so that by 1977 there were more than 15 hospital employees per 1,000 population (Figure 6.4). Between 1963 and 1977, the number of employees at the local hospital increased more than 250%. It is

FIGURE 6.4



of interest that the number of allocated beds per capita in the area in 1970 was above the 4.0 beds per 1,000 recommended by the national guidelines;[32] subsequent construction projects pushed the rate still higher.

Area 12 contrasts with Area 5. At the beginning of the study period, the per-capita expenditure and employment rates were among the highest in the State. Expenditures continued to expand rapidly until about 1969 when they leveled off; by 1977, hospital expenditures per capita in the area were among the lowest in the State. The drop in expenditures was associated with a reduction in the number

of allocated beds and personnel per capita. The changes occurred at the largest hospital in the area where employment per capita has remained virtually constant in the 1970's and where hospital beds have been closed following an administrative re-organization and a reduction in acute care admissions, associated with the development of a strong ambulatory care program. By 1977, the number of allocated hospital beds in the area was 3.3 per 1,000--a rate which, by coincidence, is equal to the 1963 rate in Area 5, before the drive to expand began there. The nine-year trend downward in rate of growth of expenditures in Area 12, the largest hospital area in Vermont, is the major reason why the statewide rate of increase in expenditures per capita for hospitalization in Vermont was the lowest among the New England States in the 1970's. (See Chapter IX." This re-organization and the build-up of ambulatory services occurred in a State without strong planning or regulatory programs, and stand as good examples of what can be accomplished through intelligent management within the private sector.

TRENDS IN UTILIZATION

Nine Year Trends in Vermont

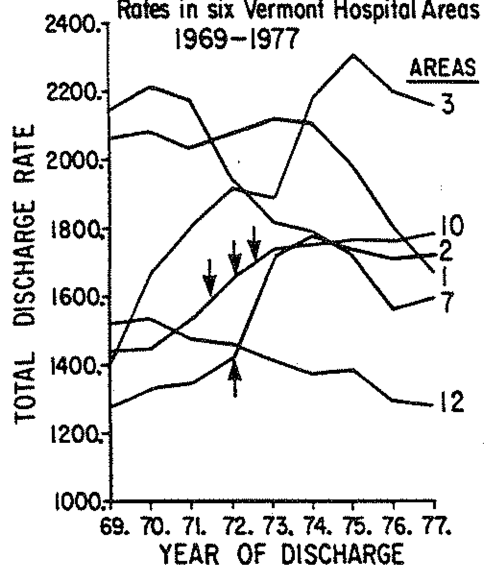
State-wide rates: Few conclusions can be drawn from observations of trends in utilization over time when data were tabulated at the State of Vermont Health System Agency levels, since the large differences among hospital areas on a cross-sectional and temporal basis are masked when the data are aggregated. The only perceptible trends in total hospital use over the decade for Vermont occur in the over-75 age group, where the rate has increased by one-fourth from 400 to 500 per 1,000, and in the age group 15 through 24, where the rate has declined by more than one-fourth from 175 to 128. The latter is associated with declining birth rates and the consequent reduction in obstet-

rical admissions. The rate for all ages has remained fairly constant with minor perturbations around 160 admissions per 1,000.

<u>Hospital area rates</u>: In contrast with the relative stability of the average admission rate over the nine-year period for the entire State are the marked changes in different communities. Figure 6.5 exhibits trends in age-adjusted rates for six hospital areas. Several distinct

FIGURE 6.5

Trends in total Hospital Discharge Rates in six Vermont Hospital Areas 1969–1977



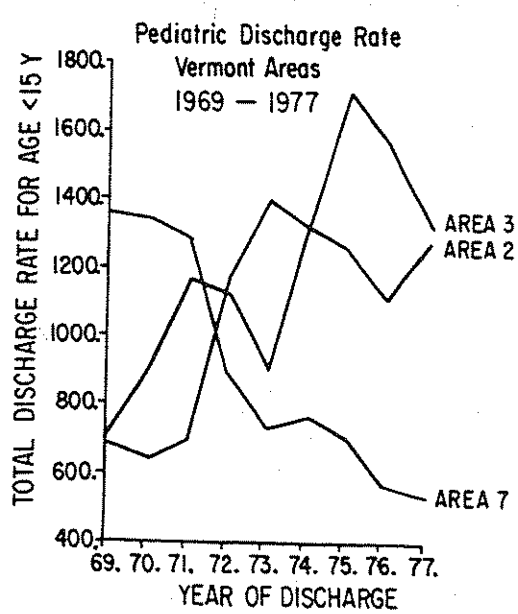
Increase in Acute Care Beds in Area 2 and 10 indicated by arrows

patterns are clearly evident in the trend lines. The major feature is relative to stability from year-to-year with long-term trends. Three areas (12, 7 and 1) exhibit downward trends over the nine years. Area 12 began the decade at or near the State average and declined regularly thereafter, so that by 1977 it was more than 20% lower. Area 1 residents were hospitalized at a rate exceeding the State average by one-quarter until 1975, when a downward trend

began. Area 7 began the period at the highest hospital-utilizing community in the entire State, nearly 40% above the State average. After 1971, its rate declined sharply to below the State average by 1976-1977. By contrast Areas 2, 3 and 10 show steep increases. Increases in Area 10 occur sharply during the first half of the decade, followed by plateaus in the second half. For Area 3 residents, the hospitalization rate increased rapidly and dramatically after 1969 and from well below that State average to 43% above State average. This represents a 62% increase over seven years.

Figure 6.6 shows the changes that occurred in pediatric admissions over the nine-year period in two hospital areas.

FIGURE 6.6



While the trends for the State have been relatively constant (around 72 admissions per 1,000 per year, with a small decline after 1974), marked and dramatic changes have occurred in these hospital areas. Area 7, with the highest rate in the State during the first three years of the study, nearly double the average, registered a remark-

able decline from 1972 onwards. By 1977, the rate had declined to well below the State average. By contrast, Area 2, which began the decade on the low side of the state average, had a rapid increase in admissions in the years 1972-73; Area 3 had a steady increase through the first seven years of the study period, followed by a small decline. Areas 2 and 3 achieved rates substantially higher than Area 12 in the last years of the trend; for example, in 1977, pediatric admissions in Area 3 exceeded Area 12 by nearly three-fold.

ON THE CAUSES OF THE TRENDS

Why do hospital areas show such striking differences in utilization trends? The reasons relate to (1) changes in numbers of beds and changes in practice patterns brought about by (a) changes in nature of local physician stock; or (b) changes in management practices by local physicians.

Changes in Facility Supply: Roemer[33] proposed the hypothesis that an increase in numbers of beds would result in more patients hospitalized, an example of Parkinson's laws applied to the medical care industry. Areas 2 and 10 illustrate the temporal relationships between exapnsion of acute care beds and utilization predicted by Roemer's law.

In Area 10 the age-adjusted rates increased prior to and in conjunction with the increments of acute care beds that occurred in 1971-73 and continued at an almost constant level from 1973 onward (see Figure 6.5). Prior to the construction of new beds, the occupancy level in the hospital had reached nearly 100%, which led to the decision to increase bed supply.

A second example of Roemer's law might be found in Area 2 where the consolidation of the local hospitals into a new regional center was associated with a sharp increase in utilization from 20% below the state average to nearly 100% above.

However, the relationship between hospital beds and hospital utilization is not a consistent one. Marked downward changes occurred in utilization in Area 7 while marked increases occurred in Area 3, although, in each case, the number of acute beds remained constant. In the case of Area 3, a severely overbedded area (allocated beds number 7.8 per 1,000) the increases did not raise the occupancy level to the point where physicians found it difficult to admit patients. In the case of Area 7, the decrease was associated with a net decline in occupancy rate, a problem that caused some concern to the local hospital administration. The importance of taking population-based rates of utilization into account in interpreting the significance of occupancy rates is discussed in some detail in Chapter VII. Roemer's generalization results from the specific observation that when hospital beds are built, they tend to be filled, but the data show the generalization to be clearly false. The applicability of Roemer's law is in the narrow context of hospital bed expansion that results from pressure from increased occupancy or from decisions to expand scope of services. In each of these cases, of course, the underlying phenomenon relates to physician behavior. Underlying the generalization of Roemer's observation is the assumption that empty beds cause administrators to put pressure on attending physicians to fill them, a hypothesis which the data available to us cannot test.

Changes in Physician Supply: Analysis of the changes that occurred in areas with constant bed supply suggests the importance of physician behavior in determining utilization differences. Changes in rates in Area 1 relate to changes in composition of local physician supply. Between 1969 and 1975, the age-adjusted hospital admission rate varied between 20% and 30% over the predicted rates based on the State average. After 1974, a uniform decline was observed so that,

by 1977, the excess was under 10% and rates in Area 1 were approaching the State average.

An explanation for the change during the latter half of the study period may be found in the change in the physician complement serving the community. The addition of two general practitioners who are low hospital utilizers and the retirement of two high utilizers occurred during the period. Such an effect could not be predicted statistically using the number of primary physicians per capita, since all four would be classified as primary care physicians. However, if the physicians are cross-classified by whether or not their practice patterns included performing surgery, an association is demonstrated.

Changes in Area C appear to relate to the out-migration from the area of an internist with conservative habits in use of hospitalization and the subsequent recruitment of two physicians, one a general internist, the other a pediatrician, who favored large inpatient case loads: The changes in overall admission and the changes in pediatric admission rates rose correspondingly.

<u>Changes in Clinical Management Practices</u>: Changes in rates in Area 7 relate, at least in part, to changes in clinical management practices. On more detailed examination, the decline in pediatric admission rates in this area was due to the almost total abandonment of tonsillectomy in the community hospital. In our study[34], one cause of the practice change was ascribed to the effect of data feedback that resulted in review of potential tonsillectomy cases by pediatricians prior to surgery. In 1977, Area 7 recorded the lowest pediatric T&A rate among the 13 communities in the State. This case is discussed further in Chapter VIII.

As we discussed above, changes in rates in Area 12 appear to relate to the implementation of a major ambulatory care facility, associated with an increase in the complement of primary care physicians.

TRENDS AND CONSTANCIES IN THE USE OF COMMON SURGICAL PROCEDURES

This section examines the use of common surgical procedures over a four-year period, 1974-1977, in each of the three New England States with the UHDDS, and presents a longer trend analysis of common procedures in Vermont.

Trends Among States for Common Procedures

For this analysis, we have defined the common procedures as the 11 most frequently performed procedures: varicose vein stripping, cholecystectomy, appendectomy, hysterectomy, inguinal hernia procedure, lens extraction (cataract surgery), dilation and curretage, tonsillectomy, hemorrhoidectomy, prostatectomy and mastectomy. Table 6.2 shows the rate of use of these procedures as a group and compares their rates to the rates for other procedures and for all procedures.

The rate of surgery declined in each State, with the greatest change, a 6.3% decline, occurring in Maine and the least in Rhode Island, 3.6%. The common procedures as defined here comprised about 34%, 37% and 40% of the surgical activity in Vermont, Maine and Rhode Island, respectively. It is the common procedures, taken as a group, which contributed to the decline in overall rate of surgery. In Vermont, they showed a 9.7% decline over the four-year period; in Maine and Rhode Island, the decline was about 17%. By contrast, other procedures increased in frequency in Maine and Rhode Island and showed only a small decline in Vermont.

TABLE 6.2

RATES FOR ALL, FOR COMMON AND FOR OTHER SURGICAL PROCEDURES BY STATE AND YEAR

Maine, Rhode Island and Vermont
1974-1977
Procedures per 10,000 Population

All Procedures	1974	1975	1976	1977	Ratio 77/74
Maine	685	661	646	643	.937
Rhode Island	622	621	602	600	.964
Vermont	608	609	584	581	.956
Common Procedures					
Maine	256	240	221	211	.825
Rhode Island	248	235	213	206	.830
Vermont	207	203	191	189	.913
Other Procedures					
Maine	429	422	425	434	1.011
Rhode Island	375	386	389	394	1.052
Vermont	401	406	393	392	.978

Table 6.3 examines the trends of the common procedures individually in the three States.

The greatest decline in absolute number of procedures and, for two States in percent of procedures was tonsillectomy. In 1977, in Rhode Island, 48.4% or 2,168, fewer tonsillectomies were performed than in 1974. In Maine, 2,098, or 39%, fewer of these procedures were done. Vermont, with a decline of 305, or 27.9%, had the lowest

TABLE 6.3

COMMON PROCEDURES IN 1974 AND 1977 IN MAINE, RHODE ISLAND AND VERMONT

Difference (1974-1977) and Percent Change

	Maine		Rhode Island		Vermont	
	N	% Change	N	% Change	N	% Change
Procedures Showing Decline in All States:						
Tonsillectomy	-2098	-39.1	-2168	-48.4	- 305	-27.9
Dilation & Curettage	-1110	-19.4	- 561	-13.6	- 19	- 1.0
Hysterectomy	- 159	- 5.6	- 363	-14.0	- 172	-18.7
Mastectomy	- 227	-11.8	- 387	-23.0	- 156	-23.0
Varicose Veins	- 158	-31.1	- 206	-39.3	- 93	-34.6
Hemorrhoidectomy	- 71	-12.7	- 199	-24.1	- 42	-19.0
Inguinal Hernia	- 202	- 7.6	- 426	-17.5	- 116	-10.8
SUBTOTAL	-4016		-4310		- 903	
Procedures Showing Rise in Some States						
Prostatectomy	- 65	- 5.0	- 64	- 5.8	+ 152	+34.1
Appendectomy	- 48	- 3.1	- 18	- 1.7	+ 59	+ 9.4
SUBTOTAL	- 113		- 82		+ 211	
Procedures Showing Increase in All States						
Cholecystectomy	+ 43	+ 1.9	+ 30	+ 1.4	+ 95	+12.0
Lens Extraction	+ 356	+ 27.0	+ 264	+17.5	+ 106	+19.0
SUBTOTAL	+ 399		294		201	
TOTAL	-3730	(-14.4)	-4098	(-18.1)	- 409	(4.7)

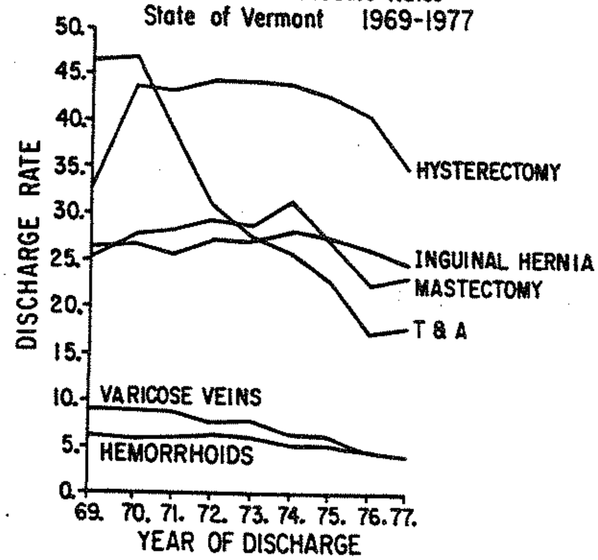
relative rate of decline. However, the rates in Vermont were considerably lower to begin with so that even in 1977, the Maine and Rhode Island rates were 70% and 41% higher than the Vermont rate. The downward trend in tonsillectomy rates in the three States is part of a national trend. The National Center for Health Statistics estimates a 41% decline in the national rates between 1965 and 1975.[35]

Nine Year Trends in Vermont

Using the Vermont data, we have examined the longer range trends for the common procedures. Figure 6.7 illustrates the longer range trend for the seven procedures that declined in frequency between 1974 and 1977. Tonsillectomy shows a rapid rate of decline throughout the nine

FIGURE 6.7

Trends in Procedure Rates
State of Vermont 1969-1977



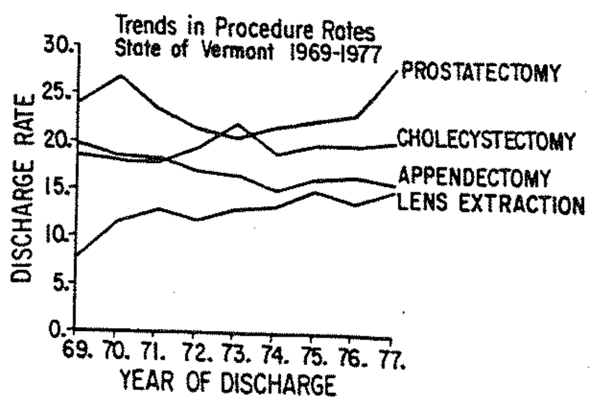
years in which the rates have been recorded. The slope of decline is such that by 1983 the procedure would virtually disappear. The rates of performance of varicose vein surgery and hemorrhoidectomies show consistent downward trends, but the slope is more gradual, such that these procedures, at the current rate of decline, would not disappear from the "most common" list until after the mid-1980's. Hysterectomy rates rose into the period of the mid-decade; the peak in 1974 may be the beginning of a reconsideration of the indications for this procedure. Inguinal hernia procedures show some, but very little, inclination toward decline.

Mastectomy provides a curious trend. In the years prior to 1974 the procedure was performed at a more or less constant frequency. But in 1974 and 1975 the rate increased by about 25%. In Maine, the 1973 rate was 24 procedures per 10,000 women. It jumped to 37 and 40 per 10,000 in 1974 and 1975; by 1976 the rate had declined, but, in contrast to Vermont, the rate did not decline all the way back to the pre-1974 value. Data for Rhode Island for 1973 are not available, but the 1974-1977 Rhode Island rates show a rise and decline similar to the Maine experience.

While any explanation for this trend is speculative, a reasonable hypothesis for the rate jump is the national publicity afforded breast cancer during 1974 and 1975 when both the First Lady and the wife of a leading Republican politician had mastectomies. The publicity may have alerted women to the dangers of breast cancer and have made some of them more willing to undergo biopsy for lumps in their breast.

Figure 6.8 graphs the rates for the procedures which showed a gain in the 1974-1977 period. Over the full eight-year period, appendectomy appears to demonstrate a downward trend (with an upward deflection in 1975-76).

FIGURE 6.8



The 1974-1977 increases in cholecystectomies and lens extractions appear to be part of a longer-term trend

toward higher rates. The situation for prostatectomy is similar, but less clear cut. Nationally, similar trends have been noted by the National Center for Health Statistics.[35] Between 1965 and 1975, nationally, the rates for cholecystectomy, prostatectomy and lens extraction increased 11%, 24% and 85%.

Trends and Constancies Among Hospital Areas

We have explored the phenomenon of geographic constancy for commonly performed procedures. The analysis is restricted to the three largest areas in Maine. For the common procedures, Table 6.4 gives the standardized utilization ratio (the ratio of the age-adjusted area rate to the statewide rate) for each year and for each area. It also gives the number of cases above or below the expected number, based on the statewide average rate. In most cases, the relative rate of an area in one year for a specific procedure is a good indicator of its rate in other years.

For Lens Extraction, Area III in Maine was consistently higher than the State average and over the four-year period 180 cases in excess of the State average are counted. In each year, the rate was significantly higher ($p < .05$) than the State average. By contrast, Area III was significantly lower, accumulating 132 fewer cases than might be expected based on the State average.

For Tonsillectomy, Area II was consistently higher than the tate average and accumulated 701 more cases than would have occurred had the rate of surgery equaled the State average. The trend upward in Area III reflects a tonsillectomy rate which declined in actual numbers, but this

TABLE 6.4

USE OF SURGERY IN THREE MAINE HOSPITAL AREAS
STANDARDIZED UTILIZATION RATES AND NUMBER OF CASES ABOVE (+) OR BELOW (-) EXPECTED^{o}

Procedure	1974	1975	1976	1977	Cases ±
Lens Extraction					
Area I	1.20^{o}	1.03	1.08	1.06	+ 96
Area II	.77^{o}	.77^{o}	.77^{o}	.70^{o}	- 132
Area III	1.29^{o}	1.42^{o}	1.39^{o}	1.25^{o}	+ 180
Tonsillectomy					
Area I	.72^{o}	.72^{o}	.73^{o}	.84^{o}	- 683
Area II	1.42^{o}	1.38^{o}	1.53^{o}	1.36^{o}	+ 701
Area III	.99	1.04	1.30^{o}	1.43^{o}	+ 235
Mastectomy					
Area I	.90	.78^{o}	.90	.69^{o}	- 243
Area II	.82^{o}	.94	.97	1.12	- 31
Area III	1.45^{o}	1.69^{o}	1.33^{o}	.98	+ 284
Prostatectomy					
Area I	1.39^{o}	1.56^{o}	1.36^{o}	1.30^{o}	+ 343
Area II	.74^{o}	.77^{o}	.90	.94	- 72
Area III	1.03	.84	1.03	.80^{o}	- 33
Hysterectomy					
Area I	1.01	1.07	.91^{o}	.92	- 72
Area II	.72^{o}	.83^{o}	.70^{o}	.70^{o}	- 317
Area III	1.56^{o}	1.59^{o}	2.10^{o}	2.02^{o}	+ 917
Hemorrhoidectomy					
Area I	.44^{o}	.40^{o}	.52^{o}	.59^{o}	- 201
Area II	.63^{o}	.78	.77	.66^{o}	- 65
Area III	1.44^{o}	1.25	1.50^{o}	1.48^{o}	+ 88
Varicose Veins					
Area I	.80	.84	.99	.84	- 49
Area II	.95	.67^{o}	.66^{o}	.51^{o}	- 46
Area III	1.11	1.46^{o}	1.29	1.55^{o}	+ 57
Cholecystectomy					
Area I	.98	.92	1.00	1.02	- 32
Area II	.66^{o}	.81^{o}	.76^{o}	.74^{o}	- 235
Area III	1.01	1.22^{o}	1.16^{o}	1.25^{o}	+ 157
Appendectomy					
Area I	.89	.88^{o}	.90	.85^{o}	- 128
Area II	.97	1.19^{o}	1.05	1.06	+ 50
Area III	1.04	1.10	1.95	.97	+ 2
Inguinal Hernia					
Area I	.93	.97	.99	.93	- 84
Area II	.75^{o}	1.02	.96	.91	- 90
Area III	1.04	1.05	1.09	1.10	+ 71

$^{o}p < .05$

decline was much less rapid than the State average, which declined in a linear fashion (and by nearly 40% over the period--see above). Thus, although rates in Area III were 52, 40, 40 and 44 procedures per 10,000 for the years, 1974-77, respectively, the relatively high position of

the area was maintained. Area I is consistently low and over the four years 683 fewer tonsillectomies were done on the children in the area than were predicted by average performance.

For Mastectomy, Area I recorded 243 fewer procedures than expected and Area III, 284 more. The trends in rates within these areas are of interest because they demonstrate different local patterns with regard to the overall jump in rates depicted in Figure 6.7. In 1975, the statewide mastectomy rates in Maine jumped 10%. Maine Area III showed an exaggerated jump, considerably higher than the average, with 1975 rates of 67 procedures per 100,000 being 26% higher than 1974 (Table 6.5). By contrast, Area I was consistently low and did not show the jump from 1974 to 1975 at all; in fact, its rates actually declined slightly, from 33 to 31 procedures per 10,000. If the theory explaining the overall rate increase is correct--that the increased rate of mastectomy in 1974-1975 reflected a heightened public awareness of cancer of the breast--then the profile in Table 6.5 suggests that physicians in different areas responded differently to the greater demand for an explanation of the cause of lumps in the breasts.

TABLE 6.5

TRENDS IN MASTECTOMY RATES IN THREE LARGEST AREAS

IN MAINE, RATES PER 10,000 WOMEN

	1973	1974	1975	1976	1977
Area I	30	33	31	29	22
Area II	20	30	37	32	35
Area III	30	53	67	44	30

For Prostatectomies, Area I was consistently higher than expected and over the four-year period 343 more cases than expected were accumulated.

For Hysterectomies, Area III was extraordinarily high, accumulating more than 900 more cases than expected; by contrast, Area II was consistently low, with 317 fewer women experiencing hysterectomies than would be predicted by the State average.

For Hemhorroids, Area III had 88 more than might have been expected and was consistently high; Areas I and II were consistently low, producing 201 and 65 fewer than expected.

For Varicose Veins, the highest rate was in Area III with 57 more operations than expected, and the lowest was Area I with 39 fewer than expected.

For Cholecystectomy, Area II produced 235 fewer cases than expected and was consistently low each year; by contrast Maine Area III was high, with 157 more cases than predicted.

For Appendectomy, Area I was consistently low and produced 128 fewer cases; Area II showed the opposite pattern with 50 cases in excess of the predicted.

Inguinal Hernia shows the "tightest" distribution of rates with only one area in one year achieving a rate that is significant at the $p = .05$ level: Area II in 1974. Over the four-year period, the area's residents incurred 90 fewer inguinal hernia procedures than the expected number (1816 procedures), although this number is not significant at the $p = .01$ level.

SUMMARY AND CONCLUSIONS

In this chapter we examined trends in resource allocations and in the use of hospital services among the New England States. The longest time series is for Vermont where hospital area specific rates were compared across a 15-year period. For that State, the ranks in expenditures

per capita among areas remain rather constant, so that an area with relatively low per-capita expenditures in the 1960's tends also to have relatively low per-capita expenditures in the 1970's (and vice versa). Changes do occur, however. A change in rank occurred in 2 of the 13 areas; one area dropped from the highest quartile to the low middle quartile; a second advanced from the low middle to the highest quartile. In these areas, changes in bed supply, hospital employment practices and in physicians' clinical management practices are the likely causes for the trends.

We also investigated trends in hospital admissions for all cases and for pediatric admissions among the hospital areas. Significant changes occurred in seven of the 13 areas. In each case, these could be related to hospital construction projects, to changes in local physician composition or to changes in the organization of local practices.

We also examined trends in rates of common surgical procedures. Over the nine-year period of 1969-1977, Vermont experienced a general downward trend in rates of common surgical procedures, mirroring national trends. However, when the area and surgery-specific rates are profiled, we find that the areas tend to maintain their relative ranking from year to year. As we discussed in the previous chapter, this phenomenon seems to relate to the tendency of local physicians to undertake approximately similar workloads from year to year.

We conclude that the relative rates of expenditures and aggregate rates of service among hospital areas reflect primarily the distribution of physician supply and hospital facilities and employees; when changes occur, they occur because of changes in the number or type of physicians

serving the area or because of changes in physicians' clinical management practices. The role of hospital beds seems secondary to the role physicians play in influencing the allocation of hospital beds per capita. The relative ranking of areas with regard to rates of specific procedures tends to remain constant from year to year, reflecting variations in local standards of practice. The expenditure differences associated with the differences in supply also tend to persist and are associated with income transfers or cross-community subsidies.

The next chapters of this report demonstrate how epidemiologic indicators of performance, derived from routinely collected data, may be constructively used in planning, management and regulation, for improving clinical management, and for evaluating the impact of public interventions in the health care market.

PART THREE

PRACTICAL EXAMPLES OF HOW TO USE THE DATA

CHAPTER VII

USE OF SMALL-AREA ANALYSIS FOR PLANNING, MANAGEMENT AND REGULATION

This chapter gives specific examples of how small-area data can be used in the planning, management or regulatory environments. Case studies present how the data actually have been used and included; others show how they could be used. The examples were selected to illustrate the uses of Medicare and UHDDS data for making specific decisions concerning Certificate of Need, hospital rate setting, for long-range planning and for hospital management.

THE NEED FOR A VALID SET OF PERFORMANCE INDICATORS

In the preceding chapters, we have shown that small-area, population-based data are important because there is wide variation in performance among neighboring communities which cannot be discovered when the indicators of performance describe institutional performance without reference to the populations they serve. Application of small-area techniques have shown that the consumption of health services varies extensively among neighboring communities within each of the six New England States. The importance for hospital administrators, health planners and regulators is that their resource allocation decisions have their impact at the local level. Small-area data reveal the current status of facility and hospital manpower distribution among community populations, and can be used to forecast the future status of the distribution based on these decisions. When small-area data are used, variations in performance can be reduced; and when they are not used, planners and regulators can contribute to greater variations. Examples of cases in which both outcomes occurred are presented in this chapter.

Commonly, decisions are made which inadvertently contribute to variations because of a lack of population-based data. Traditionally, those responsible for decisions that alter hospital practices have had to rely on institutional data, rather than population data and their decisions commonly leading to the further allocation of resources to institutions in high expenditure or high utilization areas. This is because institutional-based indicators of performance do not clearly reflect the per-capita hospitalization experience of the community, as illustrated in Table 7.1, which shows population-based indicators of hospital performance in five hospital areas in Maine and compares them to indicators that are available from institutional data.

TABLE 7.1

PROFILE OF INDICATORS OF PERFORMANCE IN FIVE LARGEST MAINE HOSPITAL AREAS, SHOWING INCIDENCE OF HOSPITALIZATION, PER CAPITA EXPENDITURES, PER CAPITA USE AND AVAILABILITY OF BEDS AND THE STATUS OF TWO INSTITUTIONAL INDICATORS°

	Population-Based Indicators				Institutional Indicators+	
	Rate of Hospitalization/ 1,000	Patient Days of Care/ 1,000	Allocated Beds	Allocated Per Capita Expenditures	Percent of Occupancy	Average Length Stay
Area I	145	1,104	4.1	102	73	7.6
Area II	153	1,244	5.0	92	73	8.1
Area III	157	1,054	4.2	75	65	6.7
Area IV	235	1,625	5.7	109	72	7.0
Area V	127	870	3.8	72	72	6.9

°For 1973 population rate per 1,000 population; incidence rate is age-adjusted; smallest population over 50,000.
+Weighted average of hospitals located in hospital area.

There is little relationship between the indicators. For example, the per-capita rates in Area IV are substantially higher than those in Area V. Yet, the percent of occupancy and the average length of stay among hospitals serving each area are nearly the same. Managers, planners or regulators

using these institutional indicators would not know that there are differences in the rates of hospitalization, patient day rates, allocated beds per capita or per-capita expenditures.

The inconsistent relationship between variations in institutional indicators and variations in population consumption rates implied in Table 7.1 has been systematically investigated through correlation studies among small areas in Vermont and Maine.[10] The results indicate that there is a low correlation (i.e., little relationship) between percent of occupancy and patient days per capita. Among Vermont hospital areas, the correlation coefficient between occupancy rate of local hospitals (expressed as a weighted average) and patient days per capita was only .24, indicating that only a small percentage of the variation (6%) in patient day rates could be explained by occupancy rates ($R^2 = .06$). Basing a decision to increase the bed size on the basis of occupancy rates of the local hospital(s) ignores the actual rate at which hospital beds are being used in the area.

Evaluating the Medical Care Equations Among Neighboring Communities

Other correlation studies show how the "medical care equations." which relate institutional indicators to per-capita rates, can be evaluated so that a complete picture of the relative importance of the components of utilization become apparent. In the case of patient days per capita, the equation is:

$$\text{Patient Days Per Capita} = \text{Admissions Per Capita} \times \text{Average Length of Stay}$$

This equation is evaluated in Figure 7.1 which shows the variation in patient days per capita for common surgical procedures and for common conditions causing hospitaliza-

tion. These variations are related to variations in admissions per capita and average length of stay. In each case, the contribution of admissions per capita to variations in patient days per capita is considerably greater than the contribution of average length of stay. This is because the range of variation in admissions per capita is greater than in average length of stay (and there is no substantial correlation between admissions and average length of stay).

Data may also be used to explore the medical care equation which relates expenditures per case and admissions per capita to expenditures per capita:

$$\text{Expenditures Per Capita} = \text{Admissions Per Capita} \times \text{Average Expenditures Per Case}$$

Again, both the Medicare and the UHDDs data are useful for evaluating of this equation. Figure 7.2 shows that expenditure per case is not an important predictor of expenditures per capita even for the low variation procedure (See Chapter 2), inguinal hernia. For the other procedures, the variation in admission rate is much greater than the variation in average cost per case and is the important determinant of variations among local markets in expenditures per capita. The MEDPAR data, which show reimbursements for each case, is particularly suited for demonstrating these relationships.

Although the contribution of admissions per capita to reimbursements per capita is strongest when specific types of cases are singled out (e.g., cholecystectomies), it is also an important factor when all conditions are aggregated. For example, among urban markets in Massachusetts, 69% of the variation in reimbursements per capita under Medicare was associated with variations in admissions per capita (in 1975); reimbursements per case explained only 36%. A similar situation was seen in the rural parts of Massachusetts.

FIGURE 7.1

CONTRIBUTION OF AREA-WIDE AVERAGE LENGTH OF STAY AND INCIDENCE OF HOSPITALIZATION TO PER CAPITA USE OF HOSPITAL BEDS FOR COMMON SURGICAL PROCEDURES AND RESPIRATORY DISEASES, THIRTEEN LARGEST MAINE HOSPITAL AREAS, 1973

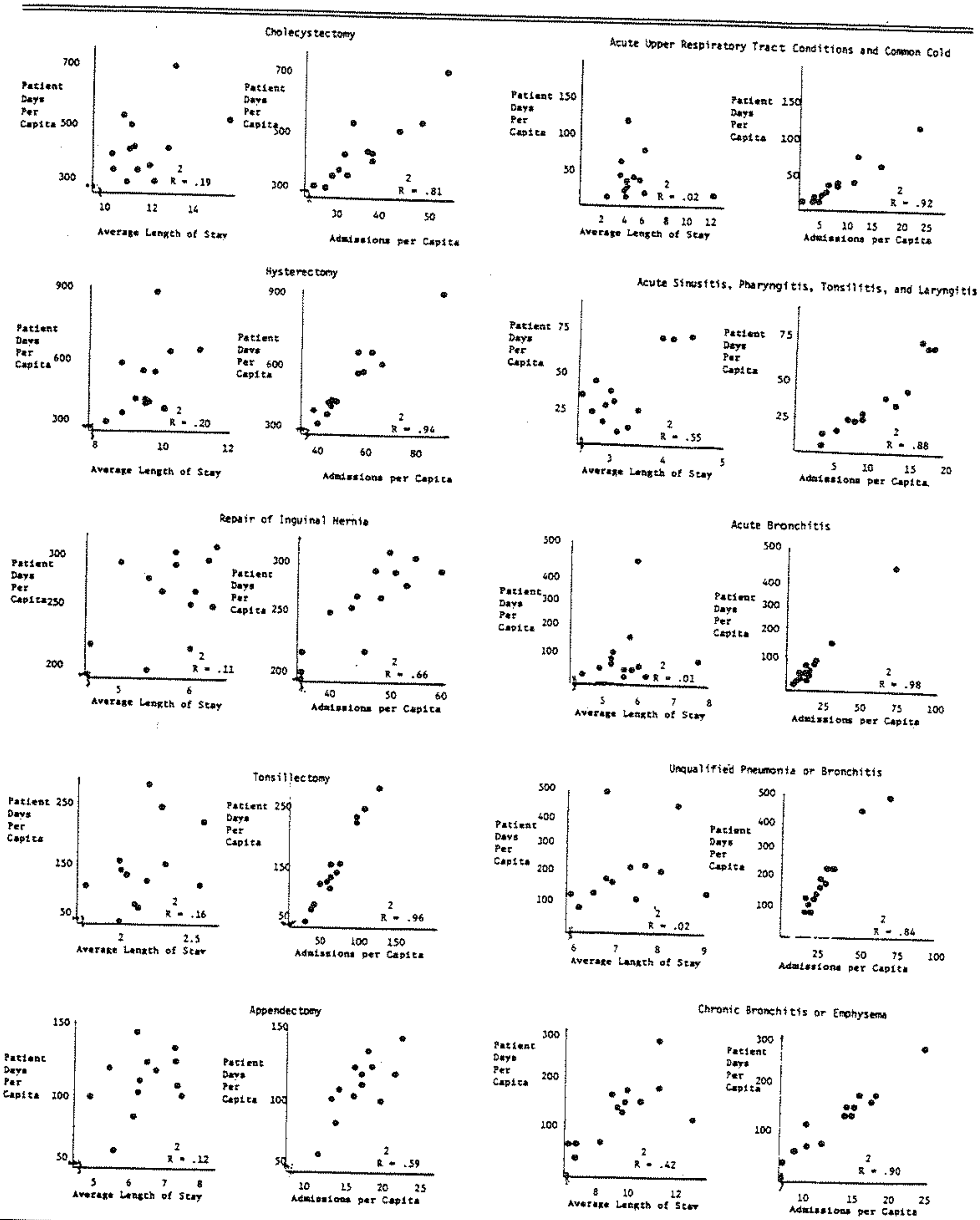
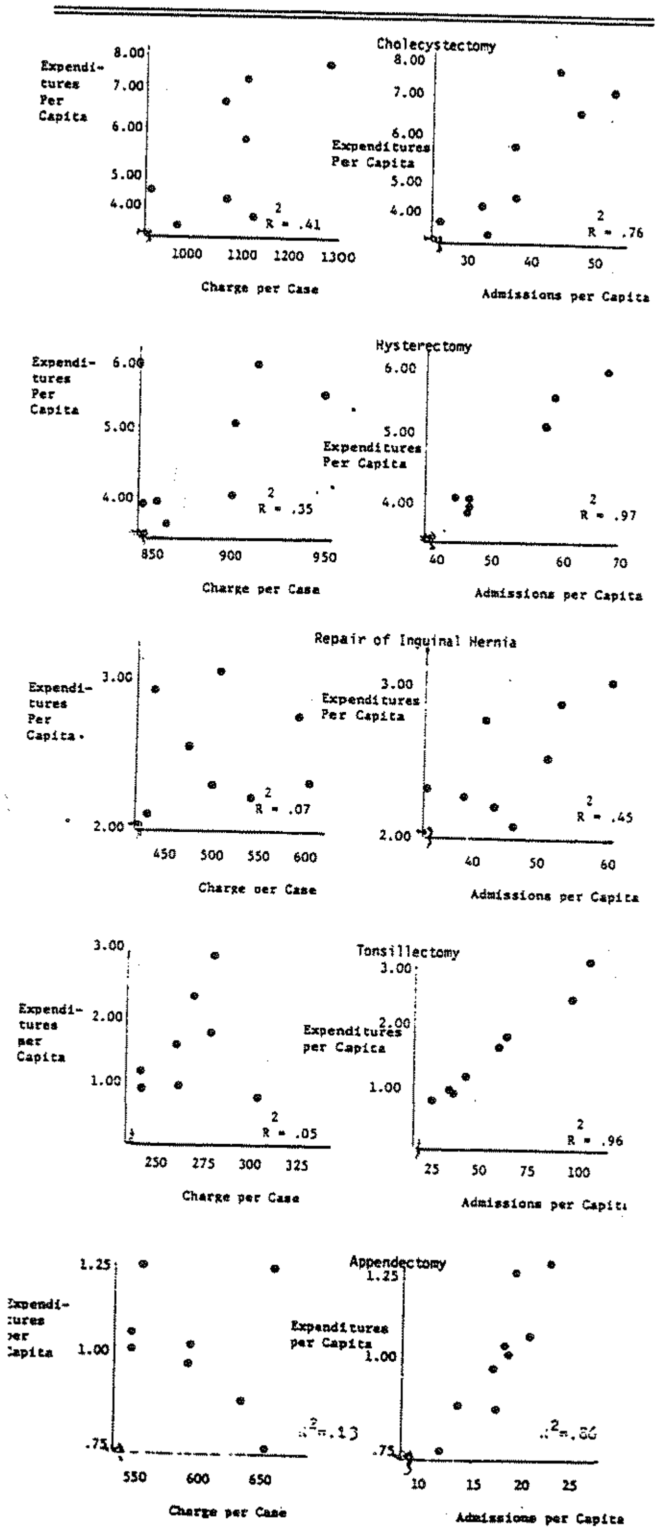


FIGURE 7.2

CONTRIBUTION OF AREA-WIDE CHARGE PER CASE AND INCIDENCE OF HOSPITALIZATION TO ESTIMATED PER CAPITA EXPENDITURES FOR COMMON SURGICAL PROCEDURES. EIGHT MAINE HOSPITAL AREAS, 1973



Other Examples of Failure of Institutional Indicators to Predict Variations in Population Consumption Rates

There are two other commonly used institutional indicators which are poor predictors of variations in per-capita utilization rates. Like length of stay, average cost per case and percentage occupancy, they are often interpreted as indicators of the relative efficiency of the performance of a hospital. The bed turnover rate (calculated by dividing the number of admissions within a time period--usually a year--by the number of beds) and the size of hospital (measured in beds) are not strongly associated with variations in population-based consumption rates. In one study in Vermont, bed turnover rates were negatively associated with average length of stay (r = -.48) and positively associated with admission rate (r = .43). The association of turnover rate with the underlying population-based bed use rates was negligible, with less than 1% of the variation in bed use related to variation in the bed turnover indicator. Although in the Vermont study 33% of the variation in per-capita expenditures was found to be associated with the bed turnover, the results were not duplicated in Maine where only 1% of per-capita expenditures related to this indicator.

The size of the hospital is often thought to be related to its efficiency but this holds true only in terms of its ability to process cases (as measured by cost per case). When the weighted mean size of the hospitals* contributing services to an area is used as a predictor of expenditure per capita, little relationship is found between the two indicators. The reason is that the important determinants of variation in expenditure per capita include admissions per capita which show an inconsistent relationship with the average size of local hospitals.

*weighted for relative number of cases

A Case Study

The insensitivity of institutional indicators to underlying per-capita consumption rates can perhaps best be illustrated by an example first mentioned in Chapter VI. In that chapter, we traced the utilization and expenditure history of Vermont hospital areas. When viewed from the perspective of per-capita rates, Areas 1 and 13, with approximately equal populations, had vastly different expenditure and utilization histories as shown in Table 7.2. Although the size of the local hospital, average

Table 7.2

Profile of Population Indicators of Performance in Two Vermont Hospital Areas

	Area 1	Area 13
Number of local hospitals	1	1
Incidence of hospitalization (1972)[o]		
All cases	195	122
Surgical cases	69	36
Hospital per capita expenditures (1972)	$ 92	$63
Medicare Part B Reimbursement per enrollee (1972)	$141	$92
Allocated beds[o]	5.9	3.4

[o]Per 1,000 population

cost per case, occupancy rate and average length of stay are approximately the same, and throughput indicators indicate a more favorable situation in Area 1 the expenditures per capita, surgery per capita, patient days per capita and reimbursements under Medicare Part B yield a different picture. Area 1 exceeds Area 13 in each population-based consumption indicator, and the amount of excess is far from trivial. Over the 15 years, expenditures in Area 1 exceed those in Area 13 by about $7 million (or $635 per capita); Medicare reimbursements are substantially higher, as are the numbers of surgeries per capita and total bed use per capita.

The differences in consumption rates among these two communities do not appear to be related to differences in the populations. As discussed in Chapter V, we investigated the hypothesis that differences in use of services were related to differences among the communities in factors associated with consumer demand for care. No differences could be found in the distribution of such important determinants of demand as illness rates, availability of care (including distance to care), medical insurance, income, percent with incomes below poverty or education levels. Also, the population of the two areas exhibited similar behavior in seeking medical care and physician services on both an episodic and an annual basis. The differences in consumption rates appear related to the per-capita numbers of physicians (classified by specialty) and the number of allocated hospital beds per capita.

The failure of institutional indicators to expose the differences in underlying consumption rates between these two areas led to paradoxical allocation decisions by planners and regulators that unjustly constrained the local hospital in Area 13 and rewarded the hospital in Area 1 with additional resources, thereby increasing the range of variation. Some of these decisions are reviewed below.

USE OF SMALL AREA DATA FOR CERTIFICATION OF NEED DECISIONS

Under current Federal health planning law, States are virtually required to establish Certificate of Need (CON) laws to define a process for determining whether proposed changes in hospital bed numbers or their functions are consistent with the public interest. While the procedures and criteria for establishing need vary from State to State, a fundamental concept of the CON laws is that need for services can be defined and that the distribution of facilities among communities should be based on their relative need for

services. It is the responsibility of the planning agencies (and ultimately of the State itself) to assure that the process is fair and objective.

As we discussed in the preceding chapters, need, defined in terms of the numbers of resources required to treat identified morbidity so as to obtain expected outcome, is a tenuous concept; the empirical data derived from small-area analysis and information based on reviews of the medical literature indicate there is little professional consensus about what need is. However, although need cannot be strictly defined, distributional information can be injected in the planning context. With the use of small-area data, determination of need can be related to existing and planned resource distribution. Chapter III presented tables showing, at the aggregate level, the rates of hospital beds per capita. Table 2.4 in Chapter II showed how, in one Maine area, the estimate of per-capita beds is broken down to identify the contribution of individual hospitals to the area. This chapter will show how data can be generated to forecast the impact of a proposed construction project on the per-capita rates of beds with the UHDDS or MEDPAR data sets. It also reviews case histories in which the data were used to make Certificate of Need decisions in Vermont and Maine.

The Case of Hospital A

In the Spring of 1975 a 71-bed acute care hospital (Hospital A) in rural Maine prepared a §1122 application for renovation and expansion, including the addition of 11 new acute-care beds. The argument for need was based on the fact that more physicians were coming to the area and that they would require additional inpatient facilities. Indeed, as a result of the recruitment process, the number of admissions had already increased by 33% between 1971 and

1975 and the occupancy rate had reached 75%. Projected further growth in physician supply would push the occupancy rate above the 80% level generally regarded as acceptable.

Although the following analysis was not used in the 1122 process, the small-area data could easily have been used to project the impact of the proposed increase in number of beds in Hospital A on per-capita rates. Prior to the request for additional beds, the area had 6.3 beds per 1,000. Table 7.3 shows the impact of adding 11 beds by adding them to the existing total and allocating a portion of this sum to the local area. If the plans of the hospital were approved, the number of beds per capita in the local area would increase to 7.03 per 1,000, exceeding the national guidelines by 76%. Similar investigations for neighboring areas in which the remaining patients of the hospital are resident would round out the projections of the impact of the change. These projections were based on the assumption that patient origin would remain constant. If Hospital A would have rebutted the assumption by giving quantitative estimates of the anticipated changes in patient origin, this estimate could then have been used to alter the forecast. In this case, a dramatic shift in hospitalizations patterns would have been required to avoid having an excessive number of hospital beds.

MEDPAR data could have been used to project the proposed impact which the increase in Hospital A's beds would have. Table 7.4 is similar to Tables 7.3 and 2.4, except that the MEDPAR data for 1975-76, rather than the patient origin data based on the UHDDS, were used for the allocations. The MEDPAR data results in a slightly smaller estimate of locally allocated beds of Hospital A to the area residents: 49.8 beds as compared to the 52.9 obtained from UHDDS. The overall current per-capita bed rate is approximately equal

TABLE 7.3

EXAMPLE OF USE OF RESOURCE ALLOCATION METHODOLOGY
TO FORECAST PER CAPITA BED DISTRIBUTION: IMPACT ON LOCAL BEDS
OF 1122 DECISION TO INCREASE BEDS IN HOSPITAL A FROM 71 TO 82

(Maine Hospital Area with Estimated Population of 10,649)

Hospital	Location	(1) Current # of Beds	(2) Planned # of Beds	(3) Area's Residents as % of Hospital's Discharges[a]	(4) Current Allocated Beds[b]	(5) Planned Allocated Beds[c]	(6) Current Beds Per Capita	(7) Planned Beds Per Capita	(8) Ratio to National Guidelines[o]
A	In Area	71	82	74.6	52.9	61.2	4.97	5.75	1.44
B	In Region	316	NC	2.3	7.1	7.1	0.63	0.63	----
C	Remote	536	NC	0.1	0.6	0.6	0.05	0.05	----
D, E, F	Neighboring Areas	---	NC	----	5.0	5.0	0.43	0.43	----
All Others	Remote	---	NC		2.3	2.3	0.17	0.17	----
TOTAL			--	----	69.6	78.2	6.30	7.03	1.76

[o]Ratio to 4.00:
Subpart B - National Health Planning Goals, 121.201 Standard of "...four non-Federal, short-stay hospital beds for each 1,000 persons in a health service area except under extraordinary circumstances..."
NC = No Change
a = From Patient Origin Data
b = (1) x (3)
c = (2) x (3)

TABLE 7.4

HOSPITAL RESOURCE ALLOCATION METHOD BASED ON DISTRIBUTION OF DISCHARGES AMONG MEDPAR SAMPLED PATIENTS (1975-1976)

Hospital Code	Location	Type of Hospital	Number of Beds	Total Number of Discharges	Number of Discharges From Area	Percent From Area	MEDPAR Beds Allocated to Area	MEDPAR Planned Allocated Beds
A	In Area	Community	71 (82)*	287	201	70.1	49.8	56.8
B	In Region	Referral	269 (NC)	1,134	21	1.9	5.1	5.1
C	Remote	Referral	536 (NC)	983	3	0.3	1.6	1.6
D	Neighboring Area	Community	130 (NC)	492	6	1.2	1.6	1.6
E	Neighboring Area	Community	38 (NC)	169	9	5.3	2.0	2.0
F	Neighboring Area	Community	14 (NC)	41	6	14.6	2.0	4.1
All Others			---	-----	18		4.1	4.1
TOTAL					264		66.2	73.2

*( ) Denotes Planned Number of Beds
NC = No Change

among the two methods: 6.2 per 1,000 with MEDPAR and 6.3 per 1,000 with UHDDS. As we have emphasized, a major advantage of the MEDPAR data is their potential availability. Tables similar to 7.4 could be generated for Certificate of Need determinations throughout the United States.

UHDDS data could also have been used to discover that for the principal population served by Hospital A, the discharge rate in 1975 was 50% higher than the State average; among the 41 hospital areas in Maine, it ranked second with 246 discharges per 1,000 population compared to a State average of 164; the surgery rate was a full one-third higher than the State average; among the common surgical procedures, per-capita rates for appendectomy, hemorrhoidectomy and cholecystectomy were each more than double the State average. Further, they had been increasing in association with the expansion of physician supply. For appendectomy, the ratio to the State average for 1973, 1974 and 1975 was 1.71, 1.85 and 2.67, respectively; for hemorrhoidectomy, the respective ratios were .57, .71 and

2.67; for cholecystectomy, they were 1.17, 1.94 and 2.31; for hysterectomy, they tended to be high and constant: 2.37, 2.14 and 2.43, respectively.

Tables containing information like 7.3 and 2.4 could have been prepared using only patient origin data. These could have been supplemented with the MEDPAR data set to provide data on patient flow in and out of States, health service areas, PSRO areas, etc. (see below).

What actually happened to Hospital A's §1122 application? Additional beds were awarded (7 rather than 11). The case serves as an example of how public decision-making that is not influenced by the existing patterns of distribution of resources can serve to increase the range of variations in consumption among the communities of the region.

The Case of Hospital B

The next cases review decisions which were based on population-based profiles comparing relative rates among communities. In 1971 Hospital B sought funds from the Regional Medical Program in Vermont to expand its coronary care unit (CCU).[10] Table 7.5 shows the distribution of CCUs throughout the 10 hospital areas in which at least one unit was then located. The areas are ranked by number of CCU beds per 10,000 population (aged 40 or over). At that time, the clinical management of coronary care was regionalized through a management committee established under Regional Medical Program auspices. The committee was responsible for establishing and publishing guidelines for the treatment of patients in the CCUs of each of the region's hospitals. It was also responsible for making recommendations on the necessity of further capital investment in coronary care units and for providing population-related data on each CCU. Hospital B was the only local

hospital in Area I and was responsible for more than 90% of Area I residents' admissions to CCUs. At the time of its request, the area was found to be the highest in CCU beds per capita in Vermont. The performance characteristics listed in Table 7.5 were reviewed by the management committee. Based on its relative per-capita ranking in utilization, resource use, bed availability and the committee's knowledge of practice patterns at the hospital, the committee recommended against expansion of facilities and proposed, instead, that educational programs be implemented which would improve the screening of patients prior to hospitalization in the CCU.

TABLE 7.5

PER-CAPITA USE OF CORONARY CARE UNIT (CCU) RESOURCES IN TEN VERMONT HOSPITAL AREAS PARTICIPATING IN A REGIONAL MANAGEMENT PROGRAM FOR CORONARY ARTERY DISEASE

(Rates Per 10,000 Population, 40 Years of Age and Older, 1969-1970)

Area*	Available CCU Beds	Coronary Care Unit Nurses	Per Capita Expenditures
1	5.0	10.3	$12.58
2	2.6	5.4	6.72
3	2.6	6.4	4.78
4	2.6	6.3	4.71
5	2.4	4.2	4.60
6	2.1	4.6	5.27
7	1.9	3.4	4.89
8	1.8	3.6	4.49
9	1.7	4.1	3.80
10	1.7	4.0	2.20

*Area ranked on CCU bed availability.

The Case of Hospital C

Claiming a 100% occupancy rate, Hospital C sought permission to build an additional 25 acute-care beds. The 175 bed hospital is the only hospital in a service area of about 50,000 comprised of several small towns, villages and rural areas. Based on comparative statistics, the area had a resource utilization profile that placed it in the lower half of the areas with regard to beds, expenditures

and utilization rates per capita. While data on the allocation of resources (expenditures, beds and personnel) were not used in the review, age-adjusted utilization rates from the UHDDS study were available and were used. The number of patient days per capita in the area was slightly less than average, but further analysis of utilization rates in the sub-hospital service area demonstrated distinct variations in the rates of use of care. In one town with a population of about 20,000, the rates were much higher than in adjacent towns and villages. Much of the excess was for cardiovascular disease; in one year the rate for this diagnosis was 245 admissions per 10,000 which is much higher than the State average and exceeds other parts of the service area by 50%. Most of this excess could be attributed to a few physicians with large inpatient caseloads who were close to retirement age. Based on an analysis of practice patterns of younger physicians and on estimates of the impact on bed need associated with the retirement of older physicians, the request for 25 beds was turned down; ultimately an increase of nine was permitted.

This case history illustrates an important point about intra-hospital service area variation: First, as was shown in Chapter V, the rate for any service area as a whole is the weighted average of rates in component markets for physician services and there may be several geographically distinct markets within an area. Second, the decision to deny the full number of requested beds was made for an area with less than average utilization, indicating that the reviewers did not consider the state average to have normative value as a standard. The decision-makers acted as if less were better, an assumption which we discuss in some detail in the Chapter X. This case is the best example of an understanding by the reviewers of the impor-

tance of physician practice patterns in determining the need for beds. By taking advantage of the epidemiologic data made possible by the particular geographic configuration of local physician markets, the reviewers were able to learn that scarcity (indicated by the 100% occupancy rate) could be related primarily to the behavior of a small number of staff physicians. The interpretation by the reviewers of this information was that it was not reasonable to build additional beds to accommodate a mode of practice which the majority of the staff physicians did not share.

USE OF SMALL-AREA ANALYSIS FOR DEVELOPMENT OR UPDATE OF STATE HEALTH PLANS

There are no actual examples available of the use of small area analysis as a basis for developing or updating a State health plan. This section illustrates the relevance of the data for understanding the distribution of resources throughout the communities and using it for long-range planning.

The indicators offer the planner information on "base line" distributions which can be used to monitor, over time, changes that may occur. For example, the use of referral hospitals across community hospital service areas may be accurately measured for bed allocation; and, if the UHDDS data set or equivalent are available, some information on the types of cases treated may be obtained. The patterns of regionalization or de-regionalization that accompany changing roles for community hospitals may be demonstrated.

The small-area data will prove particularly useful for investigating the implications of normative standards established for resource inputs. The National Health Planning Guidelines have normative standards for occupancy rates and beds per capita. Using small-area data, estimates can be made of the number of beds each hospital

should have in order to meet national guidelines in each health service area. By comparing institutional rates to population-based rates, a fallacy in the National Guidelines (which we call the 80% Occupancy Paradox below) can be avoided.

The section which follows gives three examples of the potential use of small-area data for long-range planning. The first shows how base-line statistics concerning the distribution of referral hospital services can be generated using MEDPAR data; the second demonstrates the Occupancy Paradox and how it can be avoided; the third demonstrates how institutional indicators (in this case the "needed" number of beds) can be derived from population-based rates to translate normative per-capita standards into a plan for the expansion or reduction of hospital capacity.

<u>Use of MEDPAR Data to Identify Cross-Jurisdictional Use of Hospitals</u>

Geopolitical boundaries seldom delimit the locations in which patients seek hospital care. Even though planning or regulatory agencies may have access to complete data sets describing patient origin for institutions within their jursidiction, the amount of care which residents receive outside the jurisdiction remains unknown. The situation is particularly troublesome for hospitals located just beyond the agency's boundaries and for those remote institutions which serve as referral institutions. Because the MEDPAR data set covers the full United States, it can be used to clarify border-crossing phenomena. Although the sample is representative only of the population over 65 years of age, the studies described in Chapter IV indicate that the patient origins of the over-65 population are a reasonable approximation of patient origins for the under-65 population. At the very least, they give the planner a good indication as to which out-of-area hospitals

contribute significantly to the medical care economy of his/her territory. Should more precise information on the contribution of the under-65 population be necessary, the planner will know which hospitals should be contacted for patient origin data.

This section gives an example of the use of MEDPAR data to investigate use of referral hospitals. We have studied the use of major Boston non-profit (voluntary) teaching hospitals by residents of New England. (Table 7.6). By

TABLE 7.6

HOSPITALIZATIONS BY RESIDENCE° OF MEDICARE ENROLLEE AND HOSPITAL: MAJOR VOLUNTARY BOSTON TEACHING HOSPITALS (MEDPAR:1975)

Hospital	Number of Cases	Enrollee Place of Residence as Percent of Hospital's New England Medicare Patients				
		Boston*	HSA IV	HSA V	Other Mass. HSA's	Other NE HSA's
Affiliated Hospitals	521	(46.4)	72.0	9.4	7.9	4.4
Beth Isreal	567	(66.3)	88.7	4.1	1.9	1.8
Mass. General	1,142	(42.7)	70.1	7.4	6.4	4.6
NE Deconess	495	(31.9)	64.8	12.3	5.7	9.1
NE Medical Center	318	(49.4)	69.2	11.6	6.3	5.7
University Hospital	298	(55.7)	79.9	8.4	3.4	2.0
All of the Above	3,341	(47.5)	73.6	8.4	5.5	4.6

°By Health Service Area (HSA) Boston is located within HSA IV.
*Boston residents as percent of hospital's Medicare patients.

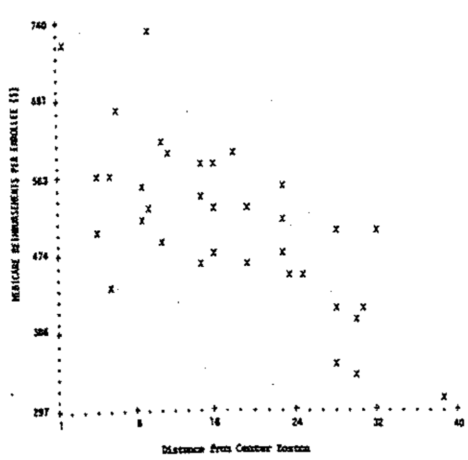
far the greatest proportion of patients come from Boston; over all, among the six major teaching centers, 47.5% of their Medicare admissions are from enrollees who give Boston zip codes as their places of residence. The hospital with the greatest proportion of local patients is Beth Israel, in which about two-thirds of Medicare patients have a Boston address; 89% of its patients come from the local Health Service Area (Area IV). New England Deaconess Hospital appears to have the lowest frequency of local admissions.

In addition to patient flow information, the data also give information on market penetration for each type of hospital.[24] The MEDPAR data show that in Boston, 39.2% of all admissions of Medicare enrollees are to one of the six hospitals listed in Table 7.6. In Health Systems Area IV, 21.6% of all Medicare admissions are to a Boston teaching hospital. By contrast, in Health Systems Area V and VI (areas which, for referral, use Boston teaching hospitals almost exclusively) only 5.3% and 6.3% of admissions are to these hospitals.

The data indicate that the teaching hospitals in Boston provide a substantial amount of the acute general hospital care for local residents; for those who live at more remote locations, the function seems to be more that of a referral hospital. While this analysis does not clarify the case-mix differences between the cohort of patients admitted from the Boston area and the cohort admitted from the more remote areas, it does point to the importance of being able to distinguish the dual role of the "teaching" hospitals. The cost implications of this dual role can be seen in Figure 7.3 which uses MEDPAR data

FIGURE 7.3

RELATIONSHIP BETWEEN DISTANCE FROM DOWNTOWN BOSTON AND PER ENROLLEE REIMBURSEMENTS IN 37 BOSTON NEIGHBORHOODS AND HOSPITAL AREAS



to show the association between per-capita costs for hospitalization and distance from Boston teaching hospitals.

Avoiding the 80% Occupancy Paradox

The National Guidelines for health planning contain a paradox. The objective of the guidelines is to constrain the use of resources for "unneeded" services by closing unoccupied beds, thereby raising the occupancy rate of the rest. However, the result of this effort could be to increase the use of medical services if hospitals choose the less painful alternative of filling the unoccupied beds instead of closing them. Without population-based data, occupancy rates are the only indicator that will be used in the local setting, and incentives to enforce this guideline are likely to be particularly strong since it can be measured so easily. Hospitals with low occupancy rates become targets for planning agency pressure, quite without regard to the underlying per-capita number of beds or per-capita utilization rates in the population served by the hospital. As we have shown in Table 7.1 per-capita beds and use rates do not correlate strongly with the occupancy rate, so efforts which result in keeping the hospitals filled may be felt across the full spectrum of hospitals, without regard to relative ranking in per-capita consumption.

Vermont's Comprehensive Health Planning Agency (CHP) fell within the trap of the 80% Occupancy Paradox. Based on a target occupancy of 80%, the agency calculated the number of beds that should be closed in each Vermont hospital that fell below the standard We correlated the number of beds per capita that were designated for closure with the total numbers of beds per capita in the area using the resource allocation methodology; there was essentially no relationship. Some hospitals with per-capita bed rates well below the National Health Planning Guidelines were labeled "inefficient" by the CHP. Look

at the hospital serving Area 13 in Table 7.2 as an example: although expenditures and beds were well below the national guideline, the Comprehensive Health Planning Agency recommended that a number of its beds be closed.

Fortunately, under the CHP rules, the analysis carried little weight and the hospital did not respond by increasing its patient day rates. However, health system agencies and tate health planning agencies have increased authority to pressure hospitals to "reform." In a number of examples the response of the hospital administration has been to recruit new surgical staff as a means of achieving the requisite guidelines. We have observed that the Sunday NEW YORK TIMES physician recruitment advertisements commonly are sponsored by hospitals with low occupancy rates but which are serving areas with high per-capita rates.

Combining the occupancy rate indicator with information about per-capita expenditures and beds per capita, a useful and accurate assessment of hospital performance can be made. The next section demonstrates a simple small-area method which incorporates the National Health Planning Guidelines concerning beds per capita with the occupancy guideline to estimate the number of beds needed by each hospital of a region.

Estimating Target Beds to Meet Normative Standards

Much health planning effort is devoted to two questions concerning the numbers of needed beds. The first question is a normative one: Given the constraints that exist on resources, the problems of competing needs and the underlying uncertainty concerning the relationship between health services and health outcomes, what resources should be allocated to the hospital sector? An example of a normative target for hospitals is the national guideline for hospital beds which calls for (not more than) 4.0 beds

per 1,000 population. The second question derives from the first: Given that a standard for resource allocation has been agreed upon, how should resources be allocated among the communities of the region to achieve the desired level of investment?

This section deals with the second question. It is concerned with translating general normative goals for hospital facility allocations into specific estimates of the numbers of beds "needed" by each hospital in the region. We describe a simple method for estimating the numbers of beds that each hospital should have so that, given the historical distribution of hospitals and current geographic patterns of patient origin, the allocation of beds per capita throughout the communities of the region is equalized at the normative goal. The method estimates for each hospital, the number of beds above or below current numbers which, if added or subtracted from the hospital, would meet the planning goal (which, in the ensuing example, we take to be 4.0 beds per 1,000). In the example given, the contribution of each institution to population welfare has equal value: The excess or deficit of beds per capita found at the community level is allocated proportionately among each hospital serving the area. While the planner may wish to evaluate the contribution of hospitals differentially (for example, seek standards for the per-capita supply of referral beds as one component of each area's total complement of 4.0 beds per 1,000), this is a normative issue and therefore an example of the first, not the second, distribution question. Once the standards are set concerning referral beds or other special components, the method can give precise estimates of the needed number.

Briefly, the method involves three steps. In step one, age-adjusted target patient day rates are estimated for each

hospital area in the region so that if this target were met, the numbers of beds per capita required for the patients would be the number called for in the national guidelines. This estimate is obtained by first standardizing the national age-sex specific patient day rates to achieve a level of hospital use equal to 4.0 beds per day at 80% occupancy. The adjusted national age-specific patient day rate is then multiplied by the population of each hospital area. The result is an age- and sex-specific estimate of the number of patient days that would occur if clinical practices in the area were such that the national guidelines were met. The actual number of patient days is divided into the normative patient days to create the "normative ratio."

In step two, the number of age- and sex-specific patient days contributed by each hospital to each area is adjusted (using the normative ratio) to reflect the relative deficit or excess of patient days per 1,000. The process is analogous to the indirect age-adjustment procedure discussed on page 27 Chapter II. For example, in area X, the normative ratio is 1.25 for males 65-74 years of age, indicating under-utilization: Fewer patient days per capita currently exist than would be needed if area X is to have 4.0 beds per capita at 80% occupancy; more hospitalizations are needed to meet the guideline: The number of beds needed for this increase is estimated (under the assumption of equal contribution to welfare by each hospital) by multiplying each hospital's age-specific patient days by 1.25. For example, if a local hospital (with 80% of its patient days from area X) contributed 1,460 patient days of care to area X patients 65-74 years of age, under the normative standard the hospital should increase to 1.25 x 1,460 or 1,825 patient days; under current practices, the hospital is allocating an average

of 4.0 beds per day to the area's 65-74 year-old male population (1,460 divided by 365), it should allocate 5.0. The experience of each hospital across each age and sex group is then accumulated to obtain the final estimate of the number of normative beds for the area.

In step three, the experience of each hospital across each of the areas from which it receives patients is accumulated to obtain an aggregate estimate of the number of patient days that the hospital should treat in order to achieve equalized age-specific patient days per capita in each of the hospital areas of the region. This estimate, which we call the target of beds estimate, can then be compared to the actual number of beds.

We have made estimates of target beds for Vermont areas, and compared them to the actual counts. The target estimates can be substantially different from the current numbers. For example, the local hospital serving Area 1 has a target bed estimate about 20% below its actual number of beds; by contrast, Area 13's local hospital "needs" about 10% more. It would, of course, be naive to use this approach as the only criteria for closing or building beds. When used in conjunction with other information about the roles and functions of hospitals, it highlights those areas where over-bedding, and potentially under-bedding, are a problem. More importantly, however, it should stand as a critique of the problem of setting normative standards where the emphasis is on increasing supply in low areas: the hospital serving Area 13, as we have shown, has a low occupancy rate and there is no indication that, at the current level of use, necessary services are not being performed.

USE OF SMALL-AREA DATA FOR REGULATING HEALTH CARE EXPENDITURES

A number of public programs, ranging from the regula-

tion of the price of insurance to control of hospital budgets, affect the flow of dollars between communities and have a profound effect on the incentives that operate in health care markets. By revealing the per-capita rates of expenditures among neighboring medical care markets, small-area data allow public policy analysts (and those responsible for regulatory decisions) to trace the flow of dollars among populations and to review the impact of their decisions on the market. Of particular importance is the relationship between a population's contribution to tax or insurance premium pools and its rate of consumption of services. This relationship is important because of the implications for equity and for inflationary growth with the uncoupling of the costs of consumption from the price of consumption.

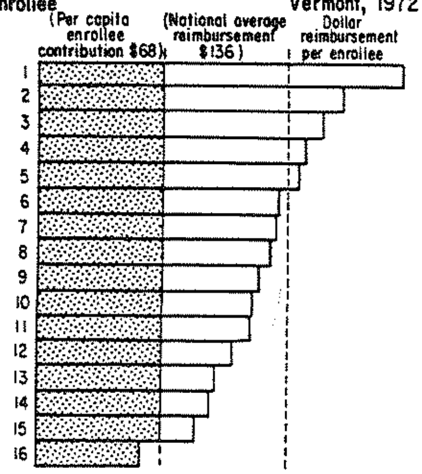
This section demonstrates how claims data can be used to document the income transfers associated with public programs or private insurance enterprises. It also demonstrates how small-area data, in particular rate setting environments, can improve decision-making by reducing income transfers.

Insurance claims data provide the most direct means for identifying the sources and dispositions of monies obtained from insurance or tax sources. While health insurance is generally viewed as a means of pooling the risk of illness so that those who are well pay a portion of the cost of caring for the ill, the association between the number of suppliers and expenditures for care indicate that illness is not the only factor associated with cost. In Vermont, as discussed in Chapter VI, the variation in rate of use of services at the community level--which does not appear to be associated with variation in illness rate--is accompanied by cross-community subsidization: residents living in low use rate communities (with lower

aggregate expenditures per capita) often pay a portion of the medical bills incurred by residents in high cost areas. The use of small area data is illustrated in Figure 7.4, which shows for each of 16 Vermont communities served by different local hospitals the established per-capita reimbursements under Medicare Part B. Per-enrollee reim-

FIGURE 7.4

Estimated Medicare Part B reimbursement per enrollee by Hospital Service Area of residence of enrollee Vermont, 1972



The Figure characterizes the distribution of Medicare dollars among Enrollee Populations (see text).

bursements in the lower hospital service area are less than one-third those in the highest area. Enrollees living in Area 16 receive less on a per-capita basis than they contribute in premiums. Residents in Areas 6-15 receive in benefits an amount equal to their own contributions to the program plus a portion of the average Federal contribution. In addition to their own and the Federal contribution, residents in Areas 1-5 effectively receive contributions from areas with lower than average reimbursements.

The impact of the income transfers on the local economy--particularly the hospital industry--is considerable.

But the more important issue is the problem of equity: The data reveal substantial disparities between contributions to insurance pools and benefits among populations with similar illness rates (e.g., as shown previously by contrasting the situations in Areas 1 and 13).

Hospital Rate Setting

Several suggestions have been made--and a few have been attempted--for methods to contain the rate of growth in hospital expenditures. Two basic strategies have been proposed: One involves controlling the unit costs of service--either the per diem cost or the cost per case; the other limits growth in expenditures by containing annual budgets within targeted figures, the so-called "global budget" or "maxicap" approach. The effort of the Price Commission during Phase II of the Price and Wage Stabilization Act of 1971 is an example of the former approach; Hospital Rate Regulation as practiced in Rhode Island (and reviewed in Chapter IX) is an example of the latter. The following reviews how small-area data can contribute to more rational decision-making in each of these environments.

Controlling Unit Prices The medical care expenditures of a population are a function of the unit cost and the per-capita volume of service. (See equation, page 140). As we have seen, the per-capita volume of services is an important determinant of the per-capita expenditure, and the unit cost cannot be relied upon as an indicator of market consumption rates. This means that strategies to contain costs by regulation of unit costs without regard to per-capita volume can be (1) ineffective, because they create incentives to increase volume to meet budgetary expectations and (2) unjust and arbitrary, because they may increase income transfers by constraining growth in low expenditure areas or increasing it in high expenditure areas. An example of the latter was observed in Vermont

during Phase II of the Wage and Price Stabilization Act when the local hospitals in Vermont Area 1 and Vermont Area 13 each proposed an exception to the 5% ceiling on annual increases in unit prices. Unit prices in each area were approximately the same, but per-capita expenditures in Area 1 far exceed those in Area 13 (see Table 7.2).

The Price Commission called for public hearings on both applications and the hospital in the low cost area withdrew its application. However, Hospital A in Area 1 went through the procedure and was rewarded with an exception. The case stands as an example of how public regulation undertaken in the absence of data on per-capita consumption rates can increase variation and contribute to income transfers.

Cost Containment Through Global Budgeting An alternative strategy to control inflation in the hospital sector involves the restriction of total annual expenditures in which hospitals negotiate with regulatory boards for an allowed increase in the previous year's budget. This approach recognizes the importance of volume of services as a contributor to costs and, if successful, can effectively limit the inflation of inpatient costs. However, by taking the historical expenditure (and case mix) experience of the regulated institutions as a given, the process merely limits costs per capita to marginal increases. The process accepts the status quo and ignores the underlying variation in per-capita rates of use of services and expenditures. By limiting growth equally in high and low expenditure areas, the process freezes the historic variations in market areas and in effect gives the income transfers the sanction of public policy. The severe equity implications of this process have not been tested in the courts. However, it seems intuitively clear that the just exercise of control over the rate of payment into insurance funds or the amounts of annual hospital budgets requires consideration of existing variations in per capita expenditures.

The small-area data can provide an indicator set which can give guidance to negotiations between hospitals and regulators under the global budget strategy. This indicator set has been described in the context of rate setting.[36] Briefly, based on some standard or normative rate of per-capita expenditures, an indicator called the parity budget is developed for each hospital. The parity budget is a global budget normalized in such a way that if each hospital achieved its parity budget, the rates of expenditures would be equalized between the hospital areas of the region. This estimate can differ substantially from the existing rates of expenditures.

For some hospitals, the parity budget will be substantially higher or lower than the actual budget. For example, using the State average for the norm for the local hospital in Area 1, the actual budget was 12% above parity in 1975. By contrast, the local hospital in Area 13 had an actual budget that was 26% below its parity budget.

This indicator can be weighted for population age structure and for hospital function or other factors, such as any difference in labor costs and can be generated from patient origin data. If UHDDS data are available, case mix can be taken into account and weights can include propensity to admit discretionary cases; if MEDPAR data is used, a similar indicator based on reimbursements can be generated which will establish parity reimbursements for Medicare services (see below). The additional information on historical performance available from the UHDDS and MEDPAR data sets can be used to contain costs and reduce inequalities among areas, as we discuss in the next section.

Medicare Parity Reimbursement Targets

The MEDPAR data can be used to develop Parity Reimbursement Targets for individual hospitals. The target budget has the following property: If each hospital achieved the budget and appropriately adjusted the distribution of its resources among hospital areas throughout the region, then reimbursements under Medicare would be equalized among enrollees in all communities of the region. The approach is illustrated in Table 7.7 which gives data for two Vermont hospital areas served by relatively small community hospitals. Area 13 is, by now, familiar; Area 3 experienced

TABLE 7.7

MEDICARE PARITY REIMBURSEMENT TARGETS ESTIMATED FOR TWO HOSPITAL MARKET AREAS IN VERMONT (1975-1976)[a]

Area 3: Enrollee Population (65 and Older) - 935

	All Hospitals	Local Hospital	Referrals	All Others
Number of Admissions	1,220	800	195	225
Reimbursements (xooo)	$1,526	$844	$379	$303
Reimbursements Per Case	$1,251	$1,055	$1,944	$1,347
Admissions Per Enrollee	652	428	104	120
Reimbursements Per Enrollee	$816	$452	$202	$162
Ratio Expected/Observed	.515	.515	.515	.515
Target Reimbursements (xooo)	$786	$435	$195	$156
Target - Actual (xooo)	$ -740	$ -409	$ -184	$ -147

Area 13: Enrollee Population (65 and Older) = 1,015

	All Hospitals	Local Hospital	Referrals	All Others
Number of Admissions	560	380	115	65
Reimbursements (xooo)	$558	$328	$157	$73
Reimbursements Per Case	$996	$863	$1,365	$1,123
Admissions Per Enrollee	276	187	57	32
Reimbursements Per Enrollee	$275	$161	$78	$36
Ratio Expected/Observed	1.53	1.53	1.53	1.53
Target Reimbursements (xooo)	$854	$502	$240	$112
Target - Actual (xooo)	$+296	$+174	$ +83	$ +39

[a]Annualized and based on MEDPAR sample for 1975-1976.

a rapid increase in utilization in 1973-74, apparently because of changes in local physician characteristics (see page , Chapter VI). Although household interviews have not been performed to assess Area 3's similarity with Area 13, there is little reason to believe that medical need differs remarkably between the communities. After the changes in physician stock described in Chapter VI, Area 3 became a high utilizer of services. As can be seen in Table 7.7, the number of admissions per capita for the Medicare population, the reimbursement per capita and, to a much lesser degree, the reimbursement per admission are higher than in Area 13.

The parity reimbursement target is derived from the data shown in the table: The ratio of the expected to the observed per-capita reimbursement rate (row 6) is obtained by dividing the average reimbursement for Vermont Medicare enrollees by the amount spent in the area; so, for Area 3, the State average is divided by the area rate of $816 per enrollee, resulting in a ratio of .515; for Area 13, the same procedure results in a ratio of 1.53. The estimate of the parity budget for the portion of each hospital's admissions that come from the area is given in row 7: In order to achieve parity reimbursements for hospitalizations under Medicare in Area 3, the area's global budget for hospitalizations should equal $786,000 over the two-year period. But, in fact, $1.526 million was spent (row 2). The target budget for this area requires a $740,000 reduction in spending; by contrast, in Area 13, the current reimbursement level is about 65% of the State average and the parity budget calls for increased reimbursements on behalf of the Medicare population of this area: To achieve parity, about $300,000 more should have been spent during the 1975-1976 study period.

The second, third and fourth columns in the table show the impact of target budgeting on the reimbursements to the individual hospitals that serve the area. As in the example above that dealt with parity beds, we choose here to weight the contribution of each hospital in the same way to estimate the parity budget--although, clearly, if the procedure were in fact used, negotiations would ensue among hospitals as to how the burden (or benefits) should be shared. Because the majority of its hospitalizations are from the local area, the greatest impact is on the local community hospital: in Area 3, the portion of the local hospital's Medicare reimbursement devoted to its own area would need to be reduced almost in half (from $844,000 to $435,000). The local hospital in Area 13, under this strategy, would have about a 50% increase in budget.

An important advantage of the parity reimbursement indicator is that it relates the magnitude of variations in per capita reimbursements to the hospitals that contribute to the variations. As we said above, there is little indication that these differences relate to differences in population need; the most likely cause is differences in practice patterns. But whatever the cause, the differences represent severe obstacles to strategies for prospective reimbursement that would uniformly constrain the growth of hospitals without regard to historic expenditure or reimbursement patterns. Using the national MEDPAR data file, indicators such as this can be developed for every community in the country. In our opinion, elementary concepts of equity require that some such indicators be used in any eventual efforts by the Federal Government to control cost inflation through capping of Medicare reimbursements to hospitals. Otherwise, the unwanted income transfers that exist between local hospital markets will be perpetuated by overt public policy.

Small Area Parity Insurance Pricing

Another, possibly complementary, approach to reducing unwanted income transfers is to rate the price of health insurance to reflect consumption rates in local hospital market areas. In this section, we illustrate the local market impact, using MEDPAR data to estimate local parity prices for health insurance. Medicare data are used in the absence of Blue Cross or other private insurance data. Blue Cross does not keep the detailed information on Vermont subscriber populations necessary to generate small-area data. Because hospital expenditures per capita and Medicare reimbursements are closely correlated, (see page 55, Chapter IV), Medicare experience is a reasonable approximation of the degree of variation one should expect to experience under other forms of insurance.

Table 7.8 lists information describing the current status of reimbursements and gives the "expected reimbursement"-- the average per-capita expenditure for Medicare over the geographic territory used for rating Blue Cross insurance in Vermont; as the table shows, $420 is expected return on insurance to the average consumer in the rating area. Under

TABLE 7.8

PRINCIPALS OF SMALL AREA PARITY INSURANCE PRICING
ILLUSTRATED FOR TWO HOSPITAL MARKET AREAS IN VERMONT

	Area 3	Area 13
Current Status		
Expected Reimbursements Per Subscriber	$420	$420
Average Reimbursements Per subscriber	$816	$296
Number of Subscribers	935	1,015
Area Reimbursements (x'ooo)	$1,526	$558
Expected Reimbursements (x'ooo)	$786	$854
Income Transfers (x'ooo)	$+740	$-296
Parity Adjustments		
Parity Price[a]	$837	$317
Parity Rebates Per Subscriber	0	$103
Parity Surcharge Per Subscriber	$417	0

[a]Includes a 5% overhead estimate based on Expected Reimbursements.

the current rating methods, "subscribers" living in Area 3 are massively subsidized by out-of-area subscribers who contribute $740,000 to their care. On the other hand, subscribers in Area 13 are net losers, giving up expected benefits valued at nearly $300,000 to residents of other areas. The table lists the parity price of the insurance in Areas 3 and 13; it also lists the surcharge or rebate that would be necessary to achieve equal per-capita expenditures: An Area 3 subscriber would need to pay an additional $417; an Area 13 subscriber, on the other hand, should receive a rebate of $103.

In our example, Medicare data were used to illustrate the principals of parity insurance pricing, but data from other third party payors could be used in the negotiations for rate-setting by State insurance commissioners. Minor adjustments in record-keeping systems by the carriers could make this type of information available for assessing the impact of public regulation on unwanted income transfers. Further, it seems reasonable to predict that if steps are taken to adjust local contributions to insurance to more closely parallel local spending, more critical local community feedback on plans for growth of the local medical-care economy could be anticipated.

USE OF SMALL AREA DATA IN THE MANAGEMENT OF HOSPITALS

Many of the data applications discussed above are relevant to the management of hospitals. The indicators can provide hospital administrators and trustees with a much clearer picture of how their hospital fits into the local or regional medical care system, and particularly how its role and functions may relate to those of other hospitals. If the information is made part of the planning process, it will allow management and trustees to estimate in advance the impact that their decisions will have on the overall pattern of resource allocation in their market area. The method for projecting the impact of plans to

build beds (page 146) is a clear example of this kind of application. In a similar vein, data on physician distribution may be used to estimate the impact on the quantity and quality of care of decisions to add new positions to the physician staff. The data may also be used to compare the employment practices among hospital areas with regard to non-physician personnel. Decisions to recruit or offer staff positions to physicians or to hire personnel have an important impact on the cost of care; with population-based data, administrators and trustees can make forecasts and develop long-range plans to target employment to reduce costs. This section gives examples of how the data can be used for these purposes. One example is a case history of the use of data to evaluate the need for a neurosurgical unit at a community hospital. The second is an extension of the normative analysis of resource allocation patterns to include non-physician hospital employees.

Does Hospital E Need a Neurosurgeon?

In 1973, Hospital E was locked in debate concerning whether or not neurosurgical services should be made available at the hospital. The hospital is the sole community hospital in a service area of about 60,000. A request was made for information on the distribution of neurosurgeons throughout the region and on the case-mix treated by neurosurgeons. The administration considered the following questions:

1. Are there enough cases in the local hospital area (i.e., is there sufficient workload to maintain skill levels of a neurosurgical unit and to provide services economically)?
2. What will be the impact on the regional distribution of services if Hospital E (and those of similar size) establish neurosurgical units?
3. Are there alternative solutions which, using currently available regional manpower, provide more efficient solutions to the manpower problems?

To answer these questions, the UHDDS data were used to (1) investigate the geographic distribution of services provided by existing neurosurgical units; (2) estimate the current allocation of neurosurgeons to the area by the same proportionate allocation approach used for beds, expenditures and non-physician manpower, (using neurosurgical discharges rather than total discharges); (3) compare neurosurgical discharge rates in the area; and (4) count the number of neurosurgical cases.

The report to the hospital staff summarized the situation as follows:

1. The caseload of neurosurgical procedures in the service area of Hospital E was not sufficient to support a neurosurgeon in residence. The rate of neurosurgical procedures in the service area was close to the State average; comparatively speaking, there was no evidence that this procedure was being under utilized. During the previous year, 22 procedures classified as operations on the brain and cerebral meninges (HICDA classification 001-029) were performed on the population of the service area. Assuming that all cases currently referred to regional hospitals were done at Hospital E, this would equal only 40% of the current average workload of a single neurosurgeon at the referral hospital. While no published standards on caseload requirements were then available, it seemed unlikely that this load was sufficient to maintain surgical skills: Only one procedure would be performed, on the average, every two-and-a-half weeks.

2. If all hospitals with similarly sized areas acquired a neurosurgeon, there would be a significant impact on area-wide distribution of services. In 1969 there were 1.27 neurosurgeons per 100,000 population in Vermont. The national average of board-certified neurosurgeons was 1.24. If Hospital E hired a neurosurgeon, the Vermont rate would rise to 1.5. If hospitals of similar size followed suit and added neurosurgeons, the rate would increase to more than 2.0. This would diminish the number of referral cases in both regional hospitals and also would decrease the efficiency and probably decrease the skill-level of all units in Vermont. It would, therefore, increase costs and hamper the training programs at both university Hospitals.

3. Alternatives may have existed which would utilize existing available manpower. Assuming that the regional supply of neurosurgical manpower was sufficient, neurologic consultation could be made available by achieving cooperative arrangements with either Hospital X or Z. Both of the areas served by X and Z had relatively large per-capita supplies of neurologic manpower. The area served by Hospital Z was particularly well-endowed from the point of view of neurologists per 100,000 population. If the neurologist in Z were able to spend half-time in consultation in the E area, this would create a distribution of neurologic manpower which would give all areas approximately the same number of neurologists per 100,000 population.

The practical result of the report was to strengthen the hands of those opposed to the idea, which was eventually dropped. If the approach is used to identify the

distribution of hospital-based specialists in hospital areas, hospital administrators facing low occupancy rates in hospitals with high per-capita utilization profiles may be able to resist pressures to recruit additional physicians. This resistance would result in lowered rates of increase in per-capita expenditures.

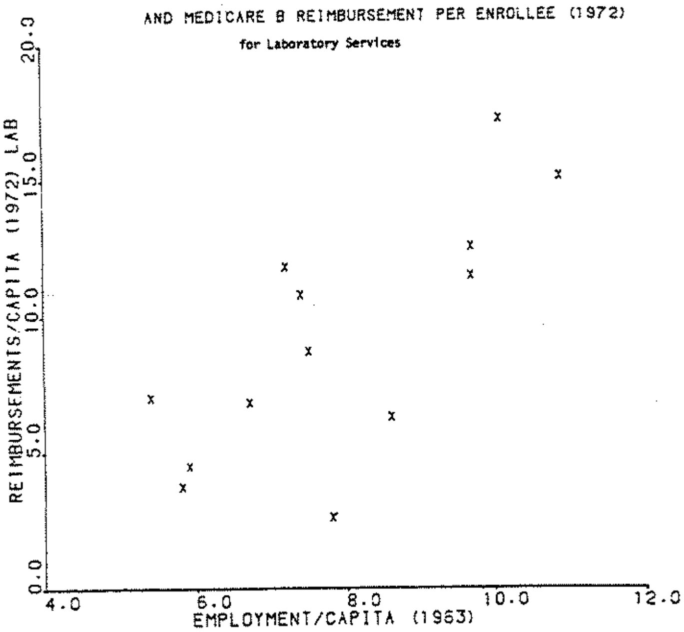
Employment Targets for Cost Containment

Chapter III gave examples of variations in the per-capita numbers of hospital employees. Based on an analysis analogous to the method used for developing the parity budget measures presented above, an indicator of target employment can be developed for each hospital. This indicator gives the numbers of employees that a given hospital should have if, under the current geographic distribution of patients, the goal is to equalize employment practices. The practical value of the indicator is in cost containment: Per-capita hospital expenditures or reimbursements under the Medicare program (See Figure 7.5) are correlated with numbers of employees per capita. With appropriate adjustments for

FIGURE 7.5

ASSOCIATION BETWEEN HOSPITAL EMPLOYMENT PER CAPITA (1963) AND MEDICARE B REIMBURSEMENT PER ENROLLEE (1972)

for Laboratory Services



differences in contracted services, this indicator can be used to signal administrators that a resource directly under their control--the number of employees--is contributing to a cost profile in their area which is higher than average.

With appropriate motivation, this information can be used as the basis for a strategy to contain costs by paring employment to meet regional (or other) empirical norms. Since the allocations can be done for all types of employees (for example, administrators, registered nurses or janitors), the manpower groups targeted for reduction can be specified.

SUMMARY AND CONCLUSIONS

The disparities among local communities in per-capita rate of use of service are extensive; actions taken by State or Federal Governments to plan or to regulate hospital facilities, expenditures or reimbursements or to control the price of health insurance without regard to the current per-capita distribution of expenditures, resources or services per capita can be against the public interest because the actions may lead to further disparities in resource distribution or may maintain unwanted income transfers (cross-community subsidies based on relative numbers of health care suppliers and not relative need for services). Small-area data make the disparities and income transfers apparent.

This chapter presented a number of examples of how the indicators can be used to identify the disparities, to evaluate plans for expansion of the industry in view of the current disparities, and to establish target for the distributions of resources or parity prices for health insurance that correspond to normative standards. The indicators presented in this chapter can be developed using data from the national Medicare program. To avoid un-

reasonable planning or regulatory decisions, we recommend that these data be used in conjunction with the national health planning program and with the implementation of any eventual Federal program to establish cost-containment programs through prospective reimbursement. The data should also be made available to States that initiate their own prospective reimbursement programs. We also recommend their widespread use by the private sector as a means for implementing private initiatives to contain the inflation of hospital costs.

CHAPTER VIII
USE OF DATA TO ASSESS CLINICAL PRACTICES
(IN THE PSRO SETTING)

Some of the most important applications of small-area data are in the evaluation of medical practices. This chapter demonstrates how the data can be used to assist the Professional Standards Review Organization (PSRO) in each of its three major areas of responsibility: Concurrent Review, Physician Profile Analysis and Medical Care Evaluation studies (MCEs). Concurrent Review and Profile Analysis are to assure that only medically necessary interventions are undertaken on patients whose care is paid for under the Medicare and Medicaid programs. Under the Concurrent Review program, consensual standards and guidelines governing the appropriateness of the hospitalization and/or surgery are developed. Most Concurrent Review programs (and the few examples of Physician Profile Analyses) have concentrated on the length of stay *after* hospitalization has occurred with an aim toward reducing length of stay in particular hospitals toward some goal, usually the mean for hospitals of similar size in the PSRO area. In Chapter VII, small-area data were used to show that for specific types of cases (e.g., hysterectomies) the variation in average length of stay is not as important as variation in admissions per-capita in determining the differences in patient days per-capita among neighboring communities. The data reveal that it is the decision to admit patients for specific conditions or procedures that carries the more important implications for resource allocation. Because small-area data measure patient days per capita and the contribution of admissions or procedures per capita to patient days per capita, review

can be focused on those cases in those hospitals that contribute most to the high-rate experiences of specific hospital areas. They thus provide indicators for selective review of cases which are the least likely to meet appropriateness criteria. This chapter presents a case study of how the data were actually used in a process of feedback and second opinion to reduce the rates of one high-variation procedure, tonsillectomy. It also illustrates how small-area data can be used to develop Physician Profile Analyses which indicate the contributions of physicians to high rates.

Small area data are also valuable for PSROs to use in conducting MCEs (Medical Care Evaluation studies), and two examples are presented. The first example, concerning the use of blood, was developed as an example of how MEDPAR data can be used in an MCE by a PSRO. The second example shows how the data can be used to evaluate survival following surgery, and the procedures prostatectomy and lens extractions are studied. The study of survival following surgery demonstrates that claims data can be used to investigate post-hospitalization outcomes associated with medical care. The Medicare Part B claims data are particularly useful because they provide a registry of medical and surgical cases for most Americans over 65 years of age. The data can make a unique contribution to information on the relationship between health care use and health care outcome: Survivorship after specific medical or surgical interventions can be studied for an indefinite period, permitting the development of a life table approach to the estimation of survival probabilities. There is no other source of information of comparable value for this purpose.

A FOCUSED REVIEW STRATEGY LINKED TO POPULATION-BASED DATA

Small-area analysis shows that hospital areas tend to have high per-capita rates for use of hospitals for some conditions or procedures and low rates for others. (See pages 94 and 129). These so-called "high-variation" procedures are those that are discretionary in the sense that alternative ways of treatment are employed in some communities, and there is debate with regard to the need for hospitalization. Areas which have high rates for these "high variation" procedures demonstrate the most significant departures from the expected value, which is the value that would have been expected in the area if the State's average rate had, in fact, occurred there. The focused review strategy singles out hospitals on a condition- or procedure-specific basis to examine their contributions to population-based "excess" rates of use of these procedures. Hospitals in areas with low rates are not reviewed.

The number of cases in excess of (or below) the number of cases expected can be large and the payoff of a successful review can be great. Table 8.1 illustrates the potential payoff of review of three commonly performed high-variation procedures in the four largest hospital service areas in Maine. A focused study strategy based on small-

TABLE 8.1

Number of Procedures Above (+) or Below (-) Expected*
in Four Maine Hospital Areas for Selected
Surgical Procedures, 1973-1976

Procedure	Area I	Area II	Area III	Area IV
Tonsillectomy	-736	+ 97	+806	+659
Hysterectomy	+ 15	+815	- 62	-228
Prostatectomy	+349	- 14	+ 2	- 83

*Expected based on accumulated numbers of cases for each year, 1973-1976. State average rate is used to estimate the expected number of cases.

area data would dictate in-depth study of tonsillectomies in Areas III and IV, of hysterectomies in Area II and of prostatectomies in Area I. Over the four-year period (1973-1976) the surveillance data indicate a total excess of more than 1,400 tonsillectomies in Areas III and IV; in these areas, the combined cost of physician and hospital services <u>in excess of</u> the State average is $750,000. Area II females underwent 860 more hysterectomies than expected and the costs are estimated to <u>exceed</u> the State average by more than $1 million. For prostatectomies, the excess in Area I is 349 cases and the cost is $650,000 above the State average. By targeting focused review on these procedures in the specific hospitals that are contributing to the large excess, one can anticipate much more specific debate on the costs, risks and benefits of these discretionary operations than would take place if all cases were to receive equal attention. If physicians in these areas were persuaded to bring their rates down to the State average, the costs in Maine for these three procedures would be reduced by over $600,000 per year.

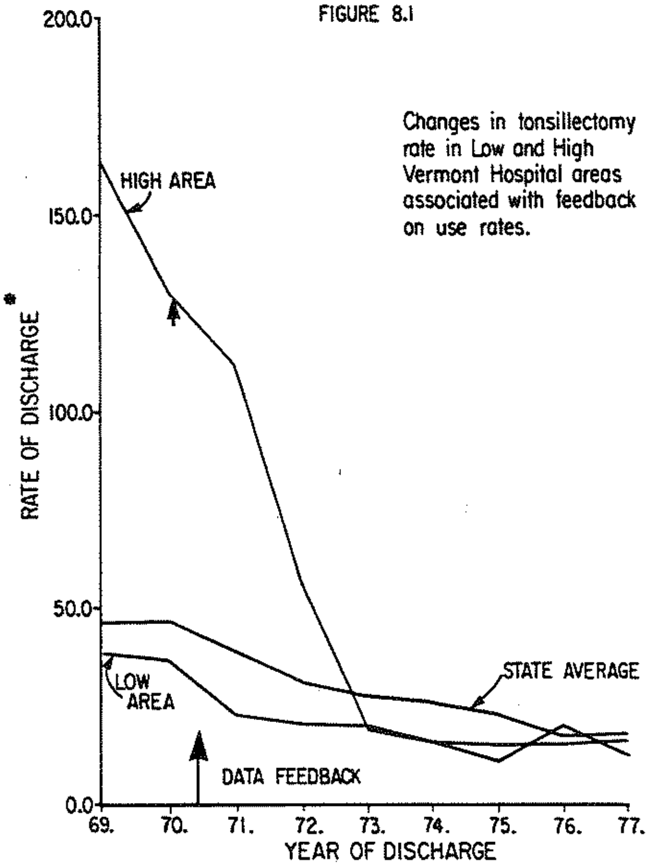
<u>A Case Study of Focused Review in Hospital G</u>

In Vermont, surveillance of tonsillectomy rates on a hospital area-specific basis began in 1969; rates were found to vary more than 10-fold. In the high area we estimated that more than 65% of children were tonsillectomized by age 20; by contrast, in the low area, the estimate was only 6%. Data on the variations were fed back to officials of the Vermont State Medical Society, who in turn gave the information to the hospitals. The physicians on the staff of Hospital G, the area hospital with the highest rate, initiated a review of the medical and surgical literature and established new criteria for the use of the procedure. In addition, all patients who

were recommended for tonsillectomy were examined by a staff pediatrician and surgeon.[34]

The changes that occurred in tonsillectomy rates in this area are shown in Figure 8.1. The rates dropped drastically

FIGURE 8.1



*Discharge per 10,000 population

in the hospital area so that by 1975 the area rate was substantially <u>below</u> the State average. The change in practice patterns was attributed by the hospital staff to the feedback, the study of the medical literature and the case study procedure by the pediatrician and surgeon. Although the example did not occur within the PSRO environment, it demonstrates how focused review, followed by feedback and review, can lead to dramatic changes in clinical practices with accompanying cost containment.

PROVIDER-AREA-PATIENT PROFILE ANALYSIS (PAPPA)

Profile analyses are a form of retrospective review in which patterns of aggregate patient care data are analyzed and related to the institutions or physicians who provide the care. According to statute, PSROs are required to develop and periodically analyze institutional, practitioner and patient profiles; this section gives further demonstrations of how practice patterns may be analyzed on a small-area basis so that variations in rates at which physicians employ certain treatments can be related to the experience of the population-at-risk. We call this approach the Provider-Area-Population Profile Analysis (PAPPA). The provider (either a physician, hospital or both) is analyzed by area and the services are described in terms of rates per defined population. This approach places the interpretation of institutional- or physician-related events within the context of the probabilities that the population-at-risk experiences for undergoing the profiled medical or surgical events. This is important because areas with substantially higher than average rates of use of discretionary services are likely to experience more cases in which the indications for service are questionable. PAPPA provides a means for identifying occasions in which data feedback on variation (and possibly, concurrent review) ought to be specifically targeted to individual physicians.

The approach is illustrated in Table 8.2 which, in Part I, gives the tonsillectomy rate in two areas, Areas A and B. Area A exceeds the State average by more than 3.5 fold. By contrast, the Area B rate is only 50% of the State average. In the profile analysis, physicians are first ranked on the relative numbers of tonsillectomies they perform compared to all physicians within the State. This rank is given by the subscript associated with the MD

TABLE 8.2

PROVIDER AREA PATIENT ANALYSIS OF USE OF TONSILLECTOMIES
IN TWO EXAMPLE HOSPITAL AREAS FOR A ONE YEAR PERIOD OF TIME

I. Hospital Area Characteristics: Tonsillectomy Rates Per 10,000

Area	Population ($x 10^3$)	Tonsillectomies	Area Rate	Ratio to State Average	% of T&As by Local MDs
A	13	176	164	3.71	98.4
B	107	213	22	0.50	96.1

II. Physician Workload Characteristics: Number of Tonsillectomies by Area of Patient Residence[o]

Physicians in Area A	Total	Area A	Area B	Other Areas
MD_4	89	80	0	9
MD_{13}	44	42	0	2
MD_{20}	28	23	0	5
MD_{21}	26	23	0	3
MD_{39}	9	8	0	1
Physicians in Area B				
MD_2	111	0	91	20
MD_5	74	0	59	15
MD_{9a}	54	2	32	20
MD_{9b}	54	0	31	23

[o]Subscript in physician label identifies the rank order on number of tonsillectomies performed among all physicians within the PSRO area.

label in Part II of the Table. Thus, for example, the physician labeled MD4 is the fourth ranked physician; MD39 is the thirty-ninth ranked physician and so on. The profile analysis shows that Area A achieves its high rate through the effort of one physician who carries a heavy tonsillectomy workload, ranking 4th in the State, and through the effort of four other physicians who undertake moderate workloads when compared to those of other physicians in the area. Area B is also comprised of "high profile" physicians; its cohort members rank from second

to ninth. However, the population served by this group of physicians is relatively large and the probabilities for tonsillectomy in the area they serve are lower than average.

The PAPPA would lead to feedback of data (or concurrent review) targeted for the physicians serving Area A, particularly physicians MD4 and MD13; by contrast, the workloads of physicians MD2 and MD5, although quite high in number of cases, would not single them out for particular attention, since their clinical decisions are not associated with a high population-probability of tonsillectomy.

Claims data can serve as the basis for a PAPPA. Table 8.3 shows the physician source of variation in use of B-12 injections among Medicare enrollees within one primary physician service area. This area is the Area A, in Table 5.5 of Chapter V (page 86). It has a high rate of B-12 injections when compared to other primary physician service areas located within the same hospital service area.

Table 8.3

Characteristics of Physician Prescribing Behavior for B-12 Injections to Medicare Enrollees Living Within a Vermont Primary Physician Service Area

MD Code	Number FTE MD (in area)	No. of Injection	No. of Patients with Injections	Percent of Area Injections	Percent of Visits with Injections	% of all Patients with Injections	Injections per FTE MD[o]
21	1.6	157	48	52	16.3	13.4	99.4
14	0.9	43	8	14	16.2	8.2	47.8
All Other	7.9	101	27	34	4.1	3.4	12.7
All MDs	10.4	301	83	100	7.9	6.2	28.9

[o] Non-primary physicians excluded from denominator

Based on 5 month Medical Billing, February-June, 1972

Table 8.3 makes clear that three physicians are the primary source of B-12 injections in this area. As the table shows, the two physicians identified by "MD Code" X provide more than half of the injections in the area: Physician Y provides 14%, the remaining physicians (7.9 FTE MDs) provide about one-third.

Table 8.3 shows other characteristics of B-12 prescribing habits of these physicians. About 16% of reimbursed ambulatory visits to physicians with high-injection use are associated with a Vitamin B-12 injection. This compares to about 4% for low-injection use physicians; about 10% of patients of high-injection use physicians received a B-12 injection. On a full-time equivalent basis (See pages 62-66, Chapter IV), the high-use physician group has about 100 injections per physician during the five-month billing period studied. (The annualized estimate is 220 injections per physician.) The low-use group has about 13 injections per physician during the study period, (or 28 injections per physician per year).

USE OF MEDPAR DATA FOR AN AREA-WIDE MEDICAL CARE EVALUATION OF BLOOD USE

A PSRO in one New England State selected the use of blood as the subject for an area-wide Medical Care Evaluation Study (MCE). The following study shows how a medical care evaluation that emerges out of the concerns of physicians can be explored using the MEDPAR data.[24] The study is possible because the MEDPAR record contains information on the number of pints of blood received per admission. The study focuses on variations in per-capita rate of use of blood transfusion among hospital service areas to raise a fundamental issue: What is the appropriate use of blood? The study is among Medicare enrollees in several large HSAs in Massachusetts and the rural portions of Health Service Area I in Western Massachusetts.

Blood Transfusion Rates

Among the areas listed in Table 8.4, the rate of transfusion is highest in Area B where in 1975, 3.1% of Medicare enrollees are estimated to have received blood; the transfusion rate is lowest in Area C where only 1.3% received

blood. The Area B rate is also highest for total number of pints of blood transfused per 1,000 enrollees: 137 pints

TABLE 8.4

Blood Transfusion Activity in Selected Massachusetts Medicare Populations, 1975

Area	Number of Enrollee Years of Exposure	Number Receiving Blood	Observed/ Expected	Percent Receiving Blood	Mean Pints Per Recipient+	Pints Per 1,000 Enrollees+
A	17361	437	1.17	2.5	4.2	104
B	8984	274	1.42	3.1	4.6	137
C	12806	165	0.60	1.3	3.4	44
D	6281	93	0.68	1.5	3.2	47
E	4202	118	1.29	2.8	4.3	122
F	6300	191	1.41	3.0	3.8	116

+Age-Adjusted rates

as compared to the low in Area C of 44. The rate in Area B is also high along two additional parameters of use: It has the highest proportion of enrollees who receive blood; and it has the highest mean number of units per recipient.

Distribution of Blood Transfusions Among Recipients

One important quality of care issue concerns the number of units transfused. Although not all experts will agree, most clinicians with extensive experience in the use of blood services feel that single unit transfusions are, from a cost-benefit point of view, usually not worth the risk: If the clinical condition is not sufficiently complex to require at least two units of blood, the therapy is probably not necessary, particularly in view of the possible adverse reactions associated with transfusion.

Compliance among physicians with the standard of care can be directly investigated using MEDPAR data. Table 8.5 gives the percent distribution of patients by the number of units transfused to each patient who received any blood. Medicare patients with residence in Area E who

TABLE 8.5

Percent Distribution of Patients By Number of Units Transfused Per Admission By Area

Number of Units	A	B	C	D	E	F
			AREA			
1	18.8	20.1	17.6	21.5	14.4	23.0
2-4	54.2	43.2	58.8	55.8	55.9	53.4
5-9	17.8	18.9	20.5	22.6	22.2	15.7
10^+	9.3	7.6	3.0	----	7.6	7.7

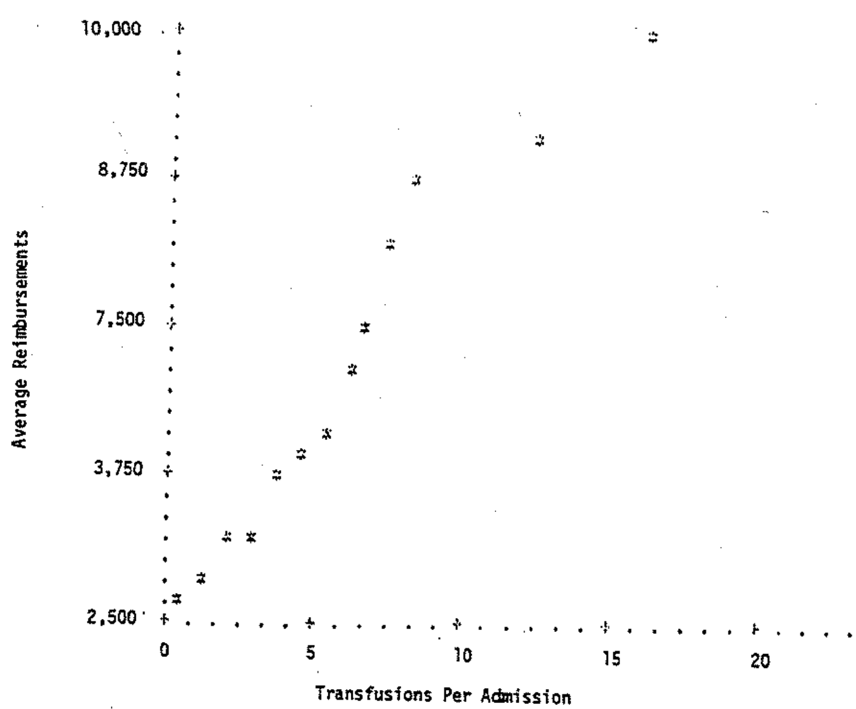
received any blood are the least likely to receive only one unit of blood during an admission (14%). Area F residents receive the most one-unit transfusions; 23% of the residents of this area who receive any blood got only one unit. This information, within the context of a Medical Care Evaluation Study, could lead to feedback to hospitals concerning variation in practice patterns, and to more effective guidelines concerning use of blood. The further monitoring of practice patterns after feedback would provide information on the effectiveness of the process. The opportunity is quite analogous to that which existed in the tonsillectomy case presented above.

Patterns of care for use of multiple transfusions can also be compared among areas. Table 8.5 shows interesting variation: Some Area A and Area B Medicare patients received transfusions totaling more than 10 pints each: (9.3% and 7.6% of recipients respectively); by contrast,

no patients from the Area D received this quantity. The variation raises interesting cost-benefit questions which cannot be answered with the existing data. In the low blood use areas (C and D), case fatality rates among those who receive one or more pints of blood are about the same as among patients who receive one or more pints in the high blood use areas. But the rates and types of surgery differ between the areas, and the interpretation of this data is difficult. It is clear, however, that the tendency to use more blood is associated with greater average reimbursements per admission. The relationship between reimbursements per case and transfusions per case is shown in Figure 8.2. More information on the reasons for the variation in blood use and, particularly, on the consequences of the variation are reasonable next targets for an MCE.

FIGURE 8.2

Average Reimbursements Per Case By Number of Transfusions Per Admission, 1975



USE OF MEDICARE PART B DATA TO INVESTIGATE DEATH RATE FOLLOWING LENS EXTRACTION AND TRANSURETHRAL PROSTATECTOMIES

This example of an MCE concerns outcome associated with specific surgical procedures. There are important reasons for asking questions concerning the outcome for patients who undergo, for example, lens extractions or prostatectomies: (1) the procedures (particularly prostatectomy) involve risk to the patient; (2) the use of the procedures--and therefore exposure to risk--varies among apparently homogeneous populations; (3) there is controversy among the profession concerning the value of the procedures; (4) the scientific literature documenting the costs, risks and benefits associated with their use is inconclusive; and (5) current uncertainties cannot be settled with current information. The clinical decision to use surgery (for all lens extractions and for most of prostatectomies) is made on the basis of expected improvement in the quality of life, rather than hope of lengthening life. Measurement of changes in the quality of life associated with use of these procedures provides an important challenge to health services research. Until this challenge is met, the benefits of the surgery and risks of untoward but non-fatal outcomes remain substantially undocumented. However, using Medicare Part B data linked to the national Medicare enrollment file (the HISKEW file), estimates of mortality associated with the use of the procedures can be made so that at least one important factor on the cost side of the cost-benefit ledger can be fixed.[37]

Medicare Part B claims data indicate a substantial increase over expected in mortality rates throughout the first year after surgery for patients who have undergone transurethral prostatectomy. For prostatectomies, surgery-associated deaths per capita were investigated in high- and low-surgery rate areas. Death rates were significantly

higher in populations with greater rates of surgery. The higher rates were related to higher case fatality rates as well as higher exposure to surgery. Similar analysis of individuals undergoing lens extraction does not appear to reflect increased mortality rates.

Data Sources

The Medicare Part B File used for this study contains a unit record for each claim processed for Maine residents between July, 1975 and September, 1977. The claims record contains the date and charges for each visit or procedure for which payment was made. Patient age, sex and date of death were merged into the claims unit records from the Medicare enrollment file. Date of death is current through October, 1977; 95% of claims records were successfully merged with the patient data. For this study, all patients who had a procedure between October 1, 1975, and September 30, 1976, were placed in a cohort to determine survival or date of death within 12 months after surgery.

The Medicare Enrollment File (HISKEW File) also contains information on all Maine enrollees, regardless of whether or not they receive Medicare services. In 1977, there were more than 100,000 enrollees in the file. This file was used to determine mortality rates for all enrollees to estimate the expected numbers of deaths in the study group. Unfortunately, date of death is coded as the last day in the month during which death occurred, so intervals between death and surgery took place are counted as first-month deaths, deaths in the second month as second-month deaths, etc. This leads to a net undercounting of deaths by reducing the annual risk period to fifty weeks of net risk.

Survivorship in Year Following Surgery

Transurethral Prostatectomies: Table 8.6 gives the number of procedures and deaths and the case fatality rate

for the one year follow-up period.

TABLE 8.6

PROSTATECTOMY DEATHS (TRANSURETHRAL)
WITHIN ONE YEAR OF SURGERY

Age	Number of Procedures	Number of Deaths	Percent Dead	Relative Risk*
65 - 69	165	18	10.9	3.7
70 - 74	211	21	10.0	2.2
75 - 79	152	22	14.5	2.2
80 - 84	124	20	16.1	1.7
85 - 89	51	11	21.6	1.5
90 - 99	25	8	32.0	1.4
All Ages	760	103	13.5	---

* $\frac{\text{Prostatectomy Death Rate}}{\text{Expected Death Rate}}$

In our cohort overall, 103, or 13.5%, of the patients undergoing prostatectomy died before the end of the year in which surgery occurred. In each five-year age group, over 65 years of age, 10% or more of patients did not survive the year. The last column in Table 8.6 gives the relative risk of death for prostatectomized males compared to all males within age groups. For the youngest group, the death rates are nearly four times that of all enrollees. (The risk is high throughout each quarter in the year following surgery.) For increasingly older age groups, the relative risk becomes less, so that the oldest age group appears to have a relative 1.5 times that of the control group.

Lens Extractions: In contrast to prostatectomized men, individuals undergoing lens extraction do not appear to experience increased risk of death after the initial period following surgery. On an age- and sex-specific basis there were no differences in mortality between those whose lenses were extracted and all Medicare patients.

Mortality Within One Year of Transurethral Prostatectomy in High and Low Rate Areas

To investigate the importance of variations in rate of surgery to variations in deaths per capita following surgery, the hospital service areas of Maine were ranked according to rate of prostatectomy per capita and grouped into two larger populations, one with higher than average and one with lower than average rates of surgery. For each of the two grouped areas, prostatectomy procedure rates and death rates were calculated. The results are in Table 8.7. The high rate area had substantially (and statistically significant) higher rates for procedures and for

TABLE 8.7

MORTALITY WITHIN ONE YEAR OF SURGERY IN HIGH AND LOW RATES AREAS

High Area	Number of Cases (1)	Number of Deaths (2)	Population (3)	Deaths Per 1,000 Enrollees (2 ÷ 3)	Deaths Per 100 Cases (2 ÷ 1)	Procedures Per 1,000 Enrollees (1 ÷ 3)
Age: 65-74	208	23	15834 (63.2)	1.45	11.06	14.5
75-84	144	26	7466 (29.8)	3.48	18.06	19.3
85+	35	8	1757 (7.0)	4.55	22.86	19.9
All Ages	387	57	25057 (100.0)	2.27	14.73	15.4
Low Area						
Age: 65-74	95	11	12824 (63.1)	.86	11.58	7.4
75-84	81	9	5984 (29.5)	1.50	11.11	13.5
85+	26	5	1487 (7.4)	3.34	19.23	17.5
All Ages	202	25	20295 (100.0)	1.23	12.38	9.9

deaths per capita. The elevations were seen in each age group. The rate of deaths following surgery (the case fatality rate) was also higher for cases performed on residents in the high rate area, but the difference was not statistically significant.

Using standardized mortality ratios for each component in the "medical care equation", the results of the evaluation (for all age groups) can be summarized as follows:

DEATHS per capita		=	Deaths per case	X	procedures per capita
High Area:	1.26	=	1.06	X	1.19
Low Area:	0.68	=	0.89	X	0.77

The relationship between procedures per capita and deaths per case as determinants of deaths per capita is multiplicative, and the relative contribution can be readily seen from the above. In the high area, the numbers of deaths exceed that predicted by the experience of all areas by 26%; this increase resulted from a 19% higher procedure rate and a 6% higher case-fatality rate. By contrast, in the low-rate area deaths per capita were 68% of the number predicted; this was because of both lower procedure rates (77% of predicted) and lower case-fatality rates (89% of predicted). The age structure of the populations are similar, so the summary estimates are not biased significantly by age difference. Although the difference in case-fatality rates was not significant, it suggests that criteria for selecting cases in the high-rate area result in a cohort of patients which, overall, may be at slightly higher risk than the cohort selected for operation in the low-rate area.

Comments

Lens extractions and prostatectomies are examples of procedures which demonstrate a relatively high degree of

variation in the use rates among geographically defined populations. International comparisons show rates in the United States to be much higher than in the United Kingdom or in Norway. Studies comparing Canadian provinces, New England States and (as shown in Chapters V and VI) neighboring communities defined by use of local hospitals also demonstrate differences in rates. Typically, high variation (high discretion) procedures are those in which "need" is not clear and is certainly not a yes-or-no (dichotomous) situation; for these procedures there is often considerable controversy as to the circumstances under which the procedure should be used. This appears to be the case for lens extraction. The expanding rate of use of lens extraction is coming under criticism from some ophthalmologists, particularly Jaffee,[38] who calls for reconsideration of the indications (cataracts are often present, but do they need an operation?) and for reevaluation of the evidence about outcome, particularly the possibility that the objective improvement in vision is not matched by subjective improvement in the "quality of life." For benign hypertrophy of the prostate (the main reason for doing transurethral prostatectomies), the major symptom is difficulty in voiding, and determination of need has a highly subjective component. Although there has been less public controversy concerning the value of this procedure, doubts and reservations are being expressed privately by some urologists about when the procedure should be used.

By providing quantitative estimates of the probabilities of surviving surgery over variable time periods, MCE outcome studies based on Medicare Part B data can contribute significant information to the controversies associated with the use of medical care. For females 65 years of age and older in this country, lens extraction for cataract is the most commonly performed surgical procedure. In 1965, 60,000 lens extractions were performed. By 1975, the number

had increased 122% to 132,000.[35] Although the numbers of deaths available for study in this report are small, the results indicate that the population selected for intervention in 1975 in Maine did not have an associated increase in risk of death in the year following surgery. At least for this population, the risks associated with the procedure are mostly those that occur around the time of surgery. The "trade-off" of expected life for gains in the quality of life--whatever they may prove to be--appears to be small.

For males over 65 years of age, prostatectomy is the most common surgical procedure: in 1965, 191,000 prostatectomies were performed on American males; by 1975, the number had increased 39% to 266,000.[35] The data indicate a substantial increase in risk of death in the months following prostatectomy. The increase in risk is greatest for the youngest age group (ages 65-69) for whom the relative risk in the year after surgery is nearly four times the expected rates. Among this group, nearly 11% of those undergoing prostatectomy were dead by the end of the first year. Throughout all age groups, the relative risk of death was greater than for controls. Although some of these procedures may have been done to palliate late stages of prostatic cancer, that does not seem a reasonable way to account for the number of deaths. Rather, the results suggest that the loss in expected life "bargained" against the quality of life return may be considerably larger than that predicted by immediate case fatality rates. Populations with higher rates of exposure have higher death rates in the year following surgery. Further investigation into the mortal and non-mortal outcomes of this increasingly used procedure seems warranted.

SUMMARY AND CONCLUSIONS

Data based on uniform hospital discharge abstracts and claims data systems can produce information that should increase the effectiveness of PSROs. For concurrent review, area profiles can be developed to target review in areas where the likelihood is high that debatable care is being undertaken. Provider-area-patient profiles can be developed for ambulatory care as well as hospital care, and can detail the contributions of individual institutions and physicians to the aggregate population-based rate. To improve the efficiency of PSRO, we recommend that a target review strategy be tested using population-based data. For Medical Care Evaluation Studies, claims data can be particularly useful because medical and surgical events are recorded in greater detail than in the uniform hospital discharge abstract. Further, reimbursement and charge data can be related to utilization. We therefore recommend more extensive use of claims data in the development of Medical Care Evaluations.

Claims data can also serve as a basis for more extensive evaluation of survival after medical or surgical interventions than has been possible previously. This use of claims data should have top priority. We illustrated its potential in this chapter by a study of one-year survival after transurethral prostatectomy and lens extraction, using Medicare Part B data which were linked to the Medicare enrollment file. With this data on the over-65 population, detailed life tables on post-surgical survival can be developed for the United States by linking the data to death records and to the MEDPAR data, more detailed life tables stratified by cause of admission (during which surgery occurred) and/or cause of death can be developed. We recommend this be done as a means for reducing uncertainty concerning the outcome of common medical and surgical interventions.

CHAPTER IX

EVALUATING THE OUTCOME OF PUBLIC INTERVENTIONS IN HEALTH CARE MARKETS

This chapter explores the use of population-based data to evaluate the outcome of government programs with reference to their public policy objectives. Two broad types of programs are considered. Programs designed to regulate the industry in order to make it perform more effectively or efficiently are discussed first. The examples chosen for review are rate-setting and Certificate of Need in Rhode Island, and PSRO concurrent review in Maine. Programs which promote the more equitable distribution of health care (presumably, according to need) by providing disadvantaged groups with financial access to services they otherwise could not afford are then considered. The example selected is the Medicaid program in Vermont. The chapter concentrates on programs in Maine, Rhode Island and Vermont because their extensive data permit retrospective review of changes that occurred after the programs went into effect.

While nearly all of the New England States have rather liberal Medicaid programs, the number and stringency of hospital regulatory programs varies widely. Generally, the southern New England States reacted to the major economic burdens of Medicaid by moving to contain hospital costs through rate-setting and Certificate of Need (CON) programs before the enactment of PL 93-641 in 1975. On the other hand, until quite recently, northern New England States have perceived hospital cost increases as a far less serious problem. Vermont, Maine and Rhode Island have different approaches to regulation. Vermont, until very recently a non-interventionist State, operated a liberal Section 1122 Review Program from 1974 to 1977, and no rate-setting or CON program operated during the period of this study--1969 to 1977. PSRO delegated review was

phased in beginning in 1977: Four hospitals began review in the second quarter of that year, and seven more were added by the end of 1977. Five hospitals did not commence concurrent review until 1978.

On the other end of the regulatory spectrum, Rhode Island was one of the earliest adopters of CON (1968) and rate-setting (1971). Both programs are considered among the most stringent in the country. The first three Rhode Island hospitals to undertake PSRO concurrent review began in June, October and November of 1976. All but three Rhode Island hospitals had at least five months of PSRO review during 1977.

Maine falls somewhere in the middle. The implementation of PL 93-641 in Maine strengthened the hand of those State officials favoring more stringent hospital controls. Our studies of the decision-making process under Maine's Section 1122 review program show a dramatic increase in stringency of review of acute hospital projects after 1975. The Maine PSRO had implemented concurrent review in all major Maine hospitals by the end of 1976.

THE POTENTIAL IMPACT OF SPECIFIC HOSPITAL REGULATORY PROGRAMS

Relating observed changes in hospital use patterns to the regulatory milieu of a state is a complex matter. It is useful at the outset to develop a set of program-specific predictors of potential changes in hospital use and expenditures which might be expected under optimal conditions.

The hospital regulatory program which could most directly and rapidly impact on hospital use rates is the <u>concurrent review portion of the PSRO program</u>. Assuming a high rate of unneeded hospital bed use in a given area, a stringent concurrent review program could reduce rates of use for Medicare and Medicaid patients. In the three study States only Maine had operational concurrent review in all hospitals for at least

one year during the period of observation.

Facilities review programs (CON and Section 1122 Review) would be expected to have a more indirect, and obviously much slower, influence on hospital use rates. Approval of hospital expansion programs would be predicted to result in increased hospital use rates and expenditures per capita. As we demonstrated in Chapter VI using Vermont data, in certain cases changes in utilization and expenditures per capita could be related to hospital construction projects when longer range trend data were available. Several years usually elapse between the approval of a hospital bed expansion project and the opening of the additional beds, so that the predicted impact on use rates will be observed several years after the CON or 1122 decision. Hospital expenditure rates, on the other hand, can be directly influenced by CON and 1122 programs, since the approval of any project will be translated into increased hospital per diem rates and reflected in the local (and state) per-capita figures. Stringent facilities review programs, which denied or discouraged applications to increase bed complements, would not be expected to affect directly existing hospital use rates; the potential impact of such programs could only be assessed by comparison between such a restricted area and a set of appropriate control areas where the number of hospital beds was increased. Rhode Island, which first put its CON law into effect in 1969, had no major construction projects in the 1970s.

Hospital rate-setting programs have potential impact on hospital bed use and costs. By limiting annual hospital budget increases, rate-setting programs can significantly contain the increase in per-capita expenditures for hospital services. This impact should be rapid and direct, measured in a reduction in rate of annual increase in per-capita expenditures.

What outcome criteria should be adopted to evaluate the impact of regulatory programs?

Although the PSRO program, hospital rate setting and Certificate of Need laws each have different regulatory targets--the first concerned with improving clinical decision-making, the second constraining global budgets and the third assuring that beds are built only if needed--the programs affect the system in similar ways. First, if successful, each will result in cost containment. Second, each program is responsible for decisions that impact directly on the use of resources in specific communities. In executing mandates to contain costs or control the distribution of resources, the programs can be evaluated with regard to their impact on (1) cost containment within their jurisdiction and (2) the distribution of resources of services among the communities of the region.

The impact on cost containment can be measured by historical trend analysis which relates the implementation of the program to changes in trends in hospitalization or expenditure rates (while controlling for non-program effects). The criterion for a successful program would be a reduction in rates as compared to their baseline values or to some targeted goal. For example, in the case of PSRO the evaluation question is: Does implementation of concurrent review lead to a reduction in patient days of care for the target population?

The impact on the distribution of services can be measured by a historical analysis which compares cross-sectional variations in rates of use of hospitals among community populations before and after the implementation of the program. The criterion for successful outcome would be a narrowing of the variations which relate to the explicit or implied objectives of the program. For example, in the case of PSRO, the issue is whether the application on a region-wide basis of standards and guide-

lines for care results in more uniformity in clinical decision-making after implementation than existed before implementation. In particular, do admissions which show high variation in per-capita rates show reduced variation which can be related to the application of standards and guidelines?

This chapter gives four examples of efforts to use small area data for the evaluation of public programs. The first is Hospital Rate Setting in Rhode Island; the second is Certificate of Need legislation in Rhode Island; the third is concurrent review under PSRO in Maine; the fourth is Medicaid in Vermont. A final section deals with the limitations--and potential advantages--of small-area techniques for the purposes explored in this chapter in an effort to avoid false interpretations because of confounding variables.

EVALUATION OF PROSPECTIVE REIMBURSEMENT IN RHODE ISLAND

Program History and Structure

In 1969, for the third consecutive year, Blue Cross of Rhode Island requested a substantial premium increase. The Director of Business Regulation refused to grant the request in full, ordering Blue Cross and the hospitals to restructure the reimbursement system to include cost-saving incentives. The result was a system of prospective rate-setting with incentive payments, referred to as prospective reimbursement. Beginning in 1970, Blue Cross established an agreement whereby all hospitals guaranteed to live within a budget which was lower than the requested 18% rate increase. At the same time a pilot prospective rate-setting experiment was carried out with the state's largest hospital. The next year, all hospitals participated in a full experiment which included cost-saving incentives. In 1972 it became administratively difficult to synchronize the prospective reimbursement experiment with the Economic Stabilization Program so the experiment was suspended.

The two-year program was evaluated by the Rhode Island Health Services Research (SEARCH) under a contract with the Social Security Administration. While empirical data would not support a conclusion that prospective reimbursement alone reduced the rate of hospital cost inflation, SEARCH concluded that the combination of prospective reimbursement with wage and price controls had held down costs relative to some other States.

A second experiment, begun in 1974 after the end of the economic stabilization program, was conducted under contract with the Social Security Administration under the provisions of Section 222 of PL 92-603. As in the earlier experiment, participants included Blue Cross, the State Budget Office (representing the interests of the State as a third party payor through Medicaid and Title V), all 16 of the State's voluntary hospitals and the Hospital Association.

The most significant feature of this current Rhode Island Program is the statewide Maxicap. The idea, born during the period of wage and price controls, stemmed from the fear that across-the-board controls were too inflexible, but that outside limits might still protect the insurers and provide some opportunities for purchases of equipment or service expansion if needed.

The Maxicap each year limits aggregate gross operating expenses for all voluntary hospitals. Excluded from controls are expenses associated with professional components (e.g., Medicare Part B) and activities financed by grants and contracts.

It must be stressed that the Maxicap is not a target for expenses, but a ceiling within which hospital budgets are negotiated with a reserve maintained for unforeseen expenses. Its purpose is to "cap" hospital operating expenses statewide for each year. This does not mean that each hospital is given an across-the-board increase up to the Maxicap. The parties

are free to negotiate individual hospital budgets above and below the limit of the cap. However, in the aggregate when budget negotiations are complete, the Maxicap should not be exceeded. While the goal is to place a ceiling on total expenses, the process allows for recognition of problems, program development and unusual circumstances at a given hospital.

After the Maxicap has been determined, each hospital negotiates its budget on an individual base. Negotiations for each hospital involve one or more sessions. Often at the first session the third party payors ask quesions that have surfaced during the budget review and are of particular concern. They summarize their position in such terms as the economic environment and the proposals of the other hospitals. The third parties then make a proposal of a bottom line figure they consider fair. At this or a subsequent session the hospital will make a counter offer, each side will again present arguments in favor of its case and the issues will be resolved. If negotiations prove fruitless the budget may be submitted to arbitration. Over the years the system has been improved so that by FY 1976-1977 more than 75% of the budgets were agreed upon in one meeting.

After completion of budget negotiations, rates are set for each hospital by processing each budget through an acceptable cost-finding procedure. Rates for Blue Cross, Medicare and Medicaid are derived from total costs according to each purchaser's principles of reimbursement. Since for each of these cases the allowable rate is lower than a hospital's actual costs, self-pay patients and commercial insurers are charged at a rate greater than cost to make up the difference. The relationship between cost and charge is expressed as the ratio of costs to charges which Medicaid and Blue Cross guarantee prospectively for one year.

The hospital in turn guarantees not to exceed these charges with certain exceptions.

<u>Program Outcome: Aggregate Containment of Costs</u>

Has the program contained costs within the targeted budget? Since the target expenditure rate for all hospitals is set administratively, and exceptions are negotiated according to prearranged protocol, one indicator of outcome related to cost containment is the degree to which the hospitals, through their collective behavior, achieve the goal that was agreed upon. Table 9.1 was developed as evidence of the success of the program. As the table indicates, the rate of inflation has been

TABLE 9.1

TOTAL OPERATING EXPENSES OF RHODE ISLAND HOSPITALS
BY FISCAL YEAR (FY) 1975-1978

Orig. Maxicap Increment	13.85%	11.5%	10.5%	10.42%
Est. Adjusted Maxicap	14.3%	12.44%	11.03%	10.42%
Est. Adjusted Maxicap $	$200,148,775	$225,056,397	$249,958,387	$276,004,051
Est. Expend. Under Retrospective System	$203,442,298	$231,678,166	$253,672,121	$283,134,579
Est. Savings Prospective vs Retrospective	$ 3,293,523	$ 6,621,769	$ 3,713,734	$ 7,130,528
Est. Medicaid Savings-8.5% Participation	$ 279,949	$ 562,850	$ 315,667	$ 606,095

Source: Request for Approval of the Prospective Reimbursement Program in the State of Rhode Island under Section 232 of P.L. 92-603. August 1977. Budget Office, State of Rhode Island.

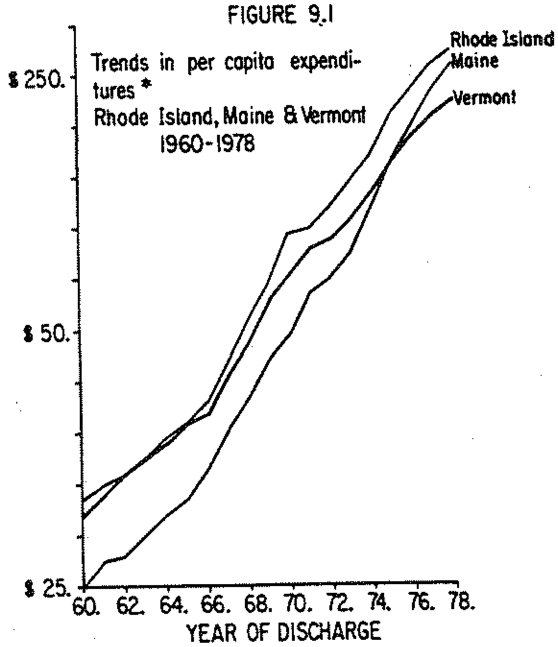
Note: The Operating Expenses in this Table include both inpatient and outpatient expenses. In addition to the acute care general hospitals, two psychiatric hospitals are also included in these figures.

reduced in comparison to the previous years (and in comparison to the national rate of growth); the use of the exception mechanisms is less frequent in later years (e.g., the original Maxicap increment is, in 1978, identical with the adjusted

Maxicap; prior to 1978 the Maxicap had been adjusted upward each year because of allowed exceptions).

However, even though the circumstantial evidence is supportive, it is difficult to isolate the impact of rate-setting on hospital cost inflation, since in all cases rate-setting is but one of a set of regulatory programs aimed at hospital cost containment and but one of several sets of circumstances that impact on hospital costs. Another approach to cost containment impact analysis would consider comparisons of change in hospital expenditures among States in light of the total hospital regulatory constellation within individual States. For purposes of reference it is useful to consider currently available data on recent increases in hospital revenues in Maine, Rhode Island and Vermont; each of which has a different regulatory environment. Figure 9.1 gives the annual per-capita expenditures (on a logarithmic scale) for non-governmental acute care hospitals from 1960 to 1978.

FIGURE 9.1



*Semi-logarithm scale

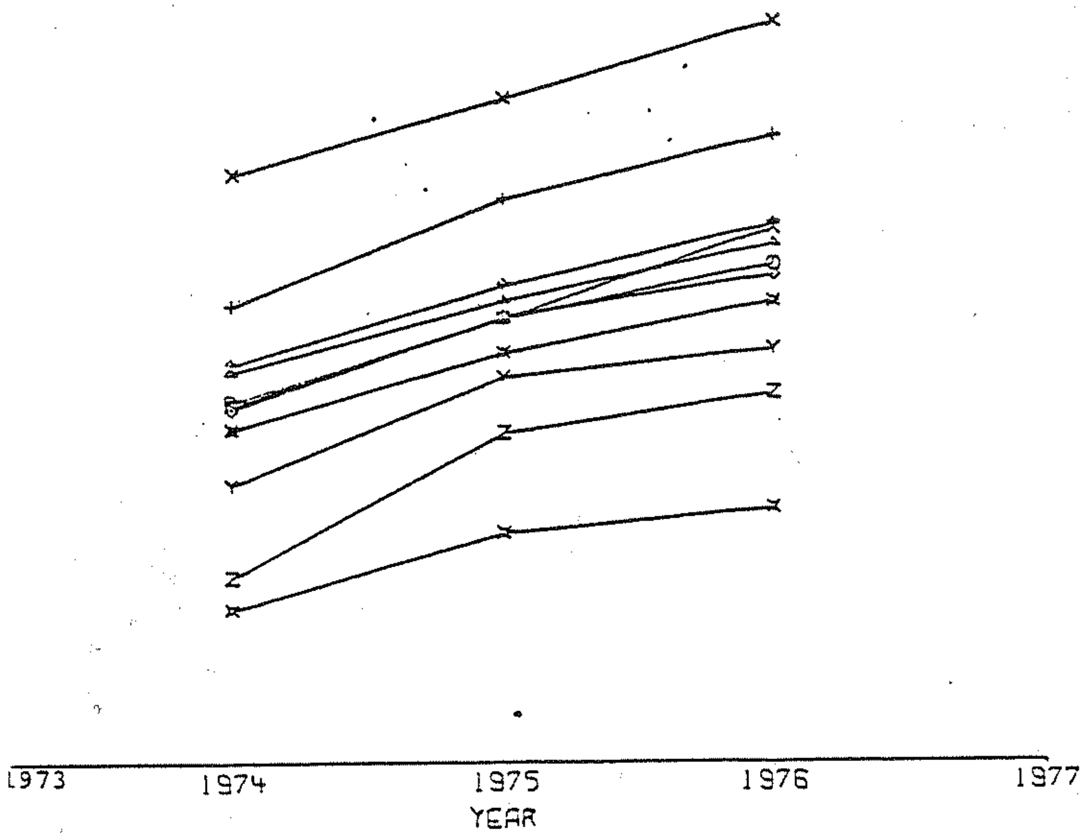
The figure shows that the rate of increase in per-capita hospital revenues has slowed in Rhode Island in the 1970s. Between 1967 and 1972, the average annual percent increase (as estimated by the regression coefficient) was 16.7%. In the period 1973-1978, the rate of increase dropped to 13.1%. In contrast, in Maine the rate of increase in per-capita hospital revenues continued at a high rate. From 1967 to 1972, the average annual increase was 15.2%; during the 1973-1978 period it was 17.5%. However, increases in the State of Vermont, where no budget regulation has occurred, appear to parallel the rate of increases observed in Rhode Island: During the 1967-1972 period, the increase was an average of 1.46% per annum. During 1973-1978, the rate was 11.7% per annum, the lowest of any of the three New England States.

The data suggest that the Rhode Island program has had an impact on containing overall costs. But what about the impact of the program on variation in area expenditure rates and the implied income transfers? Figure 9.2 shows the trends in expenditure rates among hospital service areas. It is apparent that the rate-setting process is having no impact (as are other regulatory strategies such as PSRO and Facilities Planning) on the relative distribution of expenditures within the State. Any relative decline in growth of expenditures in 1975-1976 is as likely in a low per-capita area as in a high per-capita area. Increases in the highest areas are not retarded by the regulatory strategy.

The reasons why such variations persist is not difficult to identify. In the negotiation process covering the individual hospital's budget, data on costs per capita within areas served by the individual hospitals have not been used; further, the individual hospital do not know the relative impacts they have on the populations they serve. The negotiation process goes on independently of this indicator of health systems performance. The strategies for cost containment based on Maxicaps that do

FIGURE 9.2

TRENDS IN PER CAPITA HOSPITAL EXPENDITURES IN RHODE ISLAND'S LARGEST HOSPITAL AREAS (1974–1976)



not take into account historical variations in expenditure patterns among the communities. In the course of such decisions, regulators commit local markets to maintain their relative expenditure levels, converting what were historically determined inequalities into inequalities based, de facto, on public policy. As we suggested in Chapter VII, under such a policy there can be no rationale for continuing to charge equal insurance premiums without regard to market location of the payee. If the public regulates the distribution of dollars to populations through budget review of hospitals, it cannot, rationally, disengage this regulatory function from the price that public policy determines should be charged for private health insurance or from the amount of tax that individuals must pay for public health insurance.

CERTIFICATE OF NEED LAW IN RHODE ISLAND

Historical data prior to the initiation of the Certificate of Need Law in Rhode Island is not available, so that trend analyses cannot be performed. However, the cross-sectional data for 1974-1977 provide some information about impact on this program. Compared to Vermont and Maine, there are fewer beds per capita in Rhode Island. For example, in 1975 the State rate for Maine is 4.2 per 1,000 and for Vermont it is 4.6 per 1,000; this compares to a rate of 3.4 for Rhode Island. A general conclusion might be that hospital regulation in Rhode Island has been successful in limiting bed expansion compared with the more laissez faire approach of the other two States. However, other factors have played a historic role in determining hospital bed capacity in Maine and Vermont, e.g., the population dispersion over their relatively larger land masses. Under the Hill-Burton program, many small communities in these states-built hospitals; over two-thirds of these facilities have 100 or fewer beds.

The small-area data provide three insights into the impact of CON. First, as is the case for budget review, administration

of the Certificate of Need law has not taken into account the large variations in allocated resource rates among areas, so that the pattern of variation in allocated beds per capita in Rhode Island is similar to those in the less regulated States. This is apparent in Table 5.1 (Page 74).

Second, based on inferences from the cross-sectional data, the impact of bed limitation in Rhode Island appears to be mainly on medical admissions: Surgical admission rates are about equal to those in Maine and Vermont and the pattern of intra-state variations is substantially similar. By contrast, most medical admissions have lower rates in Rhode Island. However, there are variations in medical admissions so that the impact of limiting bed supply within the range attempted in Rhode Island does not include reduction of variations. These phenomena were explored in Chapter V, page 81. Third, the relatively high hospital employment per capita (see Chapter VI) exists in spite of Certificate of Need and lower number of beds per capita. Although the data are subject to multiple interpretations, the associations suggest that attempts to control costs through limitation of beds per capita (at least within the range seen in Rhode Island) has not had much impact on costs: The effect on clinical decision-making appears to be to reduce admissions of the medical but not of the (higher cost) surgical cases.

EVALUATION OF PSRO CONCURRENT REVIEW

The evaluation method[40] explored in this section speaks directly to two topics of central importance to PSRO:

<u>The Cost Containment Goal</u> - Has the application of PSRO concurrent review been associated with a decrease in the upward trend in utilization among populations whose care is supported by Federal programs (Medicare)?

<u>Quality Assurance Goal</u> - Has the application of PSRO stan-

dards and criteria promoted greater uniformity in medical practice resulting in a reduction of the variance in clinical management practices among populations whose care is supported by Federal programs?

Background

Historically, quality assurance and the reduction of unnecessary care have been given different emphasis and attention within PSRO. Physicians tend to emphasize quality assurance and government officials, particularly those concerned with the administration of the Medicare and Medicaid programs, tend to emphasize cost containment. Although they diverge in emphasis, the advocates of cost-containment and the advocates of quality assurance roles for PSRO began from a common set of assumptions: They assumed an underlying professional consensus on what comprises appropriate diagnosis and appropriate treatment. In other words, it was assumed that given the proper opportunity to develop and administer standards and criteria, medicine and surgery could be practiced so as to assure that similar patients (similar with regard to condition and other attributes relevant to risk and need) would have reasonably uniform probabilities of receiving an equally efficacious treatment. The disagreement was (and is) on whether or not this would cost more or cost less.

In recent years it has become apparent that the end-results rationality of medical practices may be a good deal more modest than generally assumed.[41-43] The importance of controlled clinical trials in establishing the validity and limits of the claims of effectiveness of common medical practices is becoming more widely appreciated, and physicians, policy makers and, to some degree, the general public have become more acutely aware of the uncertainty that underlies much of medical practice. It may no longer be reasonable to assume that on the basis of existing professional knowledge, clinical standards and criteria can be broadly established so as to assure generally that necessary

medical care is promoted (and unnecessary care discouraged), at least if, by necessary care, we mean medical care that has a predictable beneficial impact on end results.

As we indicated in Chapter V, doubts concerning the utility of professional consensus as a means for establishing useful standards governing the common practices of medicine have been raised by accumulating evidence concerning the nature and extent of geographic variations in use of medical services among neighboring populations. Epidemiologic data, in large part from Vermont and Maine--the States in which the evaluation reported here takes place--show puzzling differences in rates of use of medical care among neighboring communities that cannot be attributed to differences in population morbidity, access to care or ability or willingness of consumers to use medical services. The variations have been taken by some as evidence of large scale unnecessary medical care and for the need for more effective application of professional standards and criteria. On the other hand, the variations have--at least for some examples of care--been defended on the basis of professional uncertainty: Since no one knows for certain what the end-result implications are, then the application of standards and criteria will do nothing more than promote homogeneous behavior, driving utilization toward some arbitrary average rate that has nothing to do with the optimum allocation of health resources.

While the evaluation methodology for the PSRO program used here will not contribute directly to this debate on the appropriateness of standards and criteria, it does offer an objective means for estimating their effectiveness (regardless of value) in changing patterns of clinical decision-making. The means for this assessment is simply to compare pre- and post- review variations in use of the hospital among populations for those specific conditions and procedures for which standards and criteria have been established. If the standards and criteria are successful

in promoting more uniform professional behavior, then some reduction in the degree of variation in clinical management practices should become apparent.

Pre- and Post-Delegation Trends in Utilization

To determine the association between PSRO concurrent review and trends in utilization, we examined the principal utilization indicators--patient days per capita, admissions per capita, and average length of stay--in 24 Maine hospital areas before and after the start of review by the hospitals in each area. The 24 areas are all areas of 10,000 population or more with at least one full year of concurrent PSRO review. We found no evidence that PSRO concurrent review leads to cost saving through reduction in aggregate demand for hospital care in the 24 study areas: Total utilization among the Medicare population, estimated by the patient days per 10,000 for patients 65 years and older, increased after review in the majority of study populations.

The results are summarized in Table 9.2. The increase in patient days per 10,000 among the population 65 years of age and older occurred in 15 of the 24 study areas. In 20 of the 24 study areas, the rate of admissions was observed to increase, while declines in average length of stay were recorded in 17 areas. Thus, in the equation:

Patient day rate = Admission rate x Average length of stay

the admission increase was generally more important than the length of stay decline, leading to a net increase in per-capita bed use in the majority of areas.

In an attempt to control for confounding variables, we developed an analysis using areas with no history of concurrent review during the study period as controls. The methods used were similar to those used in the Health Care Finance Administration's

TABLE 9.2

SUMMARY OF POST-DELEGATION VERSUS PRE-DELEGATION
INDICATORS OF HOSPITAL USE FOR POPULATION
AGED 65 AND OVER
24 MAINE HOSPITAL AREAS, 1973-1977

	Ratios of Post-Delegation to Pre-Delegation				
Area	Admission Rate	x	Average Length of Stay	=	Patient Day Rate
Area 1	1.096		.924		1.013
Area 2	1.226		.935		1.146
Area 3	1.024		1.063		1.086
Area 4	1.045		.872		.907
Area 5	1.021		.978		1.001
Area 6	1.010		.982		.995
Area 7	1.055		.966		1.015
Area 8	1.063		.930		.986
Area 9	.977		1.003		.979
Area 10	.979		.829		.811
Area 11	1.049		1.027		1.076
Area 12	1.117		.805		.899
Area 13	1.280		.997		1.266
Area 14	1.221		.865		1.063
Area 15	1.329		.945		1.260
Area 16	.938		.819		.765
Area 17	1.058		.986		1.042
Area 18	.956		1.060		1.009
Area 19	1.129		1.028		1.160
Area 20	1.097		.955		1.046
Area 21	1.180		1.068		1.263
Area 22	1.066		.939		.999
Area 23	1.038		.929		.965
Area 24	1.179		1.017		1.202

Office of Policy, Planning and Research (OPPR) study, except that the OPPR study was based on PSRO area-wide rates and our study was based on hospital service areas in Northern New England.[40] Our results detected no program effect: Patient day rates in most control areas and in areas with concurrent review increased during the study period; and areas with PSRO concurrent review were not different in behavior from control areas.

PSRO Impact on Cross-Sectional Variations in Utilization

Before PSRO standards and guidelines were adopted, there were wide differences among hospital service areas in rate of use of specific types of care (see Chapter V). Those differences included admission rates, average lengths of stay and patient day rates. After concurrent review, are norms adopted which decrease variation? Such a result would imply that the

imposition of clinical standards and criteria can change decision-making strategies and lead to greater uniformity in practice. Indeed, such a proposition is an implicit assumption behind the concept of standards and criteria. If they do not lead to change in practice patterns toward standardization, then it could be asserted that either (a) the standards and criteria are, themselves, sufficiently lax or ambiguous to be compatible with most examples of current behavior or (b) the assumption behind the activity--namely, that acknowledge and endorsed standards and criteria can affect behavior--is incorrect. Under (b) the concept of standardization would be viewed as incomplete, and under (a) the execution is incomplete.

Whatever the interpretation, our study of the patterns of variation in pre- and post-delegation periods does not indicate that PSRO standards reduce historical patterns of variation that exist among communities. Wide variations in per-capita rates of patient days, average length of stay and admissions per capita were observed both before and after concurrent review and there was no reduction in variation associated with the review. Table 9.3 reviews the data for all conditions and for common surgical procedures.

The short period of followup between the beginning of concurrent review and the measurement of impact clearly limits the interpretation of our results. Perhaps, with more time. an impact will be shown. In any case, the approach is an example of how the objectives of a regulatory program can be translated into statistical indicators that permit quantitative assessment of the degree to which the outcome objectives are reached. If the PSRO program, through repeated analyses such as these, is found to have no consistent impact on rates of increase in utilization or on measures of the distribution of high-variation procedures among populations, then the methods used by the program for concurrent review should be re-evaluated. Indeed, we believe

TABLE 9.3

SUMMARY: VARIATIONS IN POPULATION-BASED INDICATORS OF HOSPITAL UTILIZATION FOR PERSONS AGED 65 AND OVER IN MAINE BEFORE AND AFTER PSRO DELEGATED REVIEW.

Type of Admission	Coefficient of Variation Before	Coefficient of Variation After	Range: High/Low Before	Range: High/Low After	Range: 2^o High/2^o Low Before	Range: 2^o High/2^o Low After
All Conditions+						
Patient Days Per Capita*	.202	.202	2.16	2.15	2.02	1.97
Admissions Per Capita*	.189	.218	1.83	2.15	1.66	1.86
Average Length of Stay	.095	.099	1.49	1.39	1.31	1.36
Lens Extraction°						
Patient Days Per Capita	.370	.430	3.65	4.21	2.04	2.85
Admissions Per Capita	.311	.266	2.66	2.41	1.90	1.61
Average Length of Stay	.346	.348	2.46	2.91	2.12	1.65
Hernia Repair°						
Patient Days Per Capita	.212	.265	1.92	2.41	1.56	1.49
Admissions Per Capita	.243	.277	2.12	1.86	1.60	1.77
Average Length of Stay	.138	.192	1.58	1.73	1.32	1.57
Cholecystectomy°						
Patient Days Per Capita	.273	.333	2.25	3.38	1.84	1.82
Admissions Per Capita	.163	.214	1.60	2.37	1.39	1.26
Average Length of Stay	.162	.201	1.63	1.88	1.36	1.54
Prostatectomy°						
Patient Days Per Capita	.259	.315	2.64	3.87	1.44	1.58
Admissions Per Capita	.241	.289	1.94	3.76	1.41	1.47
Average Length of Stay	.188	.141	1.90	1.43	1.50	1.39

*Rates Per 10,000 Persons Aged 65 Years and Over   +24 Areas   °Areas Per 100,000

a review procedure that focuses review on cases in areas that are significantly higher than the regional average offers promise for reducing variations and containing costs and should be tested (using the outcome criteria suggested here) as soon as possible.

MEDICAID IN VERMONT

A number of studies have been undertaken to evaluate the impact of the Medicaid program on the use of health care by

the poor. The results generally show that poverty status is no longer associated with low use rates: Access to physicians and physician visits among those eligible for the program rose to equal or exceed the rates for the non-poor and rates of hospitalization were higher. This has been interpreted to indicate the success of the program and as an indicator of greater social equity. The data used in most assessments of the program are based on household interviews of samples representative of a national or large regional geographic area. Because the sample frame for these studies extends across many medical markets, they measure the average impact on utilization of large numbers of suppliers. The reference of the evaluation thus concerns longitudinal (before and after) trends in overall use rates with the system. The impact of distributional differences among specific types of services (e.g., tonsillectomies) is not investigated in such evaluations.

An evaluation that includes the impact of Medicaid on the use of specific services, we argue, is a more precise indicator for interpreting equity because it corresponds more closely to the social philosophy that guides most perceptions of a just distribution of a valued good; namely, that need exists and that there is a strategy that will see to it that the resources are allocated according to some priority schedule that ranks need and uses resources until either need is met or resources exhausted.

The following analysis demonstrates how data based on the UHDDS and household interview surveys can be combined to compare differences among local markets to give a different picture of equity than is obtained when larger-area data are used. The hypotheses concerning the cause of variation advanced in Chapters V and VI predict that, when the level of analysis is disaggregated and the terms of analysis include a detailed description of case mix, like populations will undergo different types of treatment, based on community of residence (which predicts,

more or less, which local health care system is used). We find, as expected, that the poor achieve access to care about equal to the non-poor and that, between markets, there are no differences among the poor with regard to rates of contact with the system. The differences come after contact and the profiles of service use are such that it is difficult to interpret the equity impact of the program within the more rigorous view of the nature of a just distribution.

A few examples of the variations in rates of use of service will make the point. In the year in which the survey was undertaken (1973), rates for tonsillectomy among hospital areas in Vermont varied significantly ($p < .05$) for the populations eligible for Medicaid. In one area, the rate was two times the average; in another the rate was less than 30% of average. Hysterectomies (among Medicaid-eligible women under 35 years of age) varied from 25% to 200% of the average. Dilation and curenttage showed a similar pattern. Only pediatric inguinal hernia procedures demonstrated no variation. The statistical evidence indicates that the distribution of this procedure is equitable among the Medicaid populations. Further, rates between Medicaid-eligible and above-poverty populations for this procedure appear comparable.

Two conclusions are suggested. First, equity conceived as the just distribution of valued goods does not exist in a precise manner, and equity in the use of health services among the poor has not been broadly achieved through Medicaid. For low discretionary procedures, equality does appear to exist. But for discretionary services, the poor experience the same diversity as the non-poor and medical care experiences by groups of the poor is too heterogenous to permit tight conclusions concerning equity. Second, equity so conceived cannot exist under current circumstances because of the underlying imperfections in professional knowledge concerning end results or imperfections in professional decision-making. In evaluating social policy impact on the health care system, we should not conceive the principles of equity separately

from the principles of effectiveness of services.

ON THE PROBLEMS OF INTERPRETING CHANGES

The material presented in preceding sections demonstrates some of the complexity of interpreting change and variation in hospital use rates. Many factors outside of formal hospital regulatory programs can be shown to influence the pattern of hospital use.

Changes in the state-of-the-art of medical practice, unrelated to PSRO or other regulatory programs, have substantial impact on the trends in hospital use rates. The recent example of the increasing disfavor of certain common surgical procedures, particularly tonsillectomies, among physicians has had a substantial impact on hospital use rates in Vermont and Rhode Island where no PSRO program operated during the study period.

Legal interventions in the health delivery system also can have dramatic impact on hospital use rates as witnessed by the legalization of abortion. The D&C rate is a significant contributor to the overall hospital admission rate, and variations in local preference for ambulatory abortion and/or D&C have a measurable impact on hospital use statistics.

Still another important consideration for interpreting change in hospital use patterns emerges from the Vermont data where age-specific hospital use rates varied considerably over time. In that State overall hospital bed-use patterns were not linked to any regulatory intervention.

At the local level we have described examples of changes in hospital use patterns which remain unexplained by considerations of resource input changes or regulatory interventions (Chapter V).

As we indicated, the most likely cause of the overall decline in hospital expenditures in Vermont (which in the 1970s showed the lowest growth in per-capita expenditures of all of the New England States) is the consolidation of hospital management

through merger and the development of a strong ambulatory care component in the largest hospital area in the State. The circumstantial evidence thus suggests that the most significant example of successful cost containment across the three States occurred in the least regulated State and occurred through private sector initiative.

The relevance of the case studies and discussion of causes of variation in Chapters V and VI to the topic of this chapter is that they demonstrate the complexity of identifying the cause of significant change in hospital use patterns and the hazard of linking regulatory interventions to observed change in use of service without a thorough understanding of the events that occur at the micro-level, namely, at the level of the individual hospital or primary physician markets. These events include changes in physician stock through migration, death or retirement, innovations in organization and changes in clinical management practices. They can also include such "externalities" as rapid growth or decline in population. (For example, a 20% decline in population occurred over a three-year period in one Rhode Island community, resulting in a rapid increase in number of allocated beds and expenditures per capita that was explained mainly by a shrinking denominator (i.e., population).

SUMMARY AND CONCLUSIONS

Social program impact analysis is a highly complex undertaking in most areas, but in the hospital regulatory field one must be particularly cognizant of the degree to which hospital use patterns change in the absence of any regulatory program. We undertook an evaluation of government program impact in Maine, Rhode Island and Vermont, covering the years 1973-1978. Rhode Island is strongly regulated with active Certificate of Need and rate-setting programs. Maine has the earliest example of concurrent review by PSRO, and Vermont was the least regulated.

An analysis of the effect of rate-setting in Rhode Island shows a relative decline in per-capita expenditures after the program began as measured by decline in rank order of per-capita expenditures and by a decrease in average annual rate of increase from 16.7% in the baseline years to 13.1%. Expenditures in Maine increased much more rapidly in the study period with an annual inflation rate of 17.5%. But Vermont, an unregulated State, demonstrated the best expenditure record with a rate of growth of only 11.7% during the study period, compared to 14.6% in the baseline years. We attribute this to the changes in management practices undertaken by the private sector.

The Certificate of Need program in Rhode Island is presumably responsible for the relatively fewer numbers of beds per capita in that state as compared to Maine or Vermont. The impact of fewer beds per capita in Rhode Island appears to result from the exclusion of some medical patients from hospitals; surgical procedure rates in Rhode Island are comparable to those of Maine and Vermont. Since the surgical cases are the more expensive ones, the cost implications of constraint on bed supply may be less than its advocates would hope for: Employment per capita and expenditures per capita among Rhode Island hospital areas remain relatively high when compared with several New England States (see Chapter V).

PSRO concurrent review in Maine was not associated with a decrease in the number of patient days per capita. This occurred primarily because admissions per capita increased in most markets and more than offset the decline in length of stay. The use of standards and guidelines under the concurrent review process had no measurable impact on variations in rates of use of services. Compared to Vermont, a State without concurrent review, there was no indication of a PSRO effect on utilization (number of patient days or length of stay). Further trend analysis is indicated.

The equity impact of government programs was considered. Rate-setting and Certificate of Need programs in Rhode Island have ignored variations in local market performance and, de facto, institutionalized the existing variations by constraining growth of the hospital industry in the low-rate areas as well as in the high-rate areas. We conclude these programs have a negative impact on equity by institutionalizing the cross-community subsidies associated with income transfers through insurance pricing that does not take account of local consumption differences. The equity impact of Medicaid in Vermont was considered: Although the poor now appear to have equalized access to services, they received different varieties of services, depending on place of residence. Under the more rigorous criterion that equity should be measured by the extent to which valued goods are distributed according to need, the outcome of Medicaid is, in substantial measure, problematic. We conclude that because many of the common practices of medicine are undertaken without clear evidence of effectiveness, equity cannot be fully evaluated without consideration of the outcome of services.

CHAPTER X

POLICY IMPLICATIONS AND RECOMMENDATIONS

By attributing the peculiar pattern of use of medical care among neighboring communities primarily to differences in supply of physicians and to differences among physicians in their perceptions concerning the nature of illness, the outcome of medical care or the values they assign to specific end results, we have emphasized the importance of professional uncertainty as a root cause of variations in the use of medical services. Public choices on investments or regulation of health markets, physician choices to use specific treatments and the choices patients make to accept many recommended courses of treatment involve choosing, under uncertainty, among a range of possible ways of practicing medicine. In this concluding chapter, we consider the public policy implications of professional uncertainty, particularly in the planning and regulatory context, and make two recommendations that would serve to improve the basis for decision making.

POLICY IMPLICATIONS OF PROFESSIONAL UNCERTAINTY

Much of the current policy for health is based on the belief that an underlying professional consensus exists on the optimum methods for allocating medical technology. For example, such programs as the Professional Standards Review Organization assume that consensus exists on meaningful standards of care that will promote the public health by insuring that only necessary hospitalizations and procedures are undertaken. Similarly, the development of national standards for health resources--such as numbers of physicians or beds per capita--rests on the assumption that there is an established relationship between resource input and health care outcomes. Needs-based planning, such

as that for facilities under Certificate of Need and for manpower planning as developed by the Graduate Medical Education National Advisory Committee, rests on that assumption. However, if the existing evidence is insufficient to settle controversies on the value of common medical practices, consensus standards must represent weighted averages of the opinions of those selected to establish them and cannot serve as a basis for the rational allocation of medical care resources or technology. Indeed, without more direct information on the outcomes of alternative approaches, rational allocation is not possible, at least not if the criterion for rationality is the maximization of health through the efficient use of health care.

In a similar vein, unless the choices made in resource allocation represent the informed wishes of the patients--rather than their physicians--then the same criterion for rationality cannot be met. An important implication is that the limits on informed decision-making are more severe than generally realized, affecting physicians as well as as their patients. This is a problem even when outcomes are reasonably well known: McNeil shows that the values reflected by the physician's choice of treatment do not always reflect the values of the patient; had the patient known more, he/she would have chosen otherwise.[31] And when the outcomes of alternative treatments are not well understood, as is often the case, informed decision-making or giving informed consent is difficult indeed.

The implication is inescapable: It is not certain that the central tendency of health-care markets is to provide what patients want, although most regulatory strategies assume so and direct their attention to possible cases of professional deviance. The epidemiological findings con-

cerning variations in rates of use of surgical procedures and medical admissions demonstrate, at the level at which health care is used in New England markets, that current case selection is discretionary (at the margin). For example, incremental spending in hospital areas in Maine serves to purchase services which may appear in one area as a relative excess of tonsillectomies, in another area as a relative excess of hysterectomies, in a third as a relative excess in prostatectomies and so on. (See page 90.) The lack of information on long-range outcome also promotes discretionary behavior in the fundamental sense that it cannot be objectively shown that more care is necessarily better or worse. Nor is it certain that more care would necessarily be selected by patients, were they fully informed about the possible consequences. Under current standards of practice, there is a good deal of latitude in how decisions are made and no compelling policy reason, based on evidence of consequence to the public welfare, to spend at high rates unless evidence is generated which would lead to an informed choice with regard to the cost and benefit implications.

There are important implications for the validity of traditional health planning methods, using either econometric models or needs-based models. Both models begin with the assumption that current utilization represents an important first approximation of the optimum situation. In the case of econometric approaches, where utilization equals demand, the problem of projection involves estimating the influence such variables as future income will have on consumer demand for care. For needs-based planning, the issue is to what degree current utilization meets "real" need, by which is meant the need that physicians identify after evaluation of patient morbidity. The implication of evidence reviewed in this book for the econo-

metric approach is that current utilization does not reflect what would occur if informed consent were the basis for clinical decision-making; therefore, current utilization cannot be interpreted to represent an optimum allocation based on consumer market choice. The implication for needs-based planning is that informed choice among treatments based on expected outcomes--even if those outcomes are based on physician, rather than patient, values--cannot be systematically applied because of the wide range of treatments currently employed in the common practice of medicine.

While the full cost implications of relief from previously untreated morbidity or of iatrogenic illness cannot be assessed with existing data, certain aspects of decisions to increase the rate of consumption of services can be identified. A fundamental value of population-based data is that it makes the immediate population impact of medical care visible and raises a series of questions concerning the equity, effectiveness and efficiency of varying levels of use of health care. As an example, the implications concerning the potential of the hospital industry for growth and the consumption of additional resources can be investigated as shown in Table 10.1 which indicates the range of immediate dollar cost of the different strategies for allocating common surgical procedures among the 13 largest Maine hospital service areas.

The table shows that in the areas of highest incidence, total per-capita cost (for hospitalization alone) of the nine procedures is over $29.00. If the high-use strategy were the "medically necessary" level of care, it would take (at 1973 Maine costs) a total of $6.3 billion to provide these services across the Nation. In contrast, if the low-use strategy were generalized, only $2.5 billion would be required. The potential savings for the Nation

TABLE 10.1

EXPENDITURES FOR NINE COMMON PROCEDURES IN AREAS WITH HIGHEST AND LOWEST INCIDENCE RATES. THIRTEEN LARGEST MAINE HOSPITAL AREAS COMPARED TO STATE AVERAGE

Procedure	High Use Area[1]	Low Use Area[1]	State Average
Hysterectomy	$ 6.78	$ 2.88	$ 4.30
Cholecystectomy[2]	4.98	2.51	3.46
Prostatectomy	3.54	1.47	2.34
Tonsillectomy	4.55	0.85	2.33
Hernia[3]	2.51	1.64	1.99
Dilation and Curettage	2.68	1.08	1.82
Appendectomy	1.99	0.97	1.47
Hemorrhoidectomy	1.43	0.23	0.54
Varicose Veins	0.93	0.30	0.48
All Nine Procedures	29.39	11.93	18.73

[1]Areas ranked independently on each procedure
[2]For females only
[3]For males only

for these nine procedures alone is a sufficient reason for devoting resources to determine which level is appropriate. The dollar cost of uncertainty for them is $3.8 billion or about 10% of the 1973 national investment in hospital care.

A similar display calls attention to the potential costs in terms of human lives of variations in rates of use of surgical procedures: Table 10.2 gives the estimated numbers of deaths in the United States in 1975 if existing high or low rates for seven of the most commonly performed surgical procedures were standardized across the nation.[43] The estimates are based on the assumption that the case fatality rate--the percent of operated cases that die--does not vary in relationship to the per-capita rate of surgery; thus, if an area has a rate twice that of another rate, it

will, on the average, experience twice as many deaths per capita following surgery as will the lower rate area. For

TABLE 10.2

PROJECTED SURGICALLY-ASSOCIATED MORTALITY FOR THE UNITED STATES (1975) UNDER VARIOUS STRATEGIES FOR ALLOCATING SURGICAL TECHNOLOGY TO POPULATION

Procedure	U.K. Health Region Low Rate	SOSSUS Low Rate	SOSSUS High Rate	New England Low Rate	New England High Rate	Canadian Province High Rate
Hysterectomy	241	623	1,326	512	1,506	1,172
Tonsillectomy	33	50	130	21	115	119
Herniotomy	562	1,124	1,606	963	1,659	1,445
Cholecystectomy	1,367	2,440	4,639	3,414	8,053	12,427
Appendectomy	956	735	1,250	440	1,544	1,485
Prostatectomy	840	1,624	2,977	1,895	6,768	3,358
Hemorrhoidectomy	46	121	161	40	201	229
All	4,045	6,717	12,089	7,285	19,846	20,235

comparative purposes, estimates are given based on strategies for delivering surgical services in New England, in the United Kingdom and Canada[9] and among States as reported in the American College of Surgeon's Study of Surgical Services in the United States (SOSSUS).[28] Note that the high-rate strategy based on rates in Canada results in an annual estimate of about 20,000 deaths--which represents about 1% of deaths in the United States in the index year, 1975. The low rate strategy based on United Kingdom rates results in about one-fifth as many deaths, or about 4,000. Cholecystectomies and prostatectomies are particularly interesting with regard to the variation in estimated number of deaths per capita associated with the procedure. Under the high-use strategy, cholecystectomy results in over 12,000 deaths; under the low strategy, only 1,300; for prostatectomies, under the high strategy, about 1% of males over 65 years of age could expect to die following surgery for prostatectomy. What these differences

mean is far from clear. Since many of the conditions for which the procedures are done are not life-threatening and the procedure is usually undertaken to improve the quality of life, it is likely that the high rate strategy is associated with a decline in population life expectancy. But what, precisely, is gained? Unfortunately, no one knows. And if it were known and if fully informed about the gain, would patients willingly make the kind of choices that are currently being made in the high rate area?

The data thus evoke a number of important questions: What is the appropriate level of population exposure to health care? How in a market characterized by such non-uniform performance can equity be defined? If access to service leads to such differences in outcome, how can we reasonably define a "just" distribution of resources and services? Or, in practical terms, what is the appropriate number of beds per capita or physicians per capita? Unfortunately, there are no simple answers to these or related questions. Indeed, useful answers could only emerge out of the debates and deliberations of the people involved in establishing and implementing the public policies for intervening in the health care markets, as well as the physicians who must make recommendations to their patients and the patients who face personal decisions concerning whether to accept recommended courses of treatment.

By phrasing questions with reference to affected populations, small area data should provoke a new perspective, provoke a new debate and help to establish a constituency for learning more about the outcome implications of health care. In this volume, we have shown how, in the absence of small area data, government programs can have a decidedly negative impact on equity by awarding hospitals serving high service rate use areas with additional resources and by the de facto induction or institutionalization of cross-community subsidizations (income transfers)

unrelated to social objectives. Undertaken without adequate data, the record of public planning and regulation is not particularly good. By contrast, there are the few hopeful examples which we have cited which show that when data on population-based performance are available, private as well as public sector initiatives can lead to decisions which appear more rational or at least hold promise of containing costs.

What remains to be demonstrated is the impact of systematic feedback of information when the target includes a broad spectrum of the general public--the planners, the regulators, the providers and, to the extent they may wish to avail themselves of the information, the general public. In an information poor market such as the health care market--where price of service is rarely a useful signal for use in decision-making--it should take no special argument to justify a role for government to assure the free-flow of existing information on market performance. Fortunately, in the present situation, much can be done with existing information and the problem of putting it to use is not technical but simply one of public policy: How and under what circumstances should the Federal Government use its own data to inform the public on the variations in performance that now exist among local medical markets?

TWO FINAL RECOMMENDATIONS

At the end of each chapter, we made specific recommendations on how data should be used for these specific purposes and we will not repeat these recommendations, with the exception of two which we feel are sufficiently important to highlight here.

Throughout the report, we emphasized how Medicare data could be used in a small area analysis as a surrogate for full-coverage population-based data sets (based on the uniform discharge abstract) and how it could be used to make unique contributions to the knowledge about survival following medical interventions. Because they are potentially available throughout the United States, the Medicare data could be used to develop small area analysis in each PSRO or Health Services Area in the United States. This would make an important contribution to improving the information base for planning and regulation, for informing both the public and providers on the nature of local Medicare markets and on the outcome of care. We recommend a national strategy for use of Medicare data for these purposes be designed and implemented as soon as possible.

We also recommend that priority be given to the investigations on the outcome of common medical practices. There is a need to make a substantial investment in the assessment of outcomes because the dollar, morbidity and mortality implications of various levels of intervention need to be known to establish a more rational basis for making choices on investment in health care and for informing people on the consequences of their choices as consumers of health services.

APPENDIX I

TABLE ONE	ICDA Codes Used for Surgical and Medical Case Mix Studies
TABLE TWO	Detailed Tables for Surgical Case Mix Study
TABLE THREE	Detailed Tables for Medical Case Mix Study

TABLE ONE

ICDA Codes Used for Surgical

and Medical Case Mix Studies

TABLE ONE

CONDITION CAUSING ADMISSION	DIAGNOSTIC CODE, ICDA-8
Digestive Diseases	520-577
Respiratory Diseases	460-519
Circulatory Diseases	390-458
Comps. of Pregnancy, Childbirth & Puerperium	630-678
Genitourinary Diseases	580-629
Accidents, Poisonings & Violence	800-999
Nervous System & Sense Organs	320-389
Neoplasms	140-239
Skin, Subcutaneous & Connect. Tissue & Musculoskeletal Diseases	680-738
Symptoms & Ill-defined Conditions	780-796
Mental Disorders	290-315
Endocrine, Nutrition, Metabolic & Blood	240-289
Infective & Parasitic Disease	000-136
Congenital Anomalies	740-759

PROCEDURE	SURGERY CODE, ICDA-8
Tonsillectomy	281-284
Dilation and Curettage	690,691
Hysterectomy	682-686
Inguinal Herniorrhaphy	530-533
Cholecystectomy	511
Appendectomy	470
Prostatectomy	602-606
Hemorrhoidectomy	493
Varicose Vein Stripping	384

TABLE TWO

Detailed Tables for Surgical Case Mix Study

MAINE AREA 1 - Population = 179599

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	71	84.5	.84	3.9	2.14
HEMORRHOIDECTOM	43	108.3	.40	2.4	39.38
PROSTATECTOMY	335	215.3	1.56	40.1	66.52
LENS EXTRACTION	266	259.0	1.03	14.6	.19
APPENDECTOMY	243	276.7	.88	13.6	4.11
MASTECTOMY	299	383.5	.78	31.2	18.62
CHOLECYSTECTOMY	385	418.3	.92	21.2	2.65
HERNIA	462	475.5	.97	25.5	.39
HYSTERECTOMY	565	526.6	1.07	59.2	2.80
T&A	494	686.2	.72	28.0	53.82
TOTAL-OPS	12352	11929.1	1.03	684.8	14.99

MAINE AREA 2 - Population = 107899

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	33	49.5	.67	3.1	5.50
HEMORRHOIDECTOM	50	64.5	.78	4.6	3.24
PROSTATECTOMY	88	113.7	.77	19.9	5.80
LENS EXTRACTION	103	132.9	.77	11.0	6.71
APPENDECTOMY	207	174.2	1.19	18.5	6.19
MASTECTOMY	208	220.3	.94	37.8	.69
CHOLECYSTECTOMY	197	243.2	.81	18.6	8.77
HERNIA	276	269.6	1.02	26.9	.15
HYSTERECTOMY	257	310.8	.83	45.6	9.30
T&A	581	421.4	1.38	53.6	60.46
TOTAL-OPS	6284	7139.4	.88	582.1	102.50

MAINE AREA 3 - Population = 99023

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	67	46.0	1.46	6.8	9.64
HEMORRHOIDECTOM	74	59.0	1.25	7.5	3.79
PROSTATECTOMY	100	119.7	.84	21.5	3.24
LENS EXTRACTION	200	140.6	1.42	20.2	25.10
APPENDECTOMY	168	152.5	1.10	17.1	1.57
MASTECTOMY	352	208.3	1.69	67.6	99.17
CHOLECYSTECTOMY	277	228.0	1.22	27.9	10.53
HERNIA	276	262.5	1.05	27.6	.69
HYSTERECTOMY	457	286.5	1.59	88.0	101.41
T&A	399	384.3	1.04	40.3	.56
TOTAL-OPS	6713	6545.2	1.03	678.3	4.30

MAINE AREA 4 - Population = 64879

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	35	30.6	1.15	5.3	.65
HEMORRHOIDECTOM	67	39.1	1.71	10.2	19.93
PROSTATECTOMY	92	89.9	1.02	26.3	.05
LENS EXTRACTION	104	98.4	1.06	15.0	.32
APPENDECTOMY	75	98.4	.76	11.8	5.57
MASTECTOMY	153	134.9	1.13	45.4	2.42
CHOLECYSTECTOMY	143	152.3	.94	21.6	.57
HERNIA	186	175.1	1.06	27.9	.68
HYSTERECTOMY	159	184.6	.86	47.5	3.54
T&A	240	246.8	.97	37.8	.19
TOTAL-OPS	4791	4315.0	1.11	734.3	52.51

MAINE AREA 5 - Population = 55413

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	42	25.5	1.65	7.6	10.74
HEMORRHOIDECTOM	62	32.8	1.89	11.3	26.01
PROSTATECTOMY	50	65.2	.77	19.7	3.56
LENS EXTRACTION	89	74.8	1.19	16.9	2.72
APPENDECTOMY	109	86.8	1.25	19.5	5.66
MASTECTOMY	111	113.2	.98	39.2	.05
CHOLECYSTECTOMY	157	125.7	1.25	28.7	7.80
HERNIA	139	144.1	.97	25.4	.18
HYSTERECTOMY	124	157.0	.79	43.5	6.95
T&A	335	218.4	1.53	59.6	62.19
TOTAL-OPS	4746	3643.9	1.30	861.4	333.35

MAINE AREA 6 - Population = 49977

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	22	23.5	.94	4.3	.09
HEMORRHOIDECTOM	29	30.1	.96	5.7	.04
PROSTATECTOMY	57	61.4	.93	23.9	.32
LENS EXTRACTION	86	72.6	1.18	16.8	2.46
APPENDECTOMY	71	76.2	.93	14.5	.36
MASTECTOMY	105	105.8	.99	39.7	.01
CHOLECYSTECTOMY	105	116.5	.90	20.7	1.13
HERNIA	107	134.0	.80	21.0	5.42
HYSTERECTOMY	132	144.7	.91	50.3	1.12
T&A	105	191.1	.55	21.3	38.81
TOTAL-OPS	2937	3316.2	.89	585.7	43.36

MAINE AREA 7 - Population = 34735

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	10	15.6	.64	3.0	1.99
HEMORRHOIDECTOM	12	20.3	.59	3.5	3.37
PROSTATECTOMY	29	35.6	.81	21.0	1.21
LENS EXTRACTION	46	39.8	1.16	16.4	.97
APPENDECTOMY	41	56.2	.73	11.3	4.11
MASTECTOMY	66	65.7	1.00	40.2	.00
CHOLECYSTECTOMY	77	75.9	1.01	23.3	.02
HERNIA	89	86.3	1.03	27.1	.09
HYSTERECTOMY	104	92.8	1.12	61.8	1.35
T&A	41	140.8	.29	11.3	70.73
TOTAL-OPS	2134	2265.1	.94	623.1	7.59

MAINE AREA 8 - Population = 30991

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	13	14.6	.89	4.1	.18
HEMORRHOIDECTOM	23	18.9	1.22	7.2	.88
APPENDECTOMY	41	46.1	.89	13.8	.56
PROSTATECTOMY	29	48.9	.59	15.3	8.12
LENS EXTRACTION	36	54.8	.66	9.3	6.47
MASTECTOMY	52	64.9	.80	32.0	2.58
CHOLECYSTECTOMY	62	75.5	.82	18.9	2.40
HERNIA	88	85.7	1.03	27.0	.06
HYSTERECTOMY	55	86.4	.64	35.1	11.41
T&A	124	112.2	1.11	42.9	1.24
TOTAL-OPS	1718	2111.3	.81	538.2	73.26

MAINE AREA 9 - Population = 24468

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	10	11.2	.90	4.1	.12
HEMORRHOIDECTOM	12	14.2	.84	5.0	.35
PROSTATECTOMY	40	31.1	1.28	33.1	2.52
LENS EXTRACTION	43	33.6	1.28	18.2	2.65
APPENDECTOMY	44	38.7	1.14	17.7	.73
MASTECTOMY	45	48.6	.93	37.1	.26
CHOLECYSTECTOMY	63	54.9	1.15	26.4	1.21
HERNIA	74	63.6	1.16	30.6	1.70
HYSTERECTOMY	65	67.1	.97	53.5	.06
T&A	102	99.6	1.02	39.8	.06
TOTAL-OPS	1700	1586.6	1.07	708.6	8.10

MAINE AREA 10 - Population = 26102

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	18	11.7	1.55	7.2	3.46
HEMORRHOIDECTOM	24	15.0	1.60	9.5	5.39
PROSTATECTOMY	18	28.4	.63	16.3	3.81
LENS EXTRACTION	23	29.8	.77	11.0	1.53
APPENDECTOMY	57	42.3	1.35	20.9	5.10
MASTECTOMY	69	50.5	1.36	54.6	6.74
CHOLECYSTECTOMY	53	56.4	.94	21.6	.20
HERNIA	77	65.2	1.18	31.0	2.12
HYSTERECTOMY	45	72.0	.63	34.5	10.14
T&A	169	108.9	1.55	60.3	33.18
TOTAL-OPS	1839	1677.3	1.10	725.1	15.60

MAINE AREA 11 - Population = 25928

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	11	12.0	.92	4.3	.08
HEMORRHOIDECTOM	21	15.3	1.37	8.2	2.13
PROSTATECTOMY	28	34.3	.82	21.0	1.16
LENS EXTRACTION	39	37.7	1.04	14.7	.05
APPENDECTOMY	27	39.9	.68	10.5	4.14
MASTECTOMY	44	52.9	.83	33.3	1.49
CHOLECYSTECTOMY	71	59.3	1.20	27.5	2.29
HERNIA	73	69.1	1.06	27.8	.22
HYSTERECTOMY	77	72.6	1.06	58.5	.27
T&A	115	102.2	1.13	43.7	1.60
TOTAL-OPS	1940	1703.2	1.14	753.3	32.93

RHODE ISLAND AREA 1 - Population = 90762

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	56	47.3	1.18	6.1	1.59
HEMORRHOIDECTOM	80	74.7	1.07	8.7	.38
APPENDECTOMY	112	94.5	1.19	13.1	3.24
PROSTATECTOMY	149	129.9	1.15	29.2	2.80
LENS EXTRACTION	162	185.2	.88	14.6	2.90
CHOLECYSTECTOMY	261	216.8	1.20	27.1	9.00
MASTECTOMY	241	232.8	1.03	48.5	.29
HERNIA	255	252.1	1.01	26.5	.03
HYSTERECTOMY	336	274.8	1.22	70.7	13.62
T&A	521	321.0	1.62	59.4	124.66
TOTAL-OPS	6521	5785.6	1.13	699.9	93.47

RHODE ISLAND AREA 2 - Population = 76982

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	36	38.9	.93	4.8	.21
HEMORRHOIDECTOM	66	61.8	1.07	8.7	.29
APPENDECTOMY	80	78.8	1.02	11.2	.02
PROSTATECTOMY	87	121.4	.72	18.2	9.75
LENS EXTRACTION	188	171.2	1.10	18.4	1.66
CHOLECYSTECTOMY	175	183.6	.95	21.5	.40
MASTECTOMY	186	194.3	.96	44.8	.35
HERNIA	199	218.2	.91	23.9	1.69
HYSTERECTOMY	214	225.2	.95	55.0	.56
T&A	277	280.2	.99	36.2	.04
TOTAL-OPS	5383	4955.6	1.09	674.6	36.87

RHODE ISLAND AREA 3 - Population = 85302

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	52	44.8	1.16	6.0	1.17
HEMORRHOIDECTOM	83	70.5	1.18	9.6	2.21
PROSTATECTOMY	76	95.6	.80	20.2	4.04
APPENDECTOMY	115	95.9	1.20	13.2	3.82
LENS EXTRACTION	142	127.8	1.11	18.6	1.58
CHOLECYSTECTOMY	196	191.1	1.03	23.1	.12
MASTECTOMY	198	207.7	.95	44.6	.46
HERNIA	215	218.9	.98	25.7	.07
HYSTERECTOMY	274	260.7	1.05	60.8	.68
T&A	437	310.0	1.41	51.6	52.05
TOTAL-OPS	5382	5230.5	1.03	639.0	4.39

RHODE ISLAND AREA 4 - Population = 56999

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	30	26.8	1.12	5.8	.38
HEMORRHOIDECTOM	26	42.9	.61	4.9	6.68
PROSTATECTOMY	77	51.8	1.49	37.8	12.25
APPENDECTOMY	55	0 66.4	.83	9.2	1.94
LENS EXTRACTION	67	75.2	.89	14.9	.88
CHOLECYSTECTOMY	93	113.8	.82	18.4	3.81
MASTECTOMY	120	126.6	.95	44.4	.34
HERNIA	116	143.2	.81	21.2	5.16
HYSTERECTOMY	119	162.2	.73	42.4	11.51
T&A	97	244.6	.40	14.5	89.10
TOTAL-OPS	3060	3390.0	.90	560.6	32.13

RHODE ISLAND AREA 5 - Population = 75797

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	38	41.4	.92	4.7	.28
HEMORRHOIDECTOM	63	65.2	.97	7.9	.07
APPENDECTOMY	61	79.8	.76	8.4	4.44
PROSTATECTOMY	93	109.8	.85	21.6	2.58
LENS EXTRACTION	119	147.1	.81	13.5	5.38
CHOLECYSTECTOMY	177	185.1	.96	21.6	.35
MASTECTOMY	202	197.4	1.02	47.9	.11
HERNIA	187	205.5	.91	23.8	1.67
HYSTERECTOMY	231	238.5	.97	56.0	.24
T&A	240	242.4	.99	36.2	.02
TOTAL-OPS	4548	4864.9	.94	580.6	20.64

RHODE ISLAND AREA 6 - Population = 60394

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	38	32.3	1.18	6.1	1.02
HEMORRHOIDECTOM	62	50.9	1.22	9.9	2.40
APPENDECTOMY	49	63.0	.78	8.6	3.12
PROSTATECTOMY	84	87.9	.95	24.3	.18
LENS EXTRACTION	148	121.9	1.22	20.3	5.61
CHOLECYSTECTOMY	144	146.4	.98	22.2	.04
MASTECTOMY	172	156.3	1.10	51.5	1.57
HERNIA	180	165.9	1.08	28.4	1.19
HYSTERECTOMY	176	186.0	.95	54.7	.53
T&A	197	200.8	.98	35.9	.07
TOTAL-OPS	4105	3880.5	1.06	656.9	12.99

RHODE ISLAND AREA 7 - Population = 64096

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	31	33.9	.91	4.7	.25
HEMORRHOIDECTOM	56	53.4	1.05	8.5	.13
PROSTATECTOMY	69	68.2	1.01	25.8	.01
APPENDECTOMY	66	72.9	.91	10.0	.65
LENS EXTRACTION	98	88.8	1.10	18.5	.96
CHOLECYSTECTOMY	161	142.5	1.13	25.5	2.40
MASTECTOMY	197	157.0	1.25	58.8	10.18
HERNIA	191	161.9	1.18	30.9	5.25
HYSTERECTOMY	215	200.0	1.08	62.2	1.12
T&A	236	231.5	1.02	37.3	.09
TOTAL-OPS	3977	3906.5	1.02	632.2	1.27

RHODE ISLAND AREA 8 - Population = 62599

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	38	31.3	1.22	6.3	1.45
HEMORRHOIDECTOM	56	49.5	1.13	9.2	.85
PROSTATECTOMY	79	59.8	1.32	33.6	6.16
APPENDECTOMY	101	72.3	1.40	15.4	11.40
LENS EXTRACTION	82	78.9	1.04	17.4	.12
CHOLECYSTECTOMY	188	130.4	1.44	32.5	25.48
MASTECTOMY	140	142.6	.98	46.0	.05
HERNIA	168	157.0	1.07	28.0	.77
HYSTERECTOMY	231	184.0	1.26	72.6	12.02
T&A	338	252.3	1.34	49.1	29.13
TOTAL-OPS	3938	3737.3	1.05	654.4	10.78

RHODE ISLAND AREA 9 - Population = 53998

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	23	25.8	.89	4.6	.30
HEMORRHOIDECTOM	31	41.7	.74	6.1	2.74
PROSTATECTOMY	66	42.6	1.55	39.4	12.79
LENS EXTRACTION	96	57.2	1.68	28.0	26.33
APPENDECTOMY	61	65.6	.93	10.3	.32
CHOLECYSTECTOMY	78	105.0	.74	16.7	6.96
MASTECTOMY	107	117.2	.91	42.8	.88
HERNIA	133	126.8	1.05	27.5	.31
HYSTERECTOMY	125	157.8	.79	45.8	6.81
T&A	122	219.8	.55	20.3	43.48
TOTAL-OPS	3026	3209.1	.94	585.6	10.44

RHODE ISLAND AREA 10 - Population = 50000

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	26	26.1	1.00	5.1	.00
HEMORRHOIDECTOM	43	41.2	1.04	8.5	.08
APPENDECTOMY	43	55.0	.78	8.6	2.61
PROSTATECTOMY	45	61.2	.73	18.7	4.31
LENS EXTRACTION	89	83.9	1.06	17.7	.31
CHOLECYSTECTOMY	112	114.2	.98	22.1	.04
MASTECTOMY	138	124.2	1.11	52.1	1.54
HERNIA	128	131.3	.98	25.5	.08
HYSTERECTOMY	161	153.3	1.05	60.7	.39
T&A	141	179.2	.79	28.8	8.15
TOTAL-OPS	3020	3112.1	.97	602.6	2.72

RHODE ISLAND AREA 11 - Population = 47694

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
VARICOSE VEINS	15	23.8	.63	3.2	3.23
HEMORRHOIDECTOM	47	37.7	1.25	10.2	2.30
APPENDECTOMY	50	51.6	.97	10.7	.05
PROSTATECTOMY	80	60.2	1.33	33.8	6.52
LENS EXTRACTION	78	86.7	.90	15.0	.86
CHOLECYSTECTOMY	132	107.1	1.23	27.8	5.79
MASTECTOMY	110	116.6	.94	44.2	.37
HERNIA	114	129.0	.88	23.2	1.74
HYSTERECTOMY	174	140.3	1.24	71.7	8.10
T&A	240	185.6	1.29	47.4	15.98
TOTAL-OPS	3585	2960.5	1.21	752.0	131.73

VERMONT AREA 1 - Population = 111107

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
TOTAL-OPS	6355	6565.5	.97	588.8	6.75
T&A	186	269.4	.69	15.8	25.82
APPENDECTOMY	192	189.8	1.01	16.5	.02
HEMORRHOIDECTOM	58	57.4	1.01	5.3	.01
HERNIA	268	289.2	.93	25.7	1.55
CHOLECYSTECTOMY	185	207.2	.89	17.9	2.38
VARICOSE VEINS	66	67.3	.98	6.2	.02
LENS EXTRACTION	157	129.9	1.21	17.9	5.66
PROSTATECTOMY	123	91.8	1.34	30.2	10.59
HYSTERECTOMY	267	240.8	1.11	47.5	2.85
MASTECTOMY	96	146.1	.66	17.9	17.17

VERMONT AREA 2 - Population = 53337

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
TOTAL-OPS	3296	3253.5	1.01	616.3	.55
T&A	167	122.3	1.37	31.4	16.37
APPENDECTOMY	96	86.3	1.11	18.1	1.09
HEMORRHOIDECTOM	25	28.6	.87	4.7	.45
HERNIA	138	149.0	.93	25.7	.81
CHOLECYSTECTOMY	100	106.4	.94	18.7	.38
VARICOSE VEINS	27	33.3	.81	5.1	1.19
LENS EXTRACTION	113	83.0	1.36	20.3	10.85
PROSTATECTOMY	32	60.9	.53	11.8	13.68
HYSTERECTOMY	122	116.6	1.05	44.8	.25
MASTECTOMY	89	74.1	1.20	32.3	2.98

VERMONT AREA 3 - Population = 52262

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
TOTAL-OPS	3428	3227.6	1.06	646.5	12.44
T&A	207	117.0	1.77	40.7	69.21
APPENDECTOMY	66	83.7	.79	12.8	3.74
HEMORRHOIDECTOM	43	28.4	1.51	8.1	7.52
HERNIA	181	147.5	1.23	34.0	7.62
CHOLECYSTECTOMY	122	106.3	1.15	22.8	2.31
VARICOSE VEINS	47	33.1	1.42	8.9	5.81
LENS EXTRACTION	75	87.2	.86	13.1	1.70
PROSTATECTOMY	40	59.7	.67	14.9	6.51
HYSTERECTOMY	108	117.2	.92	39.5	.73
MASTECTOMY	73	75.8	.96	26.0	.10

VERMONT AREA 4 - Population = 34124

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	32	17.6	1.82	9.7	11.82
VARICOSE VEINS	19	20.5	.93	5.8	.11
PROSTATECTOMY	32	36.8	.87	19.4	.63
MASTECTOMY	50	44.9	1.11	30.2	.58
LENS EXTRACTION	45	49.3	.91	13.8	.38
APPENDECTOMY	55	56.2	.98	15.9	.03
CHOLECYSTECTOMY	84	65.1	1.29	25.6	5.49
HYSTERECTOMY	68	71.2	.95	40.9	.14
T&A	95	82.7	1.15	26.4	1.83
HERNIA	103	93.6	1.10	30.5	.95
TOTAL-OPS	2015	2037.7	.99	602.0	.25

VERMONT AREA 5 - Population = 24570

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	18	13.6	1.32	7.1	1.43
VARICOSE VEINS	23	15.7	1.46	9.1	3.35
PROSTATECTOMY	35	32.1	1.09	24.4	.26
MASTECTOMY	43	36.3	1.18	32.1	1.22
APPENDECTOMY	34	38.1	.89	14.5	.43
LENS EXTRACTION	51	45.4	1.12	16.9	.68
CHOLECYSTECTOMY	63	51.5	1.22	24.3	2.59
T&A	72	52.6	1.37	31.4	7.12
HYSTERECTOMY	48	55.4	.87	37.2	.98
HERNIA	76	72.0	1.06	29.2	.23
TOTAL-OPS	1720	1544.5	1.11	677.9	19.94

VERMONT AREA 6 - Population = 21704

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	9	11.8	.76	4.1	.68
VARICOSE VEINS	10	13.8	.73	4.5	1.04
PROSTATECTOMY	32	26.7	1.20	26.8	1.06
MASTECTOMY	47	30.7	1.53	41.5	8.71
APPENDECTOMY	36	34.4	1.05	17.0	.07
LENS EXTRACTION	22	35.7	.62	9.3	5.26
CHOLECYSTECTOMY	40	44.2	.90	17.9	.41
HYSTERECTOMY	49	47.9	1.02	43.8	.03
T&A	26	48.3	.54	12.4	10.27
HERNIA	74	61.8	1.20	33.1	2.41
TOTAL-OPS	1430	1338.7	1.07	650.3	6.23

VERMONT AREA 7 - Population = 21270

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	4	11.7	.34	1.8	5.05
VARICOSE VEINS	13	13.6	.95	6.0	.03
PROSTATECTOMY	30	26.4	1.14	25.4	.49
MASTECTOMY	25	30.3	.83	22.3	.93
APPENDECTOMY	33	33.7	.98	15.9	.02
LENS EXTRACTION	22	35.8	.61	9.3	5.32
CHOLECYSTECTOMY	38	43.8	.87	17.2	.77
T&A	44	46.8	.94	21.6	.17
HYSTERECTOMY	44	47.1	.93	40.0	.20
HERNIA	57	60.6	.94	26.0	.22
TOTAL-OPS	1202	1318.7	.91	554.9	10.32

VERMONT AREA 8 - Population = 16432

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	7	9.1	.77	4.1	.49
VARICOSE VEINS	16	10.6	1.52	9.5	2.81
PROSTATECTOMY	25	20.5	1.22	27.3	.99
MASTECTOMY	45	24.2	1.86	50.4	17.90
APPENDECTOMY	25	25.5	.98	15.9	.01
LENS EXTRACTION	21	29.9	.70	10.6	2.65
CHOLECYSTECTOMY	44	34.4	1.28	25.4	2.69
T&A	16	34.9	.46	10.5	10.23
HYSTERECTOMY	34	36.8	.92	39.6	.21
HERNIA	33	47.9	.69	19.1	4.62
TOTAL-OPS	1104	1034.3	1.07	649.8	4.70

VERMONT AREA 9 - Population = 16551

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	4	9.6	.42	2.2	3.28
VARICOSE VEINS	10	11.4	.88	5.5	.17
PROSTATECTOMY	23	22.0	1.05	23.4	.05
MASTECTOMY	27	25.0	1.08	29.3	.17
APPENDECTOMY	22	25.1	.88	14.2	.39
LENS EXTRACTION	27	29.2	.92	14.0	.17
T&A	54	33.8	1.60	36.6	12.04
CHOLECYSTECTOMY	25	36.3	.69	13.7	3.52
HYSTERECTOMY	58	38.7	1.50	64.3	9.66
HERNIA	52	48.6	1.07	29.6	.23
TOTAL-OPS	1108	1045.0	1.06	645.4	3.79

VERMONT AREA 10 - Population = 12913

PROCEDURE	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
HEMORRHOIDECTOM	9	6.9	1.30	6.9	.61
VARICOSE VEINS	9	8.1	1.12	7.0	.11
PROSTATECTOMY	12	16.5	.73	16.2	1.24
MASTECTOMY	25	17.6	1.42	38.6	3.15
APPENDECTOMY	23	20.5	1.12	18.2	.30
LENS EXTRACTION	17	21.2	.80	12.1	.84
CHOLECYSTECTOMY	32	26.0	1.23	24.4	1.40
HYSTERECTOMY	36	27.4	1.31	56.3	2.69
T&A	28	29.2	.96	22.0	.05
HERNIA	39	36.8	1.06	29.4	.14
TOTAL-OPS	908	793.0	1.14	697.1	16.69

TABLE THREE

Detailed Tables for Medical Case Mix Study

MAINE AREA 1 - Population = 179599

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	761	855.1	.89	42.0	10.37
NERVOUS-SENSE	1116	1273.2	.88	61.9	19.42
MALIGNANT NEOPL	1570	1446.5	1.08	86.0	10.55
SKIN-MUSCULOSKE	1620	1872.3	.87	89.5	33.99
INJURIES,ADVERS	2385	2802.8	.85	132.5	62.27
RESPIRATORY	2059	3236.2	.64	114.8	428.24
GENITOURINARY	3499	3439.4	1.02	193.0	1.03
CARDIOVASCULAR	3270	3720.6	.88	179.0	54.57
DIGESTIVE	3647	4523.6	.81	201.4	169.88
TOTAL-DXS	24436	28535.4	.86	1353.2	588.92

MAINE AREA 2 - Population = 107899

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	312	480.3	.65	30.6	59.00
NERVOUS-SENSE	522	722.8	.72	51.0	55.79
MALIGNANT NEOPL	687	768.8	.89	70.8	8.70
SKIN-MUSCULOSKE	1034	1102.7	.94	96.9	4.28
INJURIES,ADVERS	1419	1682.1	.84	131.3	41.16
RESPIRATORY	1582	1855.6	.85	153.8	40.33
CARDIOVASCULAR	1612	1975.9	.82	166.2	67.02
GENITOURINARY	1534	2032.9	.76	143.2	122.44
DIGESTIVE	2088	2600.3	.80	200.6	100.94
TOTAL-DXS	13667	16810.7	.81	1284.7	587.88

MAINE AREA 3 - Population = 99023

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	475	468.2	1.01	47.9	.10
NERVOUS-SENSE	678	703.4	.96	68.1	.91
MALIGNANT NEOPL	688	788.2	.87	69.1	12.73
SKIN-MUSCULOSKE	814	1023.5	.80	82.2	42.87
INJURIES,ADVERS	1274	1536.4	.83	129.1	44.82
RESPIRATORY	1634	1799.1	.91	163.8	15.15
GENITOURINARY	2054	1878.3	1.09	207.5	16.44
CARDIOVASCULAR	1851	2020.4	.92	186.6	14.21
DIGESTIVE	2430	2479.6	.98	244.8	.99
TOTAL-DXS	15055	15651.4	.96	1520.0	22.72

MAINE AREA 4 - Population = 64879

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	286	315.8	.91	42.7	2.81
NERVOUS-SENSE	607	469.3	1.29	91.4	40.41
MALIGNANT NEOPL	552	542.5	1.02	80.6	.17
SKIN-MUSCULOSKE	775	679.6	1.14	117.9	13.39
INJURIES,ADVERS	1131	1013.4	1.12	173.7	13.65
RESPIRATORY	1018	1190.7	.85	154.2	25.05
GENITOURINARY	1313	1247.3	1.05	199.7	3.46
CARDIOVASCULAR	1220	1395.5	.87	178.1	22.07
DIGESTIVE	1707	1657.2	1.03	257.4	1.50
TOTAL-DXS	10559	10381.9	1.02	1607.2	3.02

MAINE AREA 5 - Population = 55413

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	356	256.0	1.39	65.6	39.03
NERVOUS-SENSE	627	386.8	1.62	114.6	149.20
MALIGNANT NEOPL	455	423.5	1.07	85.1	2.34
SKIN-MUSCULOSKE	859	567.4	1.51	156.5	149.84
INJURIES,ADVERS	1125	857.0	1.31	204.3	83.79
RESPIRATORY	1580	993.1	1.59	287.0	346.84
GENITOURINARY	1091	1040.5	1.05	199.0	2.45
CARDIOVASCULAR	1341	1086.3	1.23	251.5	59.74
DIGESTIVE	1870	1365.1	1.37	342.3	186.75
TOTAL-DXS	11734	8667.7	1.35	2139.2	1084.71

MAINE AREA 6 - Population = 49977

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	189	239.2	.79	37.3	10.53
NERVOUS-SENSE	301	357.4	.84	59.5	8.91
MALIGNANT NEOPL	406	406.8	1.00	79.0	.00
SKIN-MUSCULOSKE	408	520.3	.78	81.1	24.25
INJURIES,ADVERS	619	776.3	.80	124.1	31.87
RESPIRATORY	615	911.3	.67	121.7	96.31
GENITOURINARY	907	955.8	.95	180.1	2.49
CARDIOVASCULAR	917	1041.2	.88	179.4	14.82
DIGESTIVE	1050	1263.5	.83	207.6	36.07
TOTAL-DXS	6735	7945.4	.85	1339.5	184.39

MAINE AREA 7 - Population = 34735

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	127	150.3	.84	39.9	3.60
NERVOUS-SENSE	292	231.9	1.26	89.0	15.55
MALIGNANT NEOPL	200	234.7	.85	67.5	5.12
SKIN-MUSCULOSKE	330	347.7	.95	98.1	.90
INJURIES,ADVERS	552	534.0	1.03	160.9	.60
CARDIOVASCULAR	642	600.9	1.07	217.6	2.81
RESPIRATORY	501	604.3	.83	149.5	17.67
GENITOURINARY	647	638.1	1.01	192.4	.12
DIGESTIVE	804	820.3	.98	244.9	.32
TOTAL-DXS	5340	5316.7	1.00	1587.1	.10

MAINE AREA 8 - Population = 30991

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	92	161.1	.57	26.9	29.63
NERVOUS-SENSE	170	233.1	.73	51.5	17.10
MALIGNANT NEOPL	279	285.9	.98	77.3	.17
SKIN-MUSCULOSKE	271	334.7	.81	83.7	12.14
INJURIES,ADVERS	459	501.3	.92	142.5	3.57
RESPIRATORY	437	580.5	.75	135.8	35.45
GENITOURINARY	490	617.0	.79	150.7	26.15
CARDIOVASCULAR	595	746.8	.80	162.3	30.87
DIGESTIVE	670	826.8	.81	202.5	29.74
TOTAL-DXS	4152	5162.8	.80	1270.8	197.92

MAINE AREA 9 - Population = 24468

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	141	113.5	1.24	58.6	6.68
NERVOUS-SENSE	202	171.6	1.18	83.2	5.39
MALIGNANT NEOPL	221	189.6	1.17	92.3	5.21
SKIN-MUSCULOSKE	281	248.2	1.13	117.1	4.34
INJURIES,ADVERS	481	373.8	1.29	200.3	30.75
RESPIRATORY	654	440.4	1.48	267.9	103.64
GENITOURINARY	539	452.1	1.19	226.2	16.71
CARDIOVASCULAR	564	486.1	1.16	236.3	12.50
DIGESTIVE	783	600.7	1.30	325.7	55.35
TOTAL-DXS	4523	3774.0	1.20	1893.9	148.67

MAINE AREA 10 - Population = 26102

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	154	112.7	1.37	64.5	15.16
NERVOUS-SENSE	212	175.1	1.21	85.6	7.78
MALIGNANT NEOPL	152	177.5	.86	67.8	3.66
SKIN-MUSCULOSKE	338	258.2	1.31	135.4	24.69
INJURIES,ADVERS	392	394.1	.99	154.9	.01
CARDIOVASCULAR	583	451.0	1.29	263.3	38.66
RESPIRATORY	558	458.0	1.22	219.7	21.82
GENITOURINARY	460	471.1	.98	185.3	.26
DIGESTIVE	691	613.0	1.13	281.6	9.92
TOTAL-DXS	4410	3931.0	1.12	1772.8	58.36

MAINE AREA 11 - Population = 25928

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	141	123.5	1.14	53.9	2.49
NERVOUS-SENSE	228	186.1	1.22	86.6	9.44
MALIGNANT NEOPL	199	209.0	.95	75.4	.48
SKIN-MUSCULOSKE	361	267.0	1.35	139.8	33.06
INJURIES,ADVERS	437	401.1	1.09	169.6	3.21
RESPIRATORY	656	476.1	1.38	248.5	67.94
GENITOURINARY	501	488.2	1.03	194.7	.34
CARDIOVASCULAR	552	537.4	1.03	209.2	.40
DIGESTIVE	797	650.6	1.22	306.0	32.92
TOTAL-DXS	4876	4084.4	1.19	1886.5	153.44

RHODE ISLAND AREA 1 - Population = 90762

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	473	435.7	1.09	48.1	3.20
NERVOUS-SENSE	560	591.6	.95	56.4	1.69
MALIGNANT NEOPL	757	780.9	.97	72.4	.73
SKIN-MUSCULOSKE	866	914.8	.95	93.0	2.61
INJURIES,ADVERS	987	1108.0	.89	105.8	13.21
RESPIRATORY	1829	1283.5	1.42	192.0	231.84
GENITOURINARY	1685	1583.6	1.06	180.3	6.49
DIGESTIVE	2220	1978.6	1.12	230.1	29.44
CARDIOVASCULAR	2146	2125.8	1.01	203.7	.19
TOTAL-DXS	13346	12272.3	1.09	1404.2	93.93

RHODE ISLAND AREA 2 - Population = 76982

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	447	380.7	1.17	52.0	11.56
NERVOUS-SENSE	609	522.6	1.17	69.4	14.28
MALIGNANT NEOPL	624	689.4	.91	67.6	6.21
SKIN-MUSCULOSKE	877	775.6	1.13	111.1	13.25
INJURIES,ADVERS	1183	963.4	1.23	145.8	50.06
RESPIRATORY	1181	1142.0	1.03	139.3	1.33
GENITOURINARY	1357	1343.2	1.01	171.2	.14
DIGESTIVE	1802	1717.6	1.05	215.2	4.15
CARDIOVASCULAR	1822	1895.5	.96	194.0	2.85
TOTAL-DXS	11931	10650.6	1.12	1446.4	153.92

RHODE ISLAND AREA 3 - Population = 85302

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	334	365.4	.91	40.5	2.69
NERVOUS-SENSE	502	487.3	1.03	61.4	.44
MALIGNANT NEOPL	581	606.4	.96	71.6	1.06
SKIN-MUSCULOSKE	819	834.0	.98	96.4	.27
INJURIES,ADVERS	1037	987.3	1.05	124.7	2.50
RESPIRATORY	1166	1104.5	1.06	142.2	3.43
GENITOURINARY	1288	1436.2	.90	152.0	15.28
CARDIOVASCULAR	1744	1617.6	1.08	217.6	9.88
DIGESTIVE	1695	1705.2	.99	203.9	.06
TOTAL-DXS	10678	10737.4	.99	1284.1	.33

RHODE ISLAND AREA 4 - Population = 56999

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	251	229.7	1.09	48.4	1.98
NERVOUS-SENSE	329	314.9	1.05	62.2	.63
MALIGNANT NEOPL	367	349.2	1.05	78.5	.91
SKIN-MUSCULOSKE	609	529.5	1.15	113.0	11.93
INJURIES,ADVERS	845	661.7	1.28	151.6	50.76
RESPIRATORY	754	802.3	.94	126.6	2.91
GENITOURINARY	1081	898.0	1.20	204.0	37.27
CARDIOVASCULAR	1087	943.6	1.15	232.5	21.79
DIGESTIVE	1104	1093.7	1.01	207.1	.10
TOTAL-DXS	8161	6987.0	1.17	1508.2	197.26

RHODE ISLAND AREA 5 - Population = 75797

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	329	359.0	.92	40.6	2.51
NERVOUS-SENSE	382	477.1	.80	47.7	18.97
MALIGNANT NEOPL	657	641.8	1.02	76.5	.36
SKIN-MUSCULOSKE	742	775.6	.96	94.0	1.46
INJURIES,ADVERS	842	919.9	.91	108.7	6.60
RESPIRATORY	814	996.0	.82	110.1	33.26
GENITOURINARY	1300	1353.7	.96	162.8	2.13
DIGESTIVE	1419	1634.7	.87	178.1	28.47
CARDIOVASCULAR	1554	1739.3	.89	180.3	19.74
TOTAL-DXS	8929	10197.6	.88	1130.6	157.82

RHODE ISLAND AREA 6 - Population = 60394

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	341	289.5	1.18	52.2	9.17
NERVOUS-SENSE	427	388.5	1.10	65.5	3.82
MALIGNANT NEOPL	574	518.9	1.11	82.7	5.84
SKIN-MUSCULOSKE	694	615.4	1.13	110.8	10.04
INJURIES,ADVERS	722	739.6	.98	115.9	.42
RESPIRATORY	753	823.8	.91	123.2	6.09
GENITOURINARY	1060	1071.7	.99	167.6	.13
DIGESTIVE	1263	1315.5	.96	196.9	2.09
CARDIOVASCULAR	1447	1412.6	1.02	206.7	.84
TOTAL-DXS	8273	8193.4	1.01	1303.8	.77

RHODE ISLAND AREA 7 - Population - 64096

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	278	268.1	1.04	45.9	.37
NERVOUS-SENSE	369	355.3	1.04	61.9	.53
MALIGNANT NEOPL	475	437.4	1.09	81.2	3.24
SKIN-MUSCULOSKE	690	624.9	1.10	108.5	6.79
INJURIES,ADVERS	669	733.1	.91	108.4	5.61
RESPIRATORY	717	810.2	.88	119.2	10.72
GENITOURINARY	1114	1075.9	1.03	175.5	1.35
CARDIOVASCULAR	1095	1159.5	.94	190.6	3.59
DIGESTIVE	1269	1259.7	1.01	206.6	.07
TOTAL-DXS	7531	7957.4	.95	1222.0	22.85

RHODE ISLAND AREA 8 - Population = 62599

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	233	252.0	.92	41.0	1.43
NERVOUS-SENSE	412	340.2	1.21	72.2	15.16
MALIGNANT NEOPL	397	390.4	1.02	76.0	.11
SKIN-MUSCULOSKE	523	592.1	.88	86.7	8.07
INJURIES,ADVERS	728	712.4	1.02	121.3	.34
RESPIRATORY	916	837.7	1.09	147.3	7.32
GENITOURINARY	987	1008.4	.98	165.9	.45
CARDIOVASCULAR	1196	1037.9	1.15	232.6	24.09
DIGESTIVE	1265	1200.6	1.05	216.1	3.46
TOTAL-DXS	7887	7625.5	1.03	1335.5	8.97

RHODE ISLAND AREA 9 - Population = 53998

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	197	203.5	.97	42.9	.21
NERVOUS-SENSE	322	271.9	1.18	70.6	9.24
MALIGNANT NEOPL	346	287.0	1.21	90.1	12.13
SKIN-MUSCULOSKE	358	499.9	.72	70.3	40.30
INJURIES,ADVERS	622	623.2	1.00	118.5	.00
RESPIRATORY	654	701.7	.93	125.6	3.24
CARDIOVASCULAR	863	769.8	1.12	226.3	11.29
GENITOURINARY	864	857.5	1.01	170.8	.05
DIGESTIVE	1050	989.5	1.06	217.7	3.70
TOTAL-DXS	6363	6479.2	.98	1268.1	2.08

RHODE ISLAND AREA 10 -- Population = 50000

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	221	222.4	.99	44.0	.01
NERVOUS-SENSE	311	298.3	1.04	62.1	.54
MALIGNANT NEOPL	371	378.5	.98	73.3	.15
SKIN-MUSCULOSKE	520	493.9	1.05	103.4	1.38
INJURIES,ADVERS	503	591.6	.85	101.0	13.27
RESPIRATORY	537	665.7	.81	108.7	24.90
GENITOURINARY	783	853.3	.92	155.5	5.79
CARDIOVASCULAR	944	1019.0	.93	187.0	5.53
DIGESTIVE	893	1028.8	.87	178.0	17.93
TOTAL-DXS	5843	6461.2	.90	1167.7	59.14

RHODE ISLAND AREA 11 - Population = 47694

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	254	217.1	1.17	51.8	6.28
NERVOUS-SENSE	325	297.6	1.09	65.1	2.52
MALIGNANT NEOPL	385	372.7	1.03	77.2	.41
SKIN-MUSCULOSKE	571	465.5	1.23	120.5	23.89
INJURIES,ADVERS	803	570.8	1.41	167.0	94.42
RESPIRATORY	1004	684.8	1.47	197.5	148.77
GENITOURINARY	1120	798.3	1.40	237.8	129.60
DIGESTIVE	1343	999.2	1.34	275.7	118.31
CARDIOVASCULAR	1183	1010.7	1.17	236.2	29.38
TOTAL-DXS	8286	6235.9	1.33	1715.7	673.99

VERMONT AREA 1 - Population = 111107

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
TOTAL-DXS	14517	16962.1	.86	1385.2	352.47
ENDOCRINE	345	523.6	.66	34.5	60.94
NERVOUS-SENSE	1041	994.1	1.05	99.6	2.21
RESPIRATORY	1242	1766.6	.70	119.9	155.81
GENITOURINARY	1438	1757.8	.82	137.7	58.20
SKIN-MUSCULOSKE	1138	1241.1	.92	108.2	8.57
INJURIES,ADVERS	1617	1851.4	.87	149.7	29.67
MALIGNANT NEOPL	615	725.0	.85	66.2	16.69
CARDIOVASCULAR	1859	2009.7	.93	205.2	11.30
DIGESTIVE	2322	2654.2	.87	224.8	41.58

VERMONT AREA 2 - Population = 53337

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
TOTAL-DXS	9152	8669.3	1.06	1703.1	26.87
ENDOCRINE	289	281.8	1.03	53.1	.18
NERVOUS-SENSE	563	512.5	1.10	104.4	4.98
RESPIRATORY	1018	920.2	1.11	187.9	10.39
GENITOURINARY	1052	901.1	1.17	195.6	25.26
SKIN-MUSCULOSKE	571	632.0	.90	106.4	5.89
INJURIES,ADVERS	896	916.6	.98	167.7	.46
MALIGNANT NEOPL	417	424.2	.98	75.7	.12
CA-DIOVASCULAR	1331	1192.8	1.12	241.9	16.01
DIGESTIVE	1442	1382.7	1.04	267.4	2.54

VERMONT AREA 3 - Population = 52262

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
TOTAL-DXS	9472	8674.5	1.09	1763.9	73.31
ENDOCRINE	285	285.1	1.00	51.9	.00
NERVOUS-SENSE	597	508.4	1.17	111.5	15.45
RESPIRATORY	1055	912.1	1.16	197.0	22.40
GENITOURINARY	888	903.8	.98	165.3	.28
SKIN-MUSCULOSKE	716	633.2	1.13	133.4	10.84
INJURIES,ADVERS	1062	913.2	1.16	199.5	24.25
MALIGNANT NEOPL	427	435.3	.98	76.5	.16
CARDIOVASCULAR	1388	1241.4	1.12	243.8	17.31
DIGESTIVE	1448	1386.7	1.04	268.3	2.71

VERMONT AREA 4 - Population = 34124

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	217	174.1	1.25	65.1	10.59
MALIGNANT NEOPL	250	255.1	.98	76.2	.10
NERVOUS-SENSE	292	325.7	.90	85.3	3.49
SKIN-MUSCULOSKE	424	391.5	1.08	127.8	2.69
GENITOURINARY	573	554.9	1.03	173.6	.59
INJURIES,ADVERS	668	577.5	1.16	198.5	14.17
RESPIRATORY	660	584.6	1.13	192.6	9.72
CARDIOVASCULAR	798	715.4	1.11	244.4	9.54
DIGESTIVE	974	857.6	1.14	292.1	15.79
TOTAL-DXS	5977	5394.7	1.11	1791.7	62.86

VERMONT AREA 5 - Population = 24570

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	150	140.5	1.07	55.7	.64
MALIGNANT NEOPL	211	220.4	.96	74.4	.40
NERVOUS-SENSE	259	247.1	1.05	99.7	.58
SKIN-MUSCULOSKE	371	305.4	1.22	143.4	14.09
INJURIES,ADVERS	450	436.1	1.03	177.1	.44
GENITOURINARY	403	438.1	.92	154.7	2.81
RESPIRATORY	547	447.6	1.22	208.5	22.08
CARDIOVASCULAR	597	630.2	.95	207.5	1.75
DIGESTIVE	679	676.9	1.00	258.0	.01
TOTAL-DXS	4450	4211.9	1.06	1708.6	13.46

VERMONT AREA 6 - Population = 21704

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	186	117.8	1.58	82.4	39.44
MALIGNANT NEOPL	211	180.1	1.17	91.1	5.32
NERVOUS-SENSE	157	211.7	.74	70.6	14.13
SKIN-MUSCULOSKE	247	262.1	.94	111.2	.87
GENITOURINARY	403	374.5	1.08	180.9	2.17
INJURIES,ADVERS	382	376.6	1.01	174.1	.08
RESPIRATORY	394	381.6	1.03	176.2	.40
CARDIOVASCULAR	503	508.7	.99	216.6	.06
DIGESTIVE	701	575.2	1.22	313.4	27.49
TOTAL-DXS	3875	3595.3	1.08	1743.0	21.76

VERMONT AREA 7 - Population = 21270

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	110	116.7	.94	49.2	.39
MALIGNANT NEOPL	180	179.6	1.00	78.0	.00
NERVOUS-SENSE	159	207.7	.77	72.8	11.42
SKIN-MUSCULOSKE	296	259.1	1.14	134.8	5.25
GENITOURINARY	349	370.6	.94	158.4	1.25
INJURIES,ADVERS	441	371.2	1.19	203.9	13.12
RESPIRATORY	554	373.6	1.48	253.0	87.11
CARDIOVASCULAR	490	509.0	.96	210.9	.71
DIGESTIVE	668	568.2	1.18	302.3	17.54
TOTAL-DXS	3812	3547.4	1.08	1737.8	19.74

VERMONT AREA 8 - Population = 16432

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	108	93.3	1.16	60.4	2.31
MALIGNANT NEOPL	144	145.4	.99	77.0	.01
NERVOUS-SENSE	112	163.9	.68	65.0	16.43
SKIN-MUSCULOSKE	188	204.2	.92	108.7	1.29
INJURIES,ADVERS	272	292.2	.93	159.8	1.39
GENITOURINARY	356	293.0	1.22	204.3	13.53
RESPIRATORY	262	296.9	.88	150.6	4.10
CARDIOVASCULAR	352	416.9	.84	185.0	10.09
DIGESTIVE	394	451.1	.87	224.6	7.24
TOTAL-DXS	2635	2815.9	.94	1513.3	11.62

VERMONT AREA 9 - Population = 16551

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	117	94.2	1.24	64.8	5.51
MALIGNANT NEOPL	195	149.4	1.31	101.5	13.94
NERVOUS-SENSE	166	163.3	1.02	96.7	.05
SKIN-MUSCULOSKE	241	210.0	1.15	135.5	4.59
INJURIES,ADVERS	270	290.2	.93	159.7	1.40
RESPIRATORY	330	293.4	1.13	191.9	4.55
GENITOURINARY	419	301.2	1.39	233.9	46.10
CARDIOVASCULAR	486	421.3	1.15	252.7	9.94
DIGESTIVE	467	457.4	1.02	262.5	.20
TOTAL-DXS	3216	2826.3	1.14	1840.1	53.74

VERMONT AREA 10 - Population = 12913

DIAGNOSIS	OBSERVED	EXPECTED	RATIO	ARATE	CHISQUARE
ENDOCRINE	83	69.9	1.19	62.0	2.46
MALIGNANT NEOPL	148	106.3	1.39	108.2	16.32
NERVOUS-SENSE	139	126.6	1.10	104.5	1.22
SKIN-MUSCULOSKE	188	154.7	1.22	143.4	7.17
GENITOURINARY	312	220.8	1.41	237.6	37.65
INJURIES,ADVERS	278	223.8	1.24	213.3	13.15
RESPIRATORY	304	228.7	1.33	226.8	24.81
CARDIOVASCULAR	348	300.7	1.16	253.5	7.44
DIGESTIVE	404	340.9	1.19	304.8	11.69
TOTAL-DXS	2617	2132.1	1.23	1985.0	110.30

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