

WHY HOSPITAL ADMISSIONS HAVE DECLINED:

technologic change and changing patterns of care for cataract and diabetes mellitus

by

CARY SENNETT

B.S. Biological Sciences, Stanford University

(1975)

M.D., Yale University

(1982)

M.Phil. Human Genetics, Yale University

(1982)

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Signature of Author _____

Whitaker College of Health Sciences and Technology
May 4, 1990

Certified by _____

Jeffrey E. Harris
Associate Professor of Economics
Thesis Supervisor

Accepted by _____

Stan N. Finkelstein
Director, Program in Health Policy and Management

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ABSTRACT

After nearly two decades of regular increase, there was a sharp decline in the number of admissions to community hospitals after 1983. Some have suggested that this decline is a consequence of the implementation of national prospective payment for hospital care under Medicare, which began in that year. Others point to a variety of economic changes distinct from prospective payment, and attempt to account for the decline through some combination of those. While most agree that changes in medical technology have been impressive, the role that technology has played in explaining declining hospital use has not been thoroughly explored.

In this work, I attempt to better understand what has been responsible for the decline in hospital admissions after 1983. I focus in on two conditions--cataract, and diabetes mellitus--for which declines in rates of hospital admission have been especially large. For each case, I consider in detail how changes in economic conditions, and in medical technology, are likely to have contributed to observed declines in the number of hospital episodes for care of that condition.

The hospital has lost importance as the site for cataract care, because improvements in medical technology have drastically altered the nature of the care that patients with cataract receive. Although economic incentives have been offered to patients to seek, and to hospitals and alternative providers to supply, lens extraction at ambulatory sites, these incentives were extended after (and probably because) of improvements in intraocular lenses, and in the surgical technology required for lens extraction and insertion.

The hospital has lost importance as a site for diabetes care, because the development of effective methods to monitor blood sugar at home has reduced the frequency with which the common and less serious complications of diabetes occur. Although a number of incentive programs have been directed at reducing rates of admission for diabetes, the evidence suggests that these programs have had little independent impact.

Improvements in medical technology play a primary role in explaining why hospital admissions for these conditions have declined. Although the economic environment must offer incentives to choose ambulatory care in preference to hospital care, the introduction of economic incentives causes hospital admissions to fall only when technology permits. Furthermore, the economic environment may offer sufficient incentive without additional economic change; in this case, technologic change alone can cause admissions to decline.

The temporal relationship between technologic change and changing economic incentives discovered in this work implies that the systematic introduction of economic change--that is, the development of medical policy--has been in response to, or unrelated to, changes in the capacity to reduce hospital use. Insofar as this is true, the development of policy to control hospital use for patients with diabetes and cataract has been inefficient: opportunities to reduce hospital use have been lost or delayed, and more efficient use of health care resources has come with more disturbance than was needed.

A number of arguments suggest that these findings may be of general relevance. Insofar as that is true, more systematic consideration of what clinical practice implies can be done could lead to more effective economic policy; and to the development of policy strategies which take advantage of economic incentives already present, by directing (rather than responding to) technologic change in the medical practice environment.

Thesis supervisor: Jeffrey E. Harris, MD, PhD

Title: Associate Professor of Economics

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And now I understand.

CHAPTER 1

DECLINING HOSPITAL USE IN AN ERA OF PROSPECTIVE PAYMENT

I. INTRODUCTION

In the last decade, there has been a reversal of the longstanding trend toward the increasing use of the hospital for the care of the acutely ill.¹ Since 1981, there has been a marked decline in the number of inpatient days provided in non-federal short term ("community") hospitals.² This decline in inpatient days results from significant reductions in both number of episodes of care provided (that is, number of admissions), and average length of stay per episode of care provided. Significant reductions in the former are especially notable; although declines in average length of stay have been impressive, such declines represent the continuation of a secular trend which was manifest as early as 1968.^{3,4} In contrast, there were steady annual increases in the number of discharges from short-stay nonfederal hospitals in virtually every year after 1968, which increases have reversed--sharply--in each of the years since 1983.^{5,6} This trend in hospital discharges is summarized in figure 1.1.

¹American Hospital Association: Hospital Statistics, 1987 edition. Chicago, Ill.

²Farley DE: Trends in Hospital Average Lengths of Stay, Casemix, and Discharge Rates, 1980-85. (DHHS Publication No. (PHS) 88-3420). Hosp Studies Prog Res Note 11, National Center for Health Services Research and Health Care Technology Assessment. Rockville, MD: Public Health Service. April 1988.

³Cromwell J, Hewes HT, Kelly NL, Franklin S: Comparative Trends in Hospital Expenses, Finances, Utilization, and Inputs, 1970-1981. Health Care Financing Review 1987; 2:51.

⁴Luft HS: Diverging Trends in Hospitalization: Fact or Artifact? Medical Care 1981; 19:979.

⁵Hospital Care Statistics Branch, Division of Health Care Statistics: 1986 Summary: National Hospital Discharge Survey. Advancedata 1987; #145.

⁶Davis K, Anderson G, Renn SC, Rowland D, Schramm CJ, Steinberg E: Is Cost Containment Working? Health Care Financing Review 1985; 4:81.

The basis for this decline in hospital admissions has not been well established. It is not simply related to changing population size or age structure, as discharges per unit population,^{7,8} per unit civilian noninstitutionalized population,⁹ and age-adjusted per unit civilian noninstitutionalized population¹⁰ have fallen as well--in fact, more markedly. It has been suggested that changes in Medicare financing (the implementation of national Prospective Payment--PPS--for Medicare beneficiaries in fiscal year 1983) are responsible for observed altered patterns of hospital utilization.¹¹ Certainly, the timing of PPS, and the changes observed, is suggestive.

There are, however, reasons to question whether PPS has been responsible for this decline. As many analysts have pointed out^{12,13} the incentives embedded in prospective per-case hospital payment motivate higher rates of admission; empirical evidence from New Jersey--the

⁷ Moss AJ, Moien MA: Recent Declines in Hospitalization: United States, 1982-1986. *Advancedata* 1987; #140.

⁸Hospital Care Statistics Branch, Division of Health Care Statistics: 1986 Summary: National Hospital Discharge Survey. *Advancedata* 1987; #145.

⁹ Moss AJ, Moien MA: Recent Declines in Hospitalization: United States, 1982-1986. *Advancedata* 1987; #140.

¹⁰ Moss AJ, Moien MA: Recent Declines in Hospitalization: United States, 1982-1986. *Advancedata* 1987; #140.

¹¹Moss AJ, Moien MA: Recent Declines in Hospitalization: United States, 1982-1986. *Advancedata* 1987; #140.

¹²US Department of Health and Human Services: Report to Congress: The Impact of the Medicare Hospital Prospective Payment System, Annual Reports 1984 and 1985. Washington, DC.

¹³Vladek, BC: Comment on Hospital Reimbursement Under Medicare. *Milbank Memorial Fund Quarterly* 1984; 62:269.

first DRG¹⁴ state--suggest that implementation of DRG-based prospective payment does in fact lead to higher rates of hospitalization.^{15,16}

It may be that the declines in utilization evolve not from PPS itself, but rather from the utilization controls which have been attached to it. Because of the potential for abuse that exists in a strictly admissions-dependent hospital reimbursement plan, the Health Care Financing Administration (HCFA, which administers Medicare) employed Peer Review Organizations (PROs) to oversee hospital use under PPS. Specific goals of PROs included reduction of admissions for procedures that could be performed safely and effectively on an outpatient basis, and reduction of admissions which are inappropriate or unnecessary. Specific DRG's were also been targeted for admissions reductions. The decline in hospital admissions may be *prima facie*, albeit *post hoc*, evidence that PROs have been successful in addressing the concerns which motivated their employment, and have, in the process, effectively eliminated from the inpatient hospital inappropriate, unnecessary, or needlessly costly hospital care.

There is, however, much to suggest that PROs have not primarily been responsible for the decline in hospital admissions. From a theoretical standpoint, their great success would be surprising--prior utilization control efforts (such as Professional Standards Review Organizations, or PSROs) were famously unsuccessful in achieving "appropriate" hospital

¹⁴Diagnosis Related Groups; the units of hospital care for purposes of PPS reimbursement.

¹⁵Rosko MD, Broyles RW: The Impact of the New Jersey All-Payer DRG System. *Inquiry* 1986; 23: 67.

¹⁶Hsiao WE, Dunn DL: The Impact of DRG Payment on New Jersey Hospitals. *Inquiry* 1987; 24:212.

use.¹⁷ There seems no reason, *a priori*, to believe that the PRO's would do any better; particularly implausible that they would do so much better so quickly. That the PROs had the authority to disallow hospitalization does not imply that it was often the case that they did--or that the threat that they represented in that regard was credible. Through the end of 1987, PRO review had led to denial of only 2.6% of cases; subsequent reversal of nearly half of these meant that the true denial rate was only about 1.5%.¹⁸ In North Carolina, the one state in which a detailed analysis of the time course of hospital utilization changes has been published, admissions declined 11% between 1983 and 1984, even though "the Peer Review Organization in North Carolina was in an organizational state...(a)t the end of 1984."¹⁹ Furthermore, declines in hospitalizations for non-Medicare patients (whose hospitalizations would not be subject to PRO certification or review), appear to have begun before 1983.²⁰ These observations suggest that the explanation for declining rates of admission need not involve a PRO effect.

The 1970's and 1980's have been decades of tremendous change in the economic environment in which health care has been delivered. There have been important shifts in the number and distribution of persons with insurance against hospital care, and important changes in the nature of the policies that cover those persons. In particular, there have been new efforts to shift the costs of hospital care to insured persons themselves--through the more frequent use of

¹⁷Congressional Budget Office: The Impact of PSROs on Health Care Costs. US Government Printing Office, Washington DC. 1981.

¹⁸Medicare Prospective Payment and the American Health Care System: Report to Congress. Prospective Payment Assessment Commission (PROPAC) June 1988.

¹⁹Greene SB, DeMaria WJ: Hospital Utilization in North Carolina: Three Years of Decline. North Carolina Medical Journal 1986; February: 77.

²⁰see Luft (note 4) and Davis (note 6).

copayment provisions for medical care, and higher copayments where copayments already existed--in order to blunt new demand for high cost medical care; there has been the development of new forms of health care delivery--"managed care networks" which incorporate insurance into health care provider institutions; and there has been increasing regulation of health care delivery--through the development of a variety of "utilization review" programs, which attempt to establish the necessity of hospital care on a prospective, concurrent, or retrospective basis. There have been novel new programs, to offer incentives for care at sites other than the inpatient hospital, or disincentives for hospital care, when alternative sites for care exist. And there have been important and profound changes in the technology of medical care, which have created opportunities for new types of care and for care at new sites; and new opportunities for revenue that new care options imply. Each of these may have had an important impact on the use of the hospital in the 1980's; the extent to which each of these contributes to the decline in hospital admissions has not been established.²¹

Because the early 1980's was a period of such rapid and widespread economic change, it is potentially a serious error to attribute the decline in hospital discharges to PPS, or to the PPS-PRO,²² simply because these are so evident. The potential for error is great, because of the high degree of temporal correlation between the implementation of PPS and less obvious, but arguably no less important, other changes that were taking place. The potential for error is serious, because of the policy ramifications that come of misattribution of cause in this case: PPS has been such visible policy that surely it will be a model for policy yet to come. To the

²¹ Much of the remainder of this chapter focuses on the contribution that each of these may have made to changing rates of hospital admission. The reader interested in summary information on how economic conditions have changed, and summary estimates of the impact of those changes on hospital admissions, will find that in tables 1.8 and 1.9. The reader interested in the choice of variables for inclusion in those tables, and the rationale for selection of estimated values for them, will find that in the text that follows.

²² I have borrowed this from Sloan (see note 39), who uses the term to point out that the impact of PPS cannot be isolated from the impact of PROs because of their temporal correlation.

extent that desired effects are erroneously attributed to PPS, there is the real threat that future policy will be misguided, and that opportunities for rational policy-making will be lost. It is this concern that motivates the current work.

In the work that follows, I attempt to explain why hospital admissions²³ have declined and, in so doing, attempt to increase understanding of how the equilibrium volume of hospital care delivered is established. In the next section of this chapter, I propose a simple framework for analysis of the equilibrium number of hospitalizations. That permits me to specify the economic variables which may be relevant to an understanding of the problem at hand; following brief specification, I proceed to review in detail how those parameters changed in the early to mid-1980's.

Review of the changes that have taken place in those economic parameters suggested to have explanatory power permits me to consider to what extent those changes are likely to explain what has been observed; and to suggest a number of hypotheses which may permit alternative explanations to be evaluated. I submit a limited number of hypotheses, and, in the next chapter, introduce a dataset and methodology to test them. Preliminary analysis of the impact of economic change on hospital use--in chapter 2--suggests that no hypothesis is compelling in the face of the data at hand; in particular, consideration of the problem suggests that the analytic plan will have to be refined, to permit better estimation of some of the economic parameters, and explicit consideration of technologic change. I outline a strategy that will permit the analysis to proceed; detailed exploration follows in chapters 3 and 4.

In chapter 3, I consider the decline in the number of hospitalizations for the care of "cataract"--

²³ 'Admissions' and 'discharges' will be used synonymously throughout this work.

the clinical condition which I will demonstrate to be most important quantitatively to accounting for the aggregate decline in hospitalizations. I briefly describe the phenomenon; then in more detail consider whether there have been changes in the economic milieu that are especially relevant to understanding changes in the volume of hospital care delivered to treat cataract, and to what extent those changes reasonably can account for changes in the supply or demand for such hospital care. In chapter 4, I focus on "diabetes mellitus"--a clinical condition which I demonstrate also to be quantitatively important to the aggregate decline, though less important than cataract--and address the same issues.

In the final chapter of the work, I consider--more broadly--what lessons might be learned from this analysis, and briefly re-review the changing use of the hospital to test the relevance of these lessons to our general understanding of the subject. I conclude with a discussion of some of the implications of this work, for future work and for policy development.

II. ANALYTIC CONSIDERATIONS

As any other commodity, the quantity of hospital episodes observed at any point in time depends upon forces which affect the supply of, and demand for, hospital care .

A. SUPPLY OF HOSPITAL CARE

Those factors that determine the optimal supply of hospital care are those that affect the number of suppliers, and those that affect the tendency of any particular supplier to offer hospital (or alternative) care. It is convenient to consider the supply side problem as in any other economic context; namely, that observed supply is a function of the number of suppliers, and the solution to the maximization problem that each supplier faces. The number of suppliers is, in this

context, the number of hospitals; although there is some disagreement about the form of the optimization problem that each hospital faces, it is not unreasonable to work from the problem that producers face generally: namely, to maximize profit subject to factor prices and production feasibility constraints.

From this perspective, observed supply (S) equals $\sum_j n_j s_j$, where j indexes hospitals (suppliers), n_j is the number of hospitals of type "j," and " s_j " is the solution to the profit maximization problem that each hospital of type "j" faces. Clearly, n_j is a function of hospital capacity--either number or size; s_j is a function of (supply) price, factor costs, and technologic constraints which describe what can be produced, and how. Obviously, changes in the market price for hospital care, and in factor costs, may affect the solution to the supply problem. Thus, for example, the introduction of Medicare's prospective payment system--because it is a mechanism for setting the price of hospital care--may have been expected to affect the supply of hospital care.

B. DEMAND FOR HOSPITAL CARE

The demand for hospital care--as the demand for any other commodity--derives ultimately from consideration of the utility to be derived (at the margin) from the acquisition of the next unit of hospital care, relative to other commodities. The economic factors that are relevant to understanding the demand for hospital care are therefore, no different from those relevant to understanding the demand for any other commodity. Thus, aggregate demand will depend upon the size of the population; the number of persons of each type (if persons have different preferences); the (net) price of hospital care;²⁴ and the income available to each for the purchase of commodities. Because health insurance against hospital care is so prevalent in the

²⁴and the price of substitutes; that is, it is the price of hospital care relative to substitutes for it that determines the demand for hospital care (relative to substitutes).

current medical marketplace, the price, and income available, for the purchase of health care are extremely distorted. It is necessary, and politic, to fold any discussion of these into a discussion of the extent to which the average person is covered by health insurance, and the nature of the health insurance policies that obtain.

The observed quantity of hospital episodes (admissions, or discharges) is, therefore, a complex function of supply- and demand-side forces. These forces are not fundamentally different from those that set the observed quantity of any other commodity--that is, they are descriptors of the number of relevant persons/parties to the transaction, the "prices" and "costs" that each of them faces, and the constraints on production that govern what they may do. Measures of populations, and of prices and costs, have permitted analysis of the relevance of these to the volume of hospital care to proceed. However, because no satisfactory summary measure for "medical technology" has been developed, the relationship between changing technology and the volume of hospital care has been especially refractory to investigation.

It is worthwhile, therefore, to consider why it might be necessary to evaluate the role of changing medical technology on the matter at hand. It may be clear from consideration of the above that changing medical technology can affect the supply of hospital care in at least two distinct ways. By changing the productive relationship between alternative factors (eg capital and labor), technologic change may change the profit to be expected from alternative supply decisions. More simply put, changing technology may make it less costly to supply a given amount of hospital care: insofar as it does, it is likely that it will induce the supply of more care. As it has been observed that hospital care has declined, it is necessary to suggest, rather, that changing technology may have induced higher costs of production, and thereby induced supply contraction. Intuitively, that is unreasonable; it is more reasonable, however, and analytically identical to suggest that changing technology may have driven the hospital to solve

a multi-product supply problem by offering more of an alternative product (such as outpatient care), by motivating the substitution of resources which are now more efficiently spent on that alternative product away from the supply of inpatient care. Thus, technologic change may have lowered the cost of alternative uses for labor and capital, and thereby increased the opportunity (rather than the explicit) cost of supplying inpatient care.

Alternatively, changes in technology may enable the supply of inpatient care which is different with respect to some of its attributes; that is, it may expand the feasible production set, and thereby enable the production of care which had been constrained by virtue of technologic infeasibility. Again, this somewhat reconfigures that question of "what is the hospital supplying:" in this case, hospital inpatient care is a heterogeneous product (or set of products), and the hospital may--in the face of changing technology and new technologic capacity--elect to provide a new type of care (which had not been possible before). That new "product," however, will be measured as a hospital episode (that is, an "admission") in any analysis which fails explicitly to account for changing product mix.

The role of medical technology in determining the demand for hospital care has never formally been described. In a very real sense, the impact of technology on the demand for hospital care is conceptually no different from its impact on the demand for any other commodity.

However, some unusual features of the demand for medical care suggest that its role may be especially important, and in some sense unique.

If consumers are heterogeneous with respect to preferences for hospital care (price and income held constant), and if the fraction of consumers with a given preference set is w_i , then the demand (D) for hospital care is simply the sum, across persons in state i , $w_i d_i$. Technology can affect aggregate demand D , therefore, if it changes the distribution of persons across

preference states (w_i), or if it affects the nature of the commodity (or some substitute) so as to change intrinsic demand for persons in a given preference state (d_i).

Do consumers have different preferences for hospital care; might the number of persons with preferences of a given sort be subject to change as technology changes; and might changing technology affect the demand for care, for persons with stable preferences? Almost certainly, all of these are possible: clearly, persons who are critically ill are likely to seek hospital care to a greater extent than those who are well--so that the number of persons who are critically ill at any point in time might be a determinant of the observed demand for hospital care. The development of a technology which changes the number of persons who are critically ill at any point in time may have a profound impact on the demand for hospital care.²⁵ Similarly, preferences for hospital care among those critically ill may change with the development of new hospital capacities to respond to critical illness.²⁶ Finally, changing technology may facilitate changes in the cost of production--hence in the market price--of care which is preferred at one price, but not at another.²⁷ These effects, of course, are conceptually no different than pertain to any commodity where preferences vary, and attributes change over time or space.

It is not the purpose of this work to specify the relationships that exist between technology--or any of the other relevant supply and demand parameters--and the equilibrium volume of hospital care quantitatively and precisely. Rather, I hope to be able to use this general

²⁵consider what must have been the impact of the polio vaccine on the demand for hospital care.

²⁶consider what must have been the impact of the development of the "iron lung" (to manage respiratory paralysis) on the demand for hospital care, prior to the development of the polio vaccine.

²⁷for purposes of consistency, consider the development of the Sabin (oral) vaccine for polio. It is likely to have increased the demand for vaccine care, by lowering the (human) 'price' of vaccination, and thereby to have further reduced the demand for hospital care. Other examples will be considered elsewhere in the text.

specification to elucidate the qualitative relationships that have been important. Toward that end, I next review what is known about the relative importance of those factors that are expected (from consideration of the above) to bear on the supply of, and demand for, hospital care: how those factors changed over the 1980's and how those changes might have been expected to affect (sign and magnitude) the use of the hospital. This sets the stage for the analysis that proceeds in the chapters that follow.

III. REVIEW OF THE ECONOMIC MILIEU, 1980-1986

A. "SUPPLY-SIDE" FORCES

The supply of hospital care depends upon the number of suppliers of that care, the capacity of each to supply care, market prices, and the technologic constraints on production which limit what can be produced, and at which cost. The quantitative relationship between these variables and the supply of hospital care, and a review of the trend in these variables between 1980 and 1986, follows. These permit estimation of (an order of magnitude) effects of each on the supply of hospital care; these effects are summarized in table 1.9.

1. Changes in hospital capacity

Decline in the capacity of the average hospital to supply inpatient care, or in the number of hospitals that supply inpatient care, would be expected to reduce the equilibrium number of hospital episodes on a proportional basis. Table 1.1 summarizes the number of hospitals and hospital beds--measures of supply capacity--and percent bed-occupancy--a measure of capacity utilization--between 1980 and 1986.

Between 1980 and 1983, the number of hospitals declined slightly, although total bed capacity increased. Between 1983 and 1986, however, there were marked declines in the number of

hospitals (nearly 2%), and hospital beds (nearly 4%). Capacity utilization (occupancy; summarized in the right hand column of the table), however, declined. As a consequence, it seems more likely that the decline in hospital capacity was a result of--than a cause for--the decline in hospital admissions between 1983 and 1986. The net effect of changes in hospital capacity on the supply of hospital care is estimated, therefore, to be zero.

2. Changes in the market price of hospital inputs and outputs

Under historically stable cost-based reimbursement, the revenues associated with hospital care bore a (relatively) consistent relationship to the costs of that care. Under such a reimbursement scheme, the price of hospital outputs could be adjusted to reflect higher factor prices; and hospital margins could (for the most part) be maintained even in the face of rapid inflation in the factor market. With the implementation of prospective payment, however, (per case) hospital revenues were fixed, so that margins were variable (and could be negative). It is conceivable that such a change in financing could have caused the contraction of hospital supply--although, as has been pointed out, the economically reasonable response was (at the margin) to increase it. As a result, it is necessary to consider whether hospital margins declined under prospective pricing; and whether (to the extent that they did, or might have) the diffusion of prospective/per-case reimbursement systems into the insurance mechanism for hospital care can logically be implicated in accounting for the decline in rates of hospitalization.

Unfortunately, the marginal cost data needed to adequately address the theoretical relationship between market price and optimal supply are not available; what data there are, however, suggest that the appropriate response to prospective pricing ought to have been to increase the supply of hospital care. To begin with, Medicare's prospectively determined rates were set so as to be revenue neutral; that is, were set at national averages, so that, on average, hospitals would do neither worse nor better financially. Under such a system, the economically rational

supply response is to extend additional hospital care to those who are (on average) less costly to care for, and to attempt to restrict care to those who are (on average) more costly to care for. Because it was anticipated that hospitals would be better able to supply new care to those less sick than to withhold care from those more so, it was expected that hospital admissions would increase.

That they did not, or that they declined, does not establish that marginal admissions were associated with negative profits. One may at least impute that they were not, from those observations that suggest that hospital profits increased under PPS.²⁸ This suggests that hospitals face increasing marginal cost functions (so that costs decline more rapidly than price, under fixed price systems), or that hospital supply reductions were secondary to other factors. The reasonableness of these alternatives depends upon consideration of those other factors.

There is limited empiric work that speak directly to the effect of prospective hospital payment on hospital supply. A review by Morrissey et al in 1984 reports no studies which established significant reductions in hospital admission as an effect of hospital rate-setting.²⁹ Recent reviews of the Medicaid experience suggest that no sustained decline in hospital admission

²⁸Sheingold, SH: The First Three Years of PPS: Impact on Medicare Costs. Health Affairs 1989; Fall: 191. Lave, J: The Effect of the Medicare Prospective Payment System. Ann Rev Public Health 1989; 10: 141. See also Feder J, Hadley J, and Zuckerman S: How did Medicare's Prospective Payment System Affect Hospitals? New Engl Journ Med 1987; 317(14): 867.

²⁹Morrissey MA, Conrad DA, Shortell SM, Cook KS: Hospital Rate Review: A Theory and an Empirical Review. Journ of Health Econ 1984; 3:25

rates followed the implementation of prospective payment to state Medicaid populations.^{30,31}

Recent work to assess the impact of prospective payment on hospital supply has been confounded by the high degree of correlation between Medicare's PPS and other Medicare program changes (notably PRO review of hospital care) to which it was linked. Some of the earliest evaluations suggested that PPS might have no,³² or the anticipated positive^{33,34} impact on rates of hospital admissions. However, demonstration that Medicare rates of hospitalization declined in 1984, after annual increases between 1978 and 1983,³⁵ and that Medicare admissions in PPS hospitals declined between 1982 and 1984, while they increased in TEFRA hospitals,³⁶ suggested a negative impact of PPS on rates of hospitalization. Linear forecasting analyses by DesHarnais et al suggest statistically significantly fewer Medicare admissions to

³⁰Holahan JB, Adler G eds: Medicaid Program Evaluation: Final Report. Health Care Financing Administration, Washington DC. 1987.

³¹Hellinger FJ: Reimbursement under Diagnosis-Related Groups: The Medicaid Experience. Health Care Financing Review 1986; 8(2):35.

³²Smith DB, Pickard R: Evaluation of the Impact of Medicare and Medicaid Prospective Payment on Utilization of Philadelphia Area Hospitals. Health Services Research 1986; 21(4): 529.

³³Rosko MD, Broyles RW: The Impact of the New Jersey All-Payer DRG System. Inquiry 1986; 23:67.

³⁴Hsiao WE, Dunn DL: The Impact of DRG Payment on New Jersey Hospitals. Inquiry 1987; 24: 212.

³⁵Guterman S, Dobson A: Impact of the Medicare Prospective Payment System for Hospitals. Health Care Financing Review 1986; 7(3): 97.

³⁶Feder J, Hadley J, Zuckerman S: How did Medicare's Prospective Payment System Affect Hospitals? New Engl Journ Med 1987; 317(14): 867.

CPHA hospitals in the year,³⁷ or two,³⁸ after the implementation of PPS. Parallel changes in the non-Medicare population are attributed to the operation of "other factors." Sloan et al³⁹ have done a regression analysis of the impact of "PPS PROs"⁴⁰ on a variety of hospital cost and performance measures; they suggest a significant ($p < .01$) reduction of 5.3% in the number of admissions to AHA community hospitals in the first year after implementation of PPS. Finally, Scheffler et al⁴¹ have analyzed, econometrically, the impact of Medicare's PPS on hospital use in the Blue Cross/Blue Shield population. They suggest that the phase in of PPS was associated with a significantly ($p < .01$) lower rate of hospitalization among Blue Cross members; they estimate that the elasticity of admission rate with respect to PPS was -0.03 (that is, a 1% increase in the proportion of Medicare hospital days subject to PPS resulted in a 0.03% decline in admissions per thousand Blue Cross enrollees).

It is difficult from these to provide a point estimate for the elasticity of supply for prospective per-case payment. It seems likely that the effect is no greater than that suggested by Scheffler-- the larger effect that the Sloan work describes may well be (as the authors point out) attributable to the operation of other factors (including PROs). Whether the impact of prospective payment on hospital supply is in fact less than Scheffler suggests will require

³⁷DesHarnais S, Kobrinski E, Chesney J, Long M, Ament R, Fleming S: The Early Effects of Prospective Payment System on Inpatient Utilization and Quality of Care. *Inquiry* 1987; 24: 7.

³⁸DesHarnais S, Chesney J, Fleming S: Trends and Regional Variations in Hospital Utilization and Quality During the First Two Years of the Prospective Payment System. *Inquiry* 1988; 25: 374.

³⁹Sloan FA, Morrisey MA, Valvona J: Effects of Medicare Prospective Payment System on Hospital Cost Containment: An Early Appraisal. *Milbank Quarterly* 1988; 66(2): 191.

⁴⁰the authors' term, intended to capture the problem dissociating the effect of PPS from PRO.

⁴¹Scheffler RM, Gibbs JO, Gurnick DA: The Impact of Medicare's Prospective Payment System and Private Sector Initiatives: Blue Cross Experience, 1980-1986. Blue Cross Blue Shield Association paper. July 1988.

primary investigation. For the purpose of this analysis, I use Scheffler's estimate of -0.03.

Insofar as there may have been an effect of prospective pricing to constrain supply, that change in pricing can account for the decline in hospital admissions only to the extent that hospitals were subject to such prospective pricing systems. It is necessary, therefore, to consider to what extent there was diffusion of prospective payment systems into the medical market during the period during which hospital admissions were declining.

Prospective payment for Medicare beneficiaries (that is: prospectively set prices for Medicare admissions) diffused rapidly, about the time that hospital admissions began to decline.

Beginning in October 1983, hospitals (except those in four waived states) were paid under Medicare's DRG-based prospective payment system at the beginning of their next fiscal year; as a consequence, all hospitals (except those in New York, New Jersey, Massachusetts and Maryland) faced prospectively determined rates for Medicare-covered hospitalizations by October 1 of 1984.

Prospective payment by DRG's (or DRG-like fixed-price mechanisms) did not, however, come in to being for most Medicaid or private/commercial plans during that interval (October 1, 1983-September 30, 1984). At the time that that legislation requiring DRG-based PPS for Medicare was implemented, more than half of the 51 Medicaid programs were already paying hospitals on the basis of some prospective method.⁴² Most of these, however, were on an other-than-per-case (usually, per-diem) basis; DRG-like per-case reimbursement mechanisms

⁴²Zuckerman, S: Medicaid Hospital Spending: Effects of Reimbursement and Utilization Control Policies. Health Care Financing Review 1987; 2(2): 65.

were operating in no more than 4 states by the end of 1983.⁴³ Furthermore, the diffusion of per-case reimbursement into Medicaid was far from complete by the end of September, 1984: only 12 Medicaid programs had prospective payment-per-case reimbursement by the end of 1984;^{44,45} only 10 had by the end of 1985;⁴⁶ and probably no more than 18 had in 1986.^{47,48} An upper bound estimate of the number of Medicaid programs using DRGs suggests that only slightly more than half of all Medicaid programs included the features of Medicare's prospective payment system by the end of 1986.⁴⁹

Data on the diffusion of DRG/prospective (per-case) payment in the private/commercial population are somewhat less accessible, as central planning and financing do not occur, and as there is no mechanism for data collection/data sharing among the various private/commercial

⁴³Johns L, Adler GS: Evaluation of Recent Changes in Medicaid. *Health Affairs* 1989; 8(1): 171.

⁴⁴Zuckerman, S: Medicaid Hospital Spending: Effects of Reimbursement and Utilization Control Policies. *Health Care Financing Review* 1987; 2(2): 65.

⁴⁵Korda reports that there were 9 in her report : Korda, H: Innovations in Medicaid Hospital Reimbursement. Refining Prospective Payment Systems in the Eighties. Summary of State Programs, October 1985. Abt Associates, Cambridge MA. November 1985.

⁴⁶Johns and Adler; see note 43. It is likely that the difference between the 12 reported by Zuckerman in 1984, and the 10 reported by these authors, reflect different definitions of that which comprises a DRG-like prospective payment system rather than a policy change to eliminate such prospective payment in two states between 1984 and 1985.

⁴⁷Hellinger, FJ: Reimbursement Under Diagnosis-Related Groups: The Medicaid Experience. *Health Care Financing Review* 1986; 8(2) 35. Hellinger notes that there were 8 Medicaid-only DRG-based programs in operation in 1986, with four others imminent.

⁴⁸Polchow, M: State Efforts at Health Care Cost Containment: 1986 Update. National Conference of State Legislatures Health Care Cost Containment Project. December, 1986. Denver, CO.

⁴⁹assuming all non-respondents to the survey described in note 38 had such systems, there would be $14+2+9=26$, or just more than half of the 51 state programs.

insurers and Blue Cross plans. As a result, relevant data come largely from surveys of the commercial payers and Blue Cross plans; these surveys suggest that the time course over which prospective per-case reimbursement came into the private insurance market was much different from that of Medicare.

The Blue Cross experience is calculated from the data of Scheffler *et al* (Table 1, Appendix 1).⁵⁰ Between 1983 and 1986, the percentage of Blue Cross plans that reported that the "primary method of hospital payment" was based on a prospective rate rose from 0 to 24.2% (15 of 62). Another 4 plans (6.5%) primarily used prospective cost-with-formula determinations for hospital payment in 1986; a small increase over the number (3) that used such a method in 1983. Thus, there was a very rapid growth in the number of plans using hospital payment mechanisms that incorporated the key features of Medicare's DRG's; however, the number of plans using such prospective-rate based payment systems (primarily) was, by 1986, still less than one third of the Blue Cross plans surveyed. Furthermore, the diffusion of prospective payment mechanisms of all sorts into Blue Cross was incomplete in 1986; in that year, fully 30.6% of the Blue Cross Plans were still using primarily retrospective payment methods. Thus, the movement of rate-based prospective reimbursement into the Blue Cross population appears to have been much slower than into the Medicare population. Though less data are available to assess the growth of DRG's/similar prospectively set payment rates among the other commercial payers, a survey by The Equitable, done in early 1985,⁵¹ indicates that "prospective payments to hospitals based on so-called DRG's" applied probably to as little as 25%, and in any event to no more than 42%, of

⁵⁰Scheffler RM, Gibbs JO, Gurnick DA: The Impact of Medicare's Prospective Payment System and Private Sector Initiatives: Blue Cross Experience, 1980-1986. Blue Cross Blue Shield Association paper. July 1988.

⁵¹The Equitable: Corporate Initiatives & Employee Attitudes on Cost Containment. The Equitable Healthcare Survey III. Equitable Life Assurance Company. New York, 1985.

employees in that year. This suggests that the Blue Cross survey data may be representative of employer-provided health insurance generally; and that the diffusion of DRG's and similar prospective rate-based payment systems was, in the private sector as under Medicaid, much more sluggish than under Medicare.

These data suggest that the rational response to DRG/DRG-like reimbursement ought to have been to increase supply; but that the timing of DRG implementation is strongly suggestive that it (or some other variable tightly linked to it, for which it serves as proxy) may be important to explaining the decline in hospital admissions that has been observed. Table 1.8 summarizes the diffusion of prospective payment between 1980 and 1983 (when admissions were flat or rising), and between 1984 and 1986 (when they were falling sharply). Assuming a supply elasticity of -0.03, given changes in the penetration of prospective payment into various covered populations after 1983 (described above, and summarized in the first part of table 1.9), and using the distribution of covered persons in table 1.2, I calculate the aggregate impact of prospective payment on the supply of hospital admissions to be no more than -1.2%.⁵²

B. "DEMAND-SIDE" FORCES

Above, I suggest that the demand for hospital care is a function of the the size of the population that seeks care, and the distribution in that population of persons with different preferences; the (net relative) price of hospital care; and income. The profound importance of insurance against the costs of hospital care to the operation of this market suggests that, for purposes of this analysis, it is really the number of persons with health insurance, the costs that they face when they seek care, and their preferences that are important to understanding this demand. The impact of changes in the penetration and structure of health insurance are reviewed next.

⁵²Hospital admissions declined between 10.5% (AHA) and 11.7% (NHDS) between 1983 and 1986.

1. The number of persons with health insurance

Because the vast majority of persons in the United States have insurance against hospitalization, and because such persons are more likely to be hospitalized than are those without health insurance, it is reasonable to consider to what extent a decline in the number of persons so insured can account for the decline in hospitalization. Although non-comparability of these groups (with respect to health status, for example) make comparisons of hospitalization rates hazardous, it has been observed that persons without health insurance may be as much as 39% less likely to be hospitalized as persons with health insurance.⁵³

The number of persons covered against the costs of hospitalization by the major sources of that coverage are summarized in table 1.2. Because there is overlap (particularly, because there are many covered by Medicare who have additional private insurance against hospital costs), the total number of insured is less than the sum.⁵⁴

Declines in the rate of insurance against hospitalization between 1983 and 1986 were limited to those with private coverage; that number decreased about 3.7% between 1983 and 1986, and increases in coverage among those with public coverage were less than sufficient to account for that decline. Assuming that loss of health insurance reduces the demand for care by 39% (as above), contraction of private insurance may have reduced the number of hospitalizations by no more than $(.39 \times 3.7 =) 1.4\%$. Of course, if there were reciprocal increases in the number of persons covered by public payers (as table 1.2 suggests), then the decline in admissions

⁵³Freeman HE, Blendon RJ, Aiken LH, Sudman S, Mullinix CF, Corey CR: Americans Report on their Access to Health Care. Health Affairs 1987; 6(1):6.

⁵⁴Published estimates from the HIAA suggest that the insured population (though not specifically the population insured against hospitalization) numbered 202,107,000 in 1984; 204,235,000 in 1985, and 204,419,000 in 1986. [HIAA: Source Book of Health Insurance Data, 1989. Table 1.1].

anticipated from the loss of health insurance would be somewhat less.

2. The nature of the policies that cover persons with hospitalization insurance

Just as the rate of insurance was changing, so were the policies that were written; in particular, the 1980's was a period of rapid diffusion of insurance programs directed toward reducing the costs of medical care. Many of these programs attempted to do so by creating incentives which acted to reduce the demand for hospital care; the effectiveness of such programs, and their diffusion over time, are considered next.

(a) Changes in deductible and coinsurance rates

Patient copayment (deductible and coinsurance) for hospital care has long been felt to be an instrument to control the demand for hospital care; under insurance, it is only through these that the net price of hospital care can be affected. So long as hospital care is not completely price inelastic, increases in the deductible and/or coinsurance rate will be anticipated to decrease the demand for hospital care. Work from the Rand Health Insurance study⁵⁵ suggests that hospital care is price elastic. Although care must be taken when trying to isolate a pure effect on hospital demand (because hospital demand may be affected secondarily, if price affects demand for other types of care which may be substitutes for, or complements to, hospital care), the Rand group's estimates for the arc elasticity for hospital care (-0.14 to -0.17) provide the best empiric means to attempt to assess the impact of changing price on hospital use.⁵⁶

⁵⁵Manning, WG, Newhouse JP, Duan N, Keeler, EB, Liebowitz A, Marquis SM: Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment. *American Economic Review* 1987; 77(3):251.

⁵⁶ in a comprehensive review by Broyles and Rosko [Broyles RW, Rosko MD: The Demand for Health Insurance and Health Care: A Review of the Empirical Literature. *Medical Care Review* 1988; 45(2): 291.] there are no better estimates.

Aggregate hospital copayment rose from 7.8% in 1980 to 9.1% in 1983, and then to 9.4% in 1986.⁵⁷ Assuming that hospital prices to the insured beneficiary rose in direct proportion to copayment, and assuming an elasticity of approximately -0.20, then the decline in demand that would have been expected as a consequence of the increase from 9.1% to 9.4% is approximately 0.66%.⁵⁸

It is possible that aggregated copayment does not capture changes in deductible and coinsurance provisions adequately to permit assessment of the magnitude of these changes in the population. Tables 1.3 through 1.6 provide additional detail on the nature of the changes that affected various insured populations.

Table 1.3 summarizes changes in the magnitude of deductibles and coinsurance rates for Medicare beneficiaries between 1980 and 1986. The deductible for mandatory (part A insurance) is set equal to the cost of one hospital day; between 1980 and 1986 that increased, in real terms, at a regular rate. The fractional increase in part A deductible increased at virtually the same rate between 1980 and 1983 as between 1983 and 1986. The deductible for supplementary (part B) insurance increased slightly between 1980 and 1983, and then decreased slightly between 1983 and 1986; it is likely that these small changes are truly not important. Hospital coinsurance for days 0 to 60 in any benefit period (year) is 0; for days after that, it is indexed to the price of a hospital day (25% of the deductible for days 61-90; with a lifetime reserve for additional hospital days at 50% of the deductible per day). As a

⁵⁷ From tables 14 and 16 in: Division of National Cost Estimates, Office of the Actuary, Health Care Financing Administration. National health expenditures, 1986-2000. Health Care Financing Review 1987; 8(4): 1. Aggregate copayment for hospital care is taken to be the ratio of direct consumer expenditures for hospital care to expenditures from all sources for hospital care.

⁵⁸The elasticity of demand for hospital care would have to be on the order of -3.0 (that is, approximately 15 times greater than the RAND estimate) in order to account for an approximately 11% decline in hospitalizations in the setting of a 3.3% increase in net price.

result, there was effectively no change in part A coinsurance for persons who had fewer than 61 days of hospitalization in any calendar year over this interval; fractional changes in coinsurance rate for persons receiving more hospital care than this are identical to those above. The coinsurance rate for supplementary (part B) insurance--remained invariant at 20% between 1980 and 1986.

Copayment for hospital care under Medicaid is not common; in 1986, only 10 state Medicaid programs required copayment or deductible contributions from the beneficiary receiving hospital care (an 11th state--Arizona--required copayment for non-emergency surgery, but no beneficiary could be denied care because of inability to pay the copayment).⁵⁹ Two additional states required copayments for physician services which, of course, implied some copayment by the recipient of hospital care. Average deductible and coinsurance rates in these Medicaid programs are not available.

Copayment rates for care funded through private (nongovernment) sources can be estimated as the ratio of direct consumer expenditures for hospital care to total expenditures for hospital care exclusive of government payments;⁶⁰ Aggregate copayment rate estimates are presented in table 1.4. These data indicate the fraction of hospital expenditures that came directly out of pocket increased more significantly between 1980 and 1983 than between 1983 and 1986; somewhat in contrast to the more regular increase apparent from consideration of the Medicare data (above), and somewhat counterintuitive given that hospitalization rate declined only

⁵⁹Polchow, M: *State Efforts at Health Care Cost Containment: 1986 Update*. National Conference of State Legislatures Health Care Cost Containment Project. December, 1986. Denver, CO.

⁶⁰This estimator is imperfect; it is the ratio of total out-of-pocket expenditures for hospital care to total private (out-of-pocket plus private insurance) expenditures for hospital care. The numerator therefore includes out-of-pocket expenditures for persons covered with public insurance, and persons uninsured. As a result, the ratio is relatively high; the accuracy of the trend is uncertain. The problem is discussed subsequently in the text.

toward the later part of the interval. However, because the fraction of expenditures that comes directly out of pocket (calculated as I have) will vary with changes in public copayment rate, and as it may increase as the rate of insurance declines, it does not necessarily follow that copayment rate (for persons with private insurance) followed this pattern.

It is possible to assess trends in copayment rates, given private insurance, although it is difficult to present meaningful aggregate statistics for, for example, average deductible or coinsurance rate. That is so because such calculations are complicated by the fact that hospital coverage may be under a basic plan (for which there typically is no copayment⁶¹), a major medical plan (for which there typically is a deductible or coinsurance requirement,⁶² or both⁶³), or both; by the fact that the nature of copayment under major medical has changed over time; and by the fact that the fraction of persons receiving hospital coverage under one or the other has changed over time. However, it is possible to show that the fraction of persons with "basic" hospitalization coverage declined after 1980 (so that more persons faced copayment under major medical plans),⁶⁴ and that copayments (both deductible amounts and

⁶¹Frumkin, RN: Health Insurance Trends in Cost Control and Coverage. Monthly Labor Review 1986; September: 4.

⁶²see Table I of "Controlling the Cost of Health Care: Recent Trends in Employee Health Plan Design. Employee Benefit Research Institute (Brief #23). October 1983. The fraction of employees in new comprehensive major medical plans facing a deductible or first dollar copayment was 93.4% in 1982.

⁶³Frumkin, RN: Health Insurance Trends in Cost Control and Coverage. Monthly Labor Review 1986; September: 4.

⁶⁴Short, PF: Trends in Employee Health Benefits. Health Affairs 1988; 7(3): 186.

coinsurance rates) increased for those with major medical plans. Relevant data are summarized in tables 1.5 and 1.6.⁶⁵

In total, these data suggest that there were significant increases in the net price of hospital care to both the Medicare and privately insured populations during the 1980's, but that much of that increase occurred relatively early in the decade. Assuming that the relevant rates of copayment increase are those that obtained in the Medicare and private populations between 1983 and 1986,⁶⁶ and using values from tables 1.3 and (calculated from) table 1.4, then average coinsurance increased about 10%. The impact of such a change on the volume of hospital care purchased is estimated to be -2.0%.

(b) The growth of prepaid group practice ("managed care")

The late 1970's and early 1980's was a period of rapid growth of so-called "managed care."⁶⁷ Because it is widely accepted that HMO care is associated with substantially (~25%) lower

⁶⁵ Additional data from Chollet, DJ: Employer-Provided Health Benefits; Coverage, Provisions, and Policy Issues. Employee Benefit Research Institute, Washington. 1984. suggests that the fraction of employees with first dollar coverage (no copayment or deductible) declined from 36.3% in 1980 to 6.6% in 1982, suggesting that the interval 1980-1983 was a period during which private coinsurance was increasing. No data are available from that source after 1982.

⁶⁶and that copayment is not important to, or did not change for, those under Medicaid

⁶⁷by "managed care," I here mean health maintenance organizations (HMOs) and preferred provider organizations (PPO's)--that is, multiprovider institutions which have assumed some or all of the insurance function as well as the provider function. The use of "managed care" instruments (such as "utilization review" and "preadmission certification"--now relatively common among indemnity plans, is considered subsequently and separately.

rates of hospital admission,^{68,69} it is necessary to consider what impact the expansion of HMOs might have had on the purchase of hospital care.

Total enrollment into HMO's is summarized in table 1.7. Between 1980 and 1983, HMO enrollment increased nearly 40%; between 1983 and 1986, it nearly doubled. However, these fractional increases hide the fact that absolute increases were much smaller--in 1986, there were only slightly more than 11 million more persons enrolled in HMOs than there were in 1983. Assuming that there were approximately 204 million persons with health insurance in 1986,⁷⁰ less than 12% (approximately 11.6%) of the insured population (and less than 10% of the total population) was enrolled in HMOs, and less than 6% enrolled between 1983 and 1986. Assuming that enrollment into an HMO reduces the probability of hospitalization (hence the population rate) by 25%, then the percentage decline in hospitalization expected as a consequence of HMO enrollment increases between 1983 and 1986 is only about 1.3%.

Again, aggregation may hide important differences, if populations are differentially sensitive to the demand constraints imposed by HMO enrollment. While it is not possible to show precisely how rates of enrollment growth in HMOs has varied among the Medicare-, Medicaid-, and privately insured, it is rather clear that rates have varied among them; particularly, that HMO enrollment among the Medicare (and, to a lesser extent Medicaid) populations has been appreciably slower than among those under private insurance. Medicare enrollment into HMOs

⁶⁸Luft, H: *The Operation and Performance of Health Maintenance Organizations*. Washington DC. US Government Printing Office. October 1981.

⁶⁹Manning W, Lubowitz A, Goldberg G, W Rogers W: A controlled trial of the effect of a prepaid group practice on the use of services. *New Engl Journ Med* 310(23): 1505. 1984.

⁷⁰HIAA estimate (see note 4 54); this is approximately 14% less than the sum of the figures in table 1.2, and reflects irreducible double coverage (for example, Medicare persons with private "Medigap" coverage).

was essentially limited to demonstration-projects which began in 1980, until the implementation of the "risk-contracting" provisions of TEFRA in 1985.^{71,72} Medicare enrollment into HMO's increased rapidly after that: in September 1985, there were an estimated 552,096 Medicare HMO enrollees; by December of 1986, that number had reached 1,025,446.⁷³ However, that represented only 3.44% of the 29,837,534 Medicare beneficiaries with hospitalization insurance in 1986.⁷⁴

Medicaid enrollment into HMOs followed a similar course: Medicaid enrollment in HMOs in 1981 was approximately 187,000 (or less than 1% of Medicaid beneficiaries); by the end of 1984 it had risen to approximately half a million (or about 2.3% of the Medicaid population); and by the end of 1986, to 802,750 (or 3.6% of the population).⁷⁵ Although it is hazardous to attempt to estimate rates of enrollment increase from such figures, it seems reasonable to suggest that the increase in Medicaid enrollment may have begun earlier, and been somewhat more linear, than the increase in Medicare enrollment.

⁷¹Ellwood, DA: Medicare Risk Contracting: Promise and Problems. *Health Affairs* 1986; 5(1):183.

⁷²Gruber LR, Shadle M, Polich CL: From Movement to Industry: the Growth of HMOs. *Health Affairs* 1988; 7(3): 197.

⁷³McMillan A, Lubitz J, Russell D: Medicare enrollment in health maintenance organizations. *Health Care Financing Review* 1987; 8(3): 87.

⁷⁴Gornick et al (Gornick, M, Greenberg JN, Eggers PW, Dobson, A: Twenty years of Medicare and Medicaid: Covered populations, use of benefits, and program expenditures. HCFR 1985 Annual Supplement:13) report somewhat different estimates for the number of Medicare enrollees into HMOs and other capitated medical plans (CMPs): 595,000 in 1981, and 1,117,000 in 1985. They estimate that the fraction of Medicare beneficiaries enrolled into HMOs and CMPs rose from 2% in 1981 to 3.7% in 1985, largely as a consequence of TEFRA. While the time trend implicit in their estimates is somewhat different in detail from those estimates already presented, all data suggest that (1) HMO enrollment in the Medicare population was relatively unimportant until the implementation of TEFRA (1985) and (2) HMO enrollment towards the end of the study interval (1985/1986) was about 3.5% of the Medicare population.

⁷⁵Gruber LR, Shadle M, Polich CL: From Movement to Industry: the Growth of HMOs. *Health Affairs* 1988; 7(3): 197.

These contrast with the overall growth of HMOs, which we see, from table 7, was already substantial by 1980. Assuming that there were no more than about 500,000 public enrollees in HMOs in 1980, no more than about 1,000,000 in 1983, and approximately 2,000,000 by the end of 1986, then the percentage of persons with private hospitalization insurance who belonged to HMOs was, in 1980, 4.6; in 1983, 6.2; and in 1986, 12.1. Thus, on a proportional basis, the penetration of HMOs into the market for health insurance began earlier, and proceeded more rapidly, in the private market than in the public markets. The penetration into all markets, however, accelerated in the interval during which hospitalizations began to decline.

(c) Utilization review

The 1980's witnessed the growth of a variety of "utilization review" programs aimed at controlling the use of hospital services. Among the many programs which were operational by 1986 (and, therefore, may be implicated in the decline in hospitalizations which occurred toward the middle of the 1980's), a few both were directed at hospital admission, and clearly diffused during the period 1980 to 1986. It is necessary to consider whether these programs are known to have the impact that they were designed to have; and to what extent their diffusion was sufficient to account for an effect.

Among the utilization review programs that were most prominent in the 1980's, and most likely to have an impact on hospital admission rate, were programs directed at certification of hospital care before-the-fact (hospital pre-certification, or "PC"), after the fact (retrospective review of hospital claims for appropriateness of hospital care, with [at least the threat of] denial of payment, where care is judged to be inappropriate), and second-opinion programs to

evaluate planned surgery. Hospital UR, and second surgical opinion programs, are considered in turn.

(i) Hospital UR

The impact of hospital UR on hospitalization rate has been the subject of a small number of analyses; these suggest that that impact may be substantial.

The work of Scheffler, and Sloan, which are relevant to this discussion insofar as either suggests that the impact of PPS was mediated--not through financing incentives, but--through linkage with PROs, has been reviewed already. These authors suggest that PPS (or the PRO component) could account for as much as a 3% decline in (Blue Cross/Blue Shield) admissions,⁷⁶ and at least a 5.3% decline in total admissions.⁷⁷ Feldstein et al,⁷⁸ and Wickizer et al,⁷⁹ evaluated the impact of UR (precertification and concurrent review of hospital care) on the use of medical services in 222 insured groups of a single private carrier between 1984 and 1985, and 223 groups of that carrier between 1984 and 1986, some fraction of which had adopted UR measures. The impact of UR was evaluated econometrically by inclusion of a dummy variable for UR in (weighted least squares) regressions. The effects on average admission rate attributed to UR were, in these analyses, -12.3% and -13.0% (respectively);

⁷⁶Scheffler RM, Gibbs JO, Gurnick DA: The Impact of Medicare's Prospective Payment System and Private Sector Initiatives: Blue Cross Experience, 1980-1986. Blue Cross Blue Shield Association paper. July 1988.

⁷⁷Sloan FA, Morrisey MA, Valvona J: Effects of Medicare Prospective Payment System on Hospital Cost Containment: An Early Appraisal. *Milbank Quarterly* 1988; 66(2): 191.

⁷⁸Feldstein, PJ Wickizer TM, Wheeler JRC: Private Cost Containment: The Effects of Utilization Review Programs on Health Care Use and Expenditures. *New Engl Journ Med* 1988; 318(20):1310.

⁷⁹Wickizer TM , Wheeler JRC, Feldstein PJ: Does Utilization Review Reduce Unnecessary Care and Contain Costs? *Medical Care* 1989; 27(6):632.

these were highly significant, and compare with estimates that have been reported elsewhere after less rigorous evaluation.⁸⁰

There is little to permit one to rigorously establish the differential effects of precertification and retrospective review. All of the work cited above looked either at PC programs, or at UR that included both; experience suggests that retrospective review has been virtually ineffective at affecting hospital demand. Thus, I suggest that the effect of UR is entirely attributable to (and limited to) precertification programs, and that the elasticity of demand with respect to precertification is -0.13. The effect of retrospective review is, by assertion, zero.

Given the relatively large potential impact that PC utilization review is suggested to have, it is necessary to consider to what extent it was prevalent during the period when hospital admissions declined. The diffusion of hospital UR into various covered populations is described next.

Medicare

Review of hospital care for appropriateness was part of the PSRO program; the effectiveness of the PSROs at controlling hospital use, however, was never established, and the PSROs were defunded in 1982. Thus, the relevant initiatives in hospital utilization review, for the purpose of addressing the decline in hospitalizations which occurred later in the 1980's, clearly are those which relate to the implementation and operation of the Peer Review Organizations (PROs), established under the legislation which developed PPS.

⁸⁰Blue Cross/Blue Shield of Northern Ohio, for example, report a 13% decline in inpatient utilization following the implementation of their "CURE" precertification program. Same-Day Surgery, October 1984: 126.

Hospital utilization review under PROs is both retrospective and prospective;⁸¹ retrospective review was (in the first contract period: 1984-1986) required for a random sample of cases; for all admissions occurring within 7 days of a discharge; for all admissions for cardiac pacemaker implantation or reimplantation; and for all transfers. Preadmission review was required for every elective case in five procedure-related DRGs (chosen from state-specific lists of the top surgical DRGs in 1982). In addition, every PRO had defined admissions-reduction targets, and quality assurance targets, which necessarily involved additional retrospective review of cases, and could (and for many, did) involve additional preadmission review: thus, for example, it was common that PROs initiated preadmission certification for selected procedures in order to attempt to reduce the number of hospital admissions for those procedures, and it was common that PROs reviewed randomly selected records retrospectively to assess the quality of care delivered, and to identify problem hospitals/providers for intervention. Thus, both retrospective review and hospital precertification were obligatory parts of the utilization review process for every PRO; the extent to which one or the other might have dominated the operations of a single PRO, however, varied among them. HCFA estimates that about 25% of PPS admissions undergo PRO review; recent data show that 11% of reviews are preadmission reviews, and 89% are retrospective.⁸²

The diffusion into the Medicare population of UR is the time course of PRO operations. There was essentially no meaningful UR (after the dissolution of the PSROs) until late 1983; all PRO's had signed contracts by November 15, 1984. Dates at which the PROs became fully

⁸¹ this discussion of PROs depends upon review of several documents, including: Lohr, KN: Peer Review Organizations: Quality Assurance in Medicare." Rand P-7125. July 1985; Cislowski, JA: The Peer Review Organization (PRO) Program. Congressional Research Service document 87-258 EPW. March 25, 1987; and PROPAC: "Medicare Prospective Payment and the American Health Care System: Report to Congress. June 1988.

⁸²PROPAC: Medicare Prospective Payment System and the American Health Care System. Report to Congress, June 1988.

operational almost certainly varied--and it is almost certainly true that some PROs were not fully operational when contracts were signed (thus, by the end of 1984). It is a useful simplifying assumption to set the date at which UR was extended to the Medicare population to the date on which PRO contracts were signed; that assumption will compromise any analysis which depends too heavily upon it. Thus, there was rapid diffusion of preadmission certification and retrospective review to the Medicare program between late 1983 and late 1984; obviously, the timing of this expansion is consistent with the decline in hospitalizations which occurred, and a causal relationship has been suggested.

Medicaid

Like Medicare, Medicaid was served by the PSROs until that program ended. Under the Omnibus Budget Reconciliation Act of 1981 (OBRA), delegated review under Medicaid was made optional.⁸³ There was, after 1981, a rapid expansion of review initiatives into the various state Medicaid programs.

In 1980, there were only 3 state Medicaid programs which required prior authorization for all nonemergency hospital admissions, and 13 which required prior authorization for specific hospital services.⁸⁴ There was a rapid growth of these UR programs in the two years following OBRA, and, by 1983, 7 states required prior authorization for all nonemergency admissions, and 29 required prior authorization for specific services.⁸⁵ By 1987, between 60

⁸³Korda, H: Innovations in Medicaid Hospital Reimbursement. Refining Prospective Payment Systems in the Eighties. Summary of State Programs, October 1985. Abt Associates, Cambridge MA. November 1985.

⁸⁴Korda, H: Innovations in Medicaid Hospital Reimbursement. Refining Prospective Payment Systems in the Eighties. Summary of State Programs, October 1985. Abt Associates, Cambridge MA. November 1985.

⁸⁵Korda, H: Innovations in Medicaid Hospital Reimbursement. Refining Prospective Payment Systems in the Eighties. Summary of State Programs, October 1985. Abt Associates, Cambridge MA. November 1985.

and 65% of state Medicaid programs required preadmission review for at least some hospital admissions,^{86,87} and retrospective review was almost universal.⁸⁸ Thus, there was rapid but incomplete diffusion of UR initiatives to the Medicaid population after 1980; somewhat in contrast to Medicare, UR appears to have been stimulated by the regulatory relief that OBRA afforded, so that the period of rapid growth of hospital UR under Medicaid ended prior to the expansion of these UR programs into Medicare.

Private/Commercial

It is necessary to collate data from a variety of sources, in order to describe the growth of UR programs in the private/commercial sector. What data there are suggest that preadmission certification programs were relatively rare (but not unknown) in the private sector before 1983, but diffused rapidly, and linearly, thereafter, and that retrospective review was relatively common by 1984.

A Hewitt survey in 1984 reported that only 2% of companies used "preadmission utilization review (review of doctor's treatment plan prior to hospital admission)" as a cost management intervention in 1982.⁸⁹ A survey by AS Hansen, Inc,⁹⁰ suggests that 10% of employers

⁸⁶Lindsey, PA Medicaid utilization control programs: Results of a 1987 study. Health Care Financing Review 1989; 10(4): 79.

⁸⁷Polchow, M: State Efforts at Health Care Cost Containment: 1986 Update. National Conference of State Legislatures Health Care Cost Containment Project. December, 1986. Denver, CO.

⁸⁸Polchow, M: State Efforts at Health Care Cost Containment: 1986 Update. National Conference of State Legislatures Health Care Cost Containment Project. December, 1986. Denver, CO.

⁸⁹Hewitt Associates: Company Practices in Health Care Cost Management. Lincolnshire, IL 1984.

⁹⁰cited in Christofferson S, Jackson-Beeck M, Baker N, Hartwell S: Utilization Review: Past, Present, Future. Interstudy. Excelsior, MN. December 1983.

required preadmission certification before hospital admission in 1983, and a Harris poll survey of corporate benefits officers (CBOs) in 1983 suggests that 14% of CBO's indicated that their organization "had any experience with" "a system in which the patient has to obtain from the insurance company payment approval for specific expenses and length of hospitalization *prior* to nonemergency hospitalization.⁹¹ These suggest that PC programs rarely applied to those with private hospitalization insurance prior to 1984; estimates from the data of Feldstein⁹² support that.

Precertification programs began to diffuse to those privately covered thereafter. The Hewitt survey indicates that 26% of companies used PC in 1984.⁹³ Similarly, the percentage of CBO's who indicated that their company had "initiated utilization reviews by health care professionals" "during the last 3 years" was, in early 1985, 27%; the number reporting that they had "started a new program in which **employees are required to obtain approval** from the insurance company before non-emergency treatment" was 28%.⁹⁴ An HIAA survey of 121 commercial insurers, quoted in Ermann,⁹⁵ indicates that 21 percent of individuals covered by commercial (indemnity) insurance plans faced preadmission review in 1984. Feldstein's work suggests that the fraction of groups covered by UR had risen to

⁹¹The Equitable: Corporate Initiatives & Employee Attitudes on Cost Containment. The Equitable Healthcare Survey III. Equitable Life Assurance Company. New York, 1985.

⁹²Feldstein et al 1988 (see note 78). These data suggest that 40% of those 88 groups which had UR during the period 1984-1985 (out of 222 groups in total) had UR by January 1, 1984--that is, 16% of groups had UR in 1983.

⁹³Hewitt Associates: Company Practices in Health Care Cost Management. Lincolnshire, IL 1984.

⁹⁴The Equitable: Corporate Initiatives & Employee Attitudes on Cost Containment. The Equitable Healthcare Survey III. Equitable Life Assurance Company. New York, 1985.

⁹⁵Ermann, D. Hospital Utilization Review: Past Experience, Future Directions. *Journal of Health Policy, Politics and Law* 1988; 13(4): 683.

approximately 30% by the end of 1984, and 40% by the end of 1985. A business roundtable survey in 1986⁹⁶ suggests that 58.5% of that 85.9% of Roundtable companies that use UR had prospective (that is, pre-service) review programs--that is, 50% of companies did. Similarly, a followup HIAA survey in 1987 (also cited in Ermann) suggests that the use of preadmission certification among commercial carriers may have been nearly 50% by the end of 1986; according to that survey, 52% of large employers (>1000 employees), 36% of midsize employers (100-999), and 21 percent of small employers (<100 employees) required preadmission certification. Taken together, these data (from a large variety of sources) converge to suggest that the use of preadmission certification programs among those covered by employer-provided plans was rare before 1983; affected about 10-15% of the employee population in 1983; affected some 25-30% by 1984; some 40% by the end of 1985; and nearly 50% by 1986.

The diffusion of retrospective review into the commercial insurance market was somewhat different, and somewhat faster. The Hewitt survey of 1984 reports that retrospective review of hospital care was part of the health insurance plan at 18% of the companies surveyed in 1982, and of 40% of those surveyed in 1984.⁹⁷ The Business Roundtable survey of 1986 indicates that nearly 70% of Roundtable companies (80% of the 86% of companies using any sort of UR) employed retrospective utilization review in 1986.⁹⁸

While the Blue Cross experience is, in fact, subsumed under the experience of the

⁹⁶Corporate Health-Care-Cost Management and Private-Sector Initiatives. Results of the 1986 Business Roundtable. (c/o Cocks, DL. Eli Lilly and Company. Indianapolis, IN) 1987.

⁹⁷Hewitt Associates: Company Practices in Health Care Cost Management. Lincolnshire, IL 1984.

⁹⁸Corporate Health-Care-Cost Management and Private-Sector Initiatives. Results of the 1986 Business Roundtable. (c/o Cocks, DL. Eli Lilly and Company. Indianapolis, IN) 1987.

private/commercial carriers (Blue Cross plans accounted for about 40% of persons with private hospitalization insurance in the 1980's), it may still be worthwhile to consider the data that describe the Blue Cross experience independently, because such data are available in good detail. In 1980, 95% of Blue Cross plans surveyed indicated that they had retrospective utilization review plans;⁹⁹ the Blue Cross/Blue Shield Association cost containment survey administered in those years did not inquire of preadmission certification (so perhaps we can assume that such programs were rare). The frequency with which BC plans reported extant retrospective review programs remained in excess of 95% between 1980 and 1986; the frequency with which they reported preadmission certification programs rose from 27.9% in 1982 to 37.7% in 1983, to 67.2% in 1984 and to 95.1% in 1986. . Whether the higher rates of diffusion implicit in these data indicate that BC was ahead of other commercial payers; whether diffusion was more rapid to small plans than to larger ones (so that the fraction of persons covered by BC plans with PC was less than the fraction of plans employing PC); or whether these differences reflect different survey methodologies (and, perhaps, different definitions of UR) is unclear. In general, however, the lesson to be learned from the Blue Cross experience is not much different from that of the larger group of private and commercial carriers: namely, that retrospective UR proceeded more rapidly than did PC; that both were already in place in small number of plans by 1983; that PC diffused at a relatively constant rate between 1983 and 1986; and that by the 1986 at least half, but probably not all, persons covered with private health insurance were enrolled in plans in which preadmission certification was a feature.

These data suggest that hospital UR diffused importantly into all of the insurance markets, but at different rates and at different times. In particular, they suggest that there was no effective

⁹⁹Blue Cross data are from the BC/BS Association Annual Cost Containment Survey reported in Scheffler et al (note 41).

UR applied to the Medicare population before 1984, that perhaps 30% (or more) of state Medicaid programs had effective UR by then, and that 10% of those covered by private or commercial insurance faced potent UR; and that by 1986 effective UR was universal among those covered by Medicare, about 60% prevalent among state Medicaid programs, and no more than 60% prevalent among private/commercial plans. The estimated impact of the diffusion of UR after 1983 on hospital admissions, from these, the elasticity posited above (-0.13), and the distribution of those privately insured in table 1.2, is about 6.3%.

(ii) Second surgical opinion programs (SSOP)

A SSOP is a plan which requires that a beneficiary seek a second opinion prior to planned elective surgery; failure to do so implies a financial penalty. The penalty typically is in the form of a copayment differential--that is, the (net) price of surgery is lower to the patient who obtains a second opinion than to the patient who does not. SSOPs vary with respect to the magnitude of that differential; at one extreme, the insurer may refuse to pay entirely (100% copayment). SSOPs also differ with respect to the use of the information obtained at second opinion: some SSOPs require concurrence of opinion before surgery will be permitted; some require a third opinion when two opinions are different, and some require only that the beneficiary obtain the second opinion, and assume that the better-educated patient will make an intelligent decision. Finally, SSOPs differ with respect to the extent to which beneficiary participation is required: that is, participation may be mandatory (so that failure to obtain a second opinion implies a penalty, even if that opinion, in retrospect, would have validated the need for surgery), or they may be voluntary (so that the process of obtaining a second opinion is facilitated, and a penalty may be imposed if that opinion is obtained but ignored; but no penalty is imposed if no second opinion is obtained). Voluntary programs have had

especially little impact on rates of surgical care.¹⁰⁰ This discussion focuses on mandatory programs.

An estimate of the impact of these second opinion programs on the number of hospital admissions depends upon consideration of the impact of these programs on the rate of admission for elective surgery; upon the proportion of hospital admissions which are for elective surgery; and upon the rate at which these programs diffused. Ermann has reviewed the literature, and suggested that mandatory programs may reduce surgery rates from 3 to 23%.¹⁰¹ The Office of the Inspector General has estimated that mandatory SSOPs could reduce elective operations for Medicaid patients by 29%, and for Medicare patients by 18%.¹⁰² The proportion of persons hospitalized for elective surgery has not been reported. It can be estimated, however, from data that describe the nature of the hospital episode: I estimate that about 20% of hospitalizations for those under 65, and about 16% of hospitalizations for those 65 and over, were for elective surgery in 1983.¹⁰³ Assuming that those fractions obtain; that

¹⁰⁰Poggio E. *Second Surgical Opinion Programs: An Investigation of Mandatory and Voluntary Alternatives*. Abt Associates, Boston. 1981.

¹⁰¹Ermann, D: "Surgery and the Changing System of Health Care Delivery" in *Surgical Care in the United States: A Policy Perspective*, ML Finkler, ed. Johns Hopkins University Press, Baltimore. 1988.

¹⁰²Parks, P: *Mandatory Second Opinion Programs*. ACS Bulletin 1983; 68(10):25 cited in Ermann D: *Hospital Utilization Review: Past Experience, Future Directions*. Journ Health Politics, Policy and Law 1988; Winter: 683.

¹⁰³These values are calculated using data in "Utilization of Short-Stay Hospitals by Diagnosis Related Groups, United States, 1980-84." National Center for Health Statistics, Series 13 No. 87. 1986. The 20 most common DRGs for each age group were reviewed; all admissions to any DRGs which frequently would be for elective surgery were scored as elective surgeries. Elective surgeries for those under 65 included "dilation and curettage" (DRG 364); "abortion with dilation and curettage" (381); "tonsillectomy and/or adenoidectomy" (60); "nonradical hysterectomy" (355); "cholecystectomy" (198); and "inguinal and femoral hernia procedures" (DRG 162); for those over 65 they were "lens procedures" (39); "hip and femur procedures" (210); and "transurethral

the OIG estimates are reasonable; that rates of elective surgery (and sensitivity to a SSOP effect) are the same for those covered privately as by Medicaid; and that those under 65 are covered by Medicaid or by private insurance, then it is possible to estimate elasticities (fractional change in hospital admissions associated with use of SSOP) for persons in these covered groups. Those elasticities are -0.029 for Medicare, and -0.058 for those covered by Medicaid or private plans. From the distribution of covered persons in table 1.2, the population elasticity is -0.54.

The extent to which SSOPs were prevalent among covered populations is described below.

Medicare

SSOPs were not routinely part of the Medicare program until the passage of COBRA (1985), which required that PROs perform 100% pre-procedure review on at least 10 elective surgical procedures, and authorized the PROs to require second opinions as part of that review process.¹⁰⁴ In addition, the PROs were charged with responsibility for facilitating the second opinion process for beneficiaries who desired second opinions (an option made economically attractive to the beneficiary by COBRA).¹⁰⁵ The PRO SSOP was to be implemented by

prostatectomy" (336). Counts were inflated by the ratio of (sum of admissions in most common DRGs)/total admissions in 1983. Percentage of admissions which were for elective surgery is ratio of estimated elective surgical admissions to total admissions (times 100).

¹⁰⁴Cislowksi, JA: The Peer Review Organization (PRO) Program. Congressional Research Service document 87-258 EPW. March 25, 1987

¹⁰⁵Cislowksi, JA: The Peer Review Organization (PRO) Program. Congressional Research Service document 87-258 EPW. March 25, 1987

January 1, 1987.¹⁰⁶ Thus, there was little in the way of formal second opinion programs common to Medicare by 1986.

Medicaid

Medicaid SSOPs have been reviewed by Lindsey.¹⁰⁷ Before 1980, only two (of 44 responding) Medicaid plans (those in Massachusetts and Michigan) had mandatory SSOPs; by the end of 1983, that had increased to 6. By the end of 1986, 13 (of 44)¹⁰⁸ states had initiated mandatory SSOPs (although one of those was instituted in December of 1986). Thus, about as many states had mandatory SSOPs in 1983 as adopted them between 1983 and 1986. An additional 7 states and the District of Columbia had voluntary programs by 1986.

Private insurance

The growth of SSOPs in the private insurance market appears to have been faster than in the public market (especially Medicare); however, the data are somewhat confused because the distinction between programs that offer coverage for second opinions, and those that link payment differentials to those second opinions, often was not made until the mid-1980's.

The Harris/Equitable survey of CBOs suggests that SSOPs--not well defined--were already familiar in the private insurance market by 1983; 51% of CBOs surveyed indicated that they had "had any experience with "a program "requiring the patient to get a second opinion from

¹⁰⁶Cislowksi, JA: The Peer Review Organization (PRO) Program. Congressional Research Service document 87-258 EPW. March 25, 1987

¹⁰⁷Lindsey, PA Medicaid utilization control programs: Results of a 1987 study. Health Care Financing Review 1989; 10(4): 79.

¹⁰⁸Polchow (see note 48) reports 17 of 49 but does not distinguish between mandatory and other programs. 4 of the states identified by Polchow as having SSOPs in 1986 are states that Lindsey describes as voluntary program states.

another doctor to find out if the (nonemergency) surgery (contemplated) is necessary."¹⁰⁹ The Hewitt survey, however, suggests a somewhat lower rate: 28% of companies reported mandatory SSOPs in 1984;¹¹⁰ that that had risen to 56%¹¹¹ in 1986 suggests that the difference between 51% in 1983 and 28% in 1984 reflects a difference in survey technique (including the meaning of the question asked), rather than a decline in the use of such programs between 1983 and 1984. The growth of such programs is further corroborated by the Business Roundtable survey of its members, which indicates that, between 1984 and 1986, some 30-40% of companies added mandatory surgical opinion programs, and another 25-35% changed voluntary programs to mandatory.¹¹² BLS statistics, reflecting their survey of medium and large sized firms, suggest that "incentives for second surgical opinions" applied to 24% of employees in 1985, and to 35% in 1986.¹¹³ Finally, the BCBSA cost containment surveys suggest that mandatory SSOPs were present in 21% of plans in 1982, 54% of plans in 1983, and nearly 87% of plans by 1986.

Certain general truths emerge from these statistics; namely that SSOPs were not uncommon in the private insurance market in the early 1980's, and were probably relatively common by 1983. They became increasingly prevalent between 1983 and 1986.

¹⁰⁹The Equitable: Corporate Initiatives & Employee Attitudes on Cost Containment. The Equitable Healthcare Survey III. Equitable Life Assurance Company. New York, 1985.

¹¹⁰Hewitt Associates: Company Practices in Health Care Cost Management. Lincolnshire, IL 1984.

¹¹¹Hewitt Associates: Salaried Employees Benefits Provided by Major U.S. Employers in 1986. Lincolnshire, IL. 1987.

¹¹²Corporate Health-Care-Cost Management and Private-Sector Initiatives. Results of the 1986 Business Roundtable. (c/o Cocks, DL. Eli Lilly and Company. Indianapolis, IN) 1987.

¹¹³US Department of Labor, Bureau of Labor Statistics. Employee Benefits in Medium and Large Firms, 1985 and 1986. (Bulletins 2262 and 2281). Government Printing Office, Washington DC. 1986 and 1987.

The total effect of the diffusion of surgical second opinion programs can be estimated from the marginal diffusion of these after 1983 (from table 1.8) using the elasticities above. That estimate suggests that the diffusion of these programs after 1983 might have acted to reduce hospital admissions by 1.4%

(d) Reimbursement incentives for outpatient care/outpatient surgery

While it is clear that the rate at which hospital care is provided has declined, it is also clear that that does not imply that total care has declined as well; it seems certain that some of that decline must be a consequence of the substitution of care in settings other than the inpatient hospital for inpatient hospital care. To some extent, features of insurance which have already been mentioned may have facilitated this substitution--for example, preadmission certification programs rarely address the matter: is planned care needed; more often it is the matter: is it necessary to deliver such care in the hospital (or should the patient be motivated to seek that care elsewhere, by the application of a financial disincentive to hospital care). However, other programs--in particular, the introduction of differential rates of copayment--have begun in order to facilitate the movement of inpatient care out of the hospital.

The efficacy of such programs is unknown; it is reasonable to assume that the patient seeking care which may conveniently be done out of the hospital as well as in it should respond to even a small price incentive (all other things held equal) by selecting the out-of-hospital alternative. Thus, to estimate an elasticity for such programs requires estimation of the fraction of care which can be delivered out of the hospital as well as in. I assume that only elective surgical care can be re-directed this way, and that the fraction of hospital care which is elective surgical

care is 13% in the Medicare population, and 12% for others.¹¹⁴ I assume that the administrative costs of discovering planned elective care before the fact, or reviewing surgical care after the fact, are sufficiently high that only three-quarters of that care which potentially could be diverted will be;¹¹⁵ the population elasticity that evolves from these assumptions (and the distribution of persons in table 1.2) is -0.091.

The diffusion of programs that offered incentive copayment differentials to beneficiaries is summarized below.

Medicare

Copayment differentials for inpatient and outpatient care have always existed under Medicare, by virtue of the different copayment provisions which obtain for part A (hospital care) and for part B (physician care, including hospital services, and outpatient care). Review of table 1.3 makes it clear that the magnitude of beneficiary copayment (coinsurance rate and deductible) increased for part A relative to part B throughout the 1980's--that is, inpatient care became increasingly costly relative to outpatient care. That appears to have been consistently true throughout the period, though; thus, this copayment differential ought to have exerted no new pressure on the price conscious consumer to seek outpatient care in preference to inpatient care that could explain a sudden change behavior.

What changed importantly during the interval, however, was HCFA's generic willingness to pay for certain types of outpatient care; particularly, for surgical care in non-inpatient facilities.

¹¹⁴data from NCHS Series 13, No. 87 (see note 103). Surgical procedures which could be done in an outpatient setting were dilation and curettage, abortion with dilation and curettage, tonsillectomy and/or adenoidectomy, lens procedures, and transurethral prostatectomy.

¹¹⁵this assumption is testable; evaluation will be deferred, pending demonstration of the need to test.

In particular, with enactment of the Omnibus Reconciliation Act of 1980 (in September of 1982), HCFA newly covered (under part B) surgical care provided in ambulatory surgical centers and other certified (eg hospital outpatient department) facilities.¹¹⁶ By implication, the net cost to the beneficiary for outpatient surgery in a variety of facilities was reduced from 100% of the cost of the procedure (and attendant physician services), to remaining part B deductible, plus coinsurance. In fact, there is evidence that, at least for some procedures, the rate differential accessible to the hospital by substituting outpatient surgery (under cost-based reimbursement) for inpatient surgery (under DRGs) may have led to programs--legal and fraudulent--that effectively reduced the net cost to the beneficiary for outpatient surgery to zero.¹¹⁷ Thus, there was an important change in Medicare reimbursement policy toward the end of 1982, which would have been expected to facilitate the movement of surgical care from the hospital to non-inpatient sites.

Medicaid

Very similar considerations obtain with respect to Medicaid as to Medicare. Because cost differentials are not widely applied to Medicaid beneficiaries to motivate care-seeking, there appear to have been few changes in Medicaid programs which specifically introduced such cost differentials. In 1986, there were 10 state programs that required beneficiary copayment for inpatient hospital care; of those, 9 also had copayments for outpatient services. Although further investigation might prove the matter to be interesting, it seems probable that it was rarely the case that Medicaid beneficiaries faced substantially different costs for care in or out of the inpatient hospital--except where service was a covered benefit in one case, and not in the

¹¹⁶US Government Accounting Office. "Medicare and Medicaid: Effects of Recent Legislation on Program and Beneficiary Costs." US GAO Washington. April 1987.

¹¹⁷see, for example, US Subcommittee on Health and Long-Term Care of the Select Committee on Aging, US House of Representatives. "Cataract Surgery: Fraud, Waste, and Abuse." US Government Printing Office, Washington DC. July 19, 1985, and chapter 3 of this work.

other. Thus, the use of preadmission review, for example, was probably a mechanism to increase the net cost to the patient of care in an inappropriately intensive and costly environment, and to motivate care seeking out of the hospital. Further, the extension of coverage to non-inpatient surgical providers under OBRA presumably had the same impact on Medicaid beneficiaries as on Medicare beneficiaries. That impact should have been, as of late 1982 or early 1983, to decrease inpatient surgical hospitalization rate.

Private insurance

Survey evidence suggests that the private carriers were aggressive with respect to offering incentives to substitute outpatient surgery for inpatient surgery. As early as 1981, the Blue Cross/Blue Shield Association issued a policy statement recommending to member plans that they encourage "appropriate growth of ambulatory surgery and more selective use of inpatient care for surgery."¹¹⁸ By 1984, virtually all (121 of 122) business roundtable employers covered ambulatory surgery. Details about the nature and extent of programs that existed to facilitate the use of ambulatory surgery are limited. Clearly, the development of preadmission certification, and of SSOPs, may have been part of incentive schemes to encourage the use of ambulatory surgery. In addition, payment differential schemes were used. By 1984 (the first year for which survey data on BC is available), nearly 80% (49/62) BC plans responded to the annual BCBSA cost containment survey by indicating that they had, at least for some accounts, a program for which "benefits (we)re reduced when selected surgical procedures are done on an inpatient, as opposed to outpatient, basis without medical justification."¹¹⁹ The business roundtable survey of 1984 notes that 40% of companies covered outpatient surgery at a rate

¹¹⁸Detmer DE, Buchanan-Davidson BJ: Ambulatory Surgery. *Surgical Clinics of North America* 1982; 62(4): 685.

¹¹⁹Scheffler RM, Gibbs JO, Gurnick DA: The Impact of Medicare's Prospective Payment System and Private Sector Initiatives: Blue Cross Experience, 1980-1986. Blue Cross Blue Shield Association paper. July 1988.

higher than inpatient surgery (and, by the way, that "almost all of these companies have changed their benefit plans since 1982 to give employees this incentive.")¹²⁰ By 1986, virtually all (60/62) Blue Cross plans reported that they had such a program. Unfortunately, no result is published in the 1986 Roundtable survey.

The Hewitt surveys indicates that, by 1984, 45% of employers provided benefits which included higher coverage for outpatient surgery (positive incentive), or less coverage for inpatient surgery (negative incentive), when surgery could be done in alternative sites. By 1986, that had risen to 56%. These values are somewhat higher than those of the BLS,¹²¹ which indicate that some 24% of employees in 1985, and some 28% of employees in 1986, participated in plans which offered "higher coinsurance, or lower or no deductible for outpatient surgery." Again, it is likely that these differences reflect that fact that the fraction of companies/plans offering a benefit will be greater than the fraction of persons covered by that benefit.

These data suggest that incentive programs to increase the selection of outpatient alternatives to inpatient care became increasingly prevalent during the 1980's. I estimate (from table 1.8) that relevant programs diffused completely to the Medicare and Medicaid populations after 1983, but were sufficiently prevalent already among those covered privately that they diffused to only an additional 30% of the privately insured. From the elasticity (-0.091) above, and the distribution of persons in table 1.2, the calculated impact of this diffusion on hospital discharges after 1983 is -4.15%

¹²⁰Business Roundtable Task Force on Health. The 1984 Business Roundtable Task Force on Health Survey. 1985.

¹²¹US Department of Labor, Bureau of Labor Statistics. Employee Benefits in Medium and Large Firms, 1985 and 1986. (Bulletins 2262 and 2281). Government Printing Office, Washington DC. 1986 and 1987.

C. MEDICAL TECHNOLOGY

The importance of medical technology to understanding changes in supply and demand behavior has been outlined in an earlier section; changes in medical technology throughout the 1980's are obvious to casual inspection and cannot be catalogued here. Absent some plan for categorical analysis, the impact of changing technology on the volume of hospital care is impossible (and has been studiously avoided).¹²² That plan will be outlined in a subsequent chapter; discussion of the impact of changing technology on the volume of hospital care is deferred.

IV. DISCUSSION

Consideration of the above makes it clear that many changes were occurring contemporaneously over the period during which rates of hospitalization were in flux. These changes are summarized in tables 1.8 and 1.9; the impact that each of the changes might have had on the volume of hospital admissions is summarized in the lower part of table 1.9.

Quantitatively, the changes reviewed can account for (more than) the entire ~11% decline in hospital admissions. This suggests that the review has been sufficiently sensitive to capture most of the parameters which are relevant to understanding the phenomenon.

Some of the changes seem clearly to be more important than others. Supply changes that might

¹²²Scheffler et al (see note 41), in their long and thoughtful analysis of the impact of PPS and private sector initiatives on Blue Cross utilization, include medical technology explicitly in their reduced form supply and demand equations. Then, because they "have no specific or proxy measure of medical technology," they exclude it from their analysis.

have been induced by prospective payment, for example, are relatively small; on the other hand, changes in demand that might have followed the implementation of precertification for hospital care, or the increased use of programs which offered differential net prices to the patient for inpatient and outpatient care, can account for relatively large fractions of the decline.

This suggests that additional analysis of the issue may be fruitful. In particular, the wealth of information about the diffusion of the insurance programs--and the variation among the major beneficiary groups with respect to the timing of that diffusion--suggest that variation in rates of hospital use among those covered by different payers may permit distinction to be made between those program variables that changed and caused admissions to decline, and those that changed incidentally.

In the next chapter, I assess whether payer-specific changes in hospital volume can be logically related to the patterns of change in the economic variables reviewed above, and summarized in table 1.8. To the extent that they cannot, there is clearly a need to look otherwise; I will, as chapter 2 concludes, suggest that there is such a need. At the close of chapter 2, I will propose a plan to attempt further to account for declining hospital admissions, and will define the work that comprises the remaining chapters of this study.

CHAPTER 2

ACCOUNTING FOR THE DECLINE

INTRODUCTION

In chapter 1, I introduce a model for the observed number of hospitalizations. That model proposes that changes in the observed number of hospital episodes can be understood as deriving from changes in supply-side factors--that affect hospital propensity to offer inpatient care--and demand side factors--that affect consumer willingness to purchase inpatient care. Late in that chapter, I review trends in those parameters which are relevant to the predictions of the model, in order to assess whether some have changed in a way which is logically consistent with the hypothesis that they are important to explaining the change in hospital admissions which was observed.

Among the variables reviewed, most changed in a way which suggested that they might be important to explaining changes in hospital use. "Elasticities," which were developed by reviewing the literature on what is known about the sensitivity of hospital use to changes in these variables, permitted identification of changes which appeared to more important to accounting for the change than others. Most important among those were hospital utilization review and insurance programs that offered patients relatively preferred prices for outpatient care; prospective hospital payment (*per se*) was relatively unimportant. These findings seem reasonable; furthermore, virtually the entire decline in hospital admissions can be accounted for between these two factors.

The reasonableness of such an explanation can be further assessed by taking advantage of the differences in the way that these programs, and many others, moved into the marketplace. Table 1.8, and the upper portion of table 1.9 , demonstrate these changes. Hospital UR, for

example, moved much more rapidly to the Medicare population than to those privately insured or those insured by state Medicaid; copayment differentials,¹ on the other hand, had already diffused to a significant portion of those covered privately by 1983; the diffusion of that program was relatively sluggish thereafter. To the extent that UR, for example, truly accounts for the changes that table 1.9 attributes to it, we would expect changes in rates of hospitalization among those covered by Medicare to be more substantial after 1983 than before; and proportionately greater than changes among the privately insured after 1983. To the extent that copayment differentials motivated the selection of outpatient alternatives to hospital care, we should see that rates of decline for those privately insured should decelerate after 1983.

These suggest that analysis of payer-specific rates of hospitalization may permit greater understanding of the importance of these programs. To the extent that changes in rates of hospitalization among those covered by different payers track a single variable (such as utilization review), there is greater confidence that that variable has important explanatory power. To the extent that trends in hospitalization rate among those covered by different payers move in parallel with each other, despite differences in the rate at which payer policies changed, it is necessary to consider the possibility that another factor--which affected all groups--has been excluded. Clearly, such another factor could be changing medical technology; the importance of which has been built into the model, but has yet to be evaluated.

In this chapter, I describe the dataset and methods which are used throughout the remainder of this work, and begin my analysis of declining hospital admissions. Following description of the methodology, I present results from an analysis of payer-specific hospitalization trends, and show that movement of hospitalization rates among various groups has been nearly

¹ including expansion of coverage at preferred rates to new outpatient services

parallel. I suggest that there is a need to proceed to evaluate the impact of changing technology, and introduce a plan to do so. The chapter ends with specification of the cases that will permit that analysis to proceed.

DATA AND METHODS

THE NATIONAL HOSPITAL DISCHARGE SURVEY

The basic dataset which supports this analysis is the National Hospital Discharge Survey (NHDS), an annual two-stage probability sample of nonfederal short-stay hospitals produced by the National Center for Health Statistics (NCHS), and distributed through the National Technical Information Service. The design and implementation of the NHDS have been described in detail elsewhere;^{2,3} they are briefly summarized here.

The NHDS is a sample set of hospital discharge records (typically about 200,000) from nonfederal short-stay hospitals. These records are representative of the national experience by virtue of a sampling plan by which the likelihood that a record will be selected depends upon the frequency with which records like it appear in that hospital, and the likelihood that a hospital will be selected depends upon its size. In such a sampling plan, each record is representative of a number of records like it; in the NHDS, each record is assigned a weight which reflects that number. The sum of the weights associated with all records of a certain type is a measure of the total number of records of that type.

²National Center for Health Statistics: Development of the Design of the NCHS Hospital Discharge Survey. National Center for Health Statistics Series 2 Number 39. US DEpartment of Health, Education, and Welfare. Rockville, MD. 1970.

³Institute of Medicine: Reliability of National Hospital Discharge Survey Data. National Academy of Sciences. Washington, DC. 1980.

Each NHDS record comprises a set of data obtained from the record of a single hospitalized patient. The record includes information about the patient (age, sex, race, marital status); about the hospital (bedsize, ownership, census region and subregion); and about the hospital stay (date of admission, date of discharge, length of stay, discharge status, expected source(s) of payment). In addition, there is important clinical information about the hospital stay--of particular relevance to this work is information about the clinical condition which occasioned hospital admission (the first listed, or "principal", diagnosis, a five-digit ICD-9-CM code), (up to seven) other conditions (five digit ICD-9-CM codes) affecting the patient which may or may not have been relevant to the hospital stay, and the number, and type, of (up to four) surgical procedures which occurred during the hospital stay.

Data flow from the hospital to the NHDS datatape has been described in detail elsewhere;⁴ it is reviewed briefly here. Data from the hospital record is summarized on a "face sheet;" the preparation of the "face sheet" is nonstandard. In some hospitals, the face sheet is a physical document (which is usually attached to the front--that is, the "face"--of the record); in others, the face sheet is in fact a discharge summary. Important characteristics of the "face sheet"--whether it has independent life or no-- include summary demographic information about the patient, about the payer, and about the events of the hospital stay; and a physician signature. In some hospitals, the physician actually completes a face sheet (usually at the time of discharge); in other hospitals, it is prepared by the medical records room for physician review. As noted, in some hospitals the discharge summary, prepared by the physician and/or the medical records room, is functionally the face sheet as well. In all cases, the physician is required to affix his or her signature to the document, and in so doing assumes legal

⁴Institute of Medicine: Reliability of National Hospital Discharge Survey Data. National Academy of Sciences. Washington, DC. 1980.

responsibility for its accuracy.

The face sheet, or equivalent, forms the basis for the NHDS abstract. The latter document is a standard format summary of information transcribed from the face sheet, either by a medical records person (for whose time the hospital is compensated by the NCHS), or by a NCHS agent (hired from the Bureau of the Census). The NHDS abstract is then forwarded to a NHDS office in North Carolina, where the (hand-written) information is converted to machine code. Of import, before 1985, all diagnostic information provided to the North Carolina office was in the form of English language description; the translation to ICD-9-CM codes occurred in that North Carolina office, and was effected by NCHS personnel (all of whom are trained as coders) subject to quality control procedures which have been described elsewhere. Beginning in 1985, some hospital abstract data was provided to the NCHS by hospital abstracting services, in the form of machine readable code; in particular, 17% of the data in 1985,⁵ and 19% in 1986,⁶ were in this format.

Analysis of NHDS data was by conventional means. For all years prior to 1980, and where indicated after 1980, NHDS statistics were obtained from published sources. For years after 1979, NHDS datatapes were processed using SAS⁷ on Whitaker College's VAX microcomputer; subsequent analysis and graphics proceeded on the VAX using RS/1, on a pc using Lotus 1-2-3, or on a Macintosh using Excel and Cricket Graph.

⁵Hospital Care Statistics Branch, Division of Health Care Statistics: 1985 Summary: National Hospital Discharge Summary. Advancedata Number 127; 1986.

⁶Hospital Care Statistics Branch, Division of Health Care Statistics: 1986 Summary: National Hospital Discharge Summary. Advancedata Number 145. 1987.

⁷SAS Institute, Cary, North Carolina.

The standard error for any statistics estimated from NHDS data can be calculated directly,⁸ but only if hospital specific weights, and inter- and intra-hospital variances are known. Such variances are known to those who operate the survey, and used when standard errors are calculated for publication, but are unavailable to the public because of issues of hospital confidentiality.⁹ Thus, it is necessary to depend on published values for standard errors. Furthermore, because the number of statistics which can be estimated from NHDS data is essentially infinite, the publication of standard errors for all such statistics is not feasible. As a result, the NCHS calculates approximate (relative) standard errors for statistics which have similar sampling properties, and publishes those approximate (relative) standard errors on a set of nomograms which form technical appendices to NCHS publications dealing with the NHDS. Relative standard errors from these nomograms are the conventional mechanism for dealing with sampling error in the NHDS;¹⁰ these form the basis for statistical comparisons in this work. Two-sided tests of significance are reported, using t-statistics calculated from these standard errors.

By (NCHS) convention, and in order to assure comparability of primary analytic output with published values, discharge records indicating that a discharge represented a newborn (defined as Age Recode [item 17]=00) were excluded from all analyses.

Age-adjusted discharges were calculated by standardizing to the population in 1981:

⁸ National Center for Health Statistics: Development of the Design of the NCHS Hospital Discharge Survey. National Center for Health Statistics Series 2 Number 39. US DEpartment of Health, Education, and Welfare. Rockville, MD. 1970.

⁹Pokras, R, National Center for Health Statistics: personal communication.

¹⁰Pokras, R, National Center for Health Statistics: personal communication.

AGE-ADJUSTED DISCHARGES_i=

$$\sum_{j \text{ age groups}} (\text{discharges}_{i,j} / \text{population}_{i,j}) (\text{population}_{1981,j})$$

Estimates of disease prevalence are from the National Health Interview Survey, another annual product of the NCHS. The NHIS has been described fully elsewhere;¹¹ briefly, it involves sampling of a statistically valid sample of the population about their health and utilization of health services.

Other data come from sources describe in the text.

RESULTS

Figure 2.1 describes aggregate changes in the NHDS dataset for the period 1980 to 1986, when that trend reversal noted in chapter 1 occurred. Between 1980 and 1983, discharges increased, albeit at a rate that was slower than that of the 1970's. In the period between 1983 and 1986, discharges fell from their peak of 38,783,000 to 34,256,000, a decline of 4,527,000, or 11.7%. The overall decline in that interval is highly significant ($p < .01$); furthermore, the annual declines between 1983 and 1984, and between 1984 and 1985, are significant as well ($0.5 < p < .10$; $p < .05$ respectively).

Is that decline a consequence of changes in population size or structure?

Although this analysis will focus on variation by payer, a logical first question to consider is

¹¹ for example, National Center for Health Statistics: Current Estimates from the National Health Interview Survey, United States, 1986. National Center for Health Statistics Series 10, Number 164. 1987.

whether the number of discharges declined passive to a decline in the size of the larger population at risk for hospitalization: that is, was there a decline in total discharge rate? Alternative to that, was the decline in the number of admissions the consequence of a change in the structure of the population with respect to some important parameter which is likely to affect preferences for care--such as advancing age, which almost certainly implies that, other things held equal, demand for hospital care will increase.

Figures 2.2 and 2.3 argue that these are not the case. Discharges per 1000 civilians (figure 2.2), and age-adjusted discharges per 1000 civilians (figure 2.2) not only fell significantly between 1983 and 1986, but--on a fractional basis--fell more impressively than did raw discharges: discharges per capita declined 14.3%, and age-adjusted discharges per capita declined 17.5%. Insofar as these are true, the decline in discharges evident from figure 2.1 understates the truth: had the population in 1986 been of the same size and age-structure as in 1983, the decline in admissions, *cet par*, would have been more than 50% larger than that observed. Far from explaining the decline in admissions, changes in the size and age-structure of the population reinforce the significance of that finding.

Is the decline logically related to changes in Medicare policy?

The relative contemporaneity of the onset of the admissions decline, and the implementation of Medicare's PPS, has already been noted; it is reasonable to suggest that, where there is causality, one might see differential effects of PPS¹² on the Medicare population and those covered by other insurers--in particular, more pronounced, and/or earlier, declines among the Medicare population than among those otherwise insured.

¹²I mean here all of the changes in Medicare policy that were bundled with prospective payment, not only prospective per case hospital reimbursement.

Table 2.1 presents, and figure 2.4 summarizes graphically, discharges over time for hospitalizations covered by Medicare, and all other payers. Between 1983 and 1986, Medicare discharges declined 823,000 (6.7%); discharges covered by all other sources declined 3,704,000 (14%). Discharges covered by Medicare began to decline after 1983; discharges among those covered by other sources appear to have begun to decline after 1981 (though significant declines occurred only after 1983). Clearly, the decline in hospitalizations other than those covered by Medicare was larger, both absolutely and relatively, than the decline among those covered by Medicare and may have anticipated it. The decline in non-Medicare discharges accounted for more than 80%¹³ of the total.

Were there variations in admission rates among beneficiary populations?

Figure 2.5, and table 2.2, summarize how admissions (normalized for changes in beneficiary population size: that is, admissions per beneficiary) have changed over time among the populations indemnified by the major payers, whose policies changed in the 1980's as described in chapter 1.¹⁴

Admissions per capita (figure 2.3) were essentially flat between 1980 and 1983, then declined 14.3% between 1983 and 1986. Admissions per beneficiary increased between 1980 and 1983 for Medicare and Medicaid beneficiaries, then declined significantly; rates were relatively flat (decreased insignificantly) in the privately insured population between 1980 and

¹³or four times as much as the decline for Medicare. In fact, the decline for hospitalizations covered by Blue Cross and other private/commercial payers was more than four times as large, absolutely, as that for Medicare covered hospitalizations.

¹⁴Beneficiary counts are as in table 1.2. "Private payers" in figure 2.5 refers to Blue Cross and other private/commercial sources.

1983, then declined significantly. Overall, the decline in rates of hospitalization were 11.5%, 8.3%, and 18.3% for those covered by Medicare, Medicaid, and private (Blue Cross and other private/commercial) payers.¹⁵

DISCUSSION

Table 2.3 predicts percentage changes in hospitalization for the three major sources of hospitalization insurance reviewed in chapter 1, for the intervals 1980 to 1983, and 1983 to 1986. Changes in the economic variables relevant to the table are from tables 1.8 and 1.9; "elasticities" are from table 1.9;¹⁶ and the weights (used to calculate the total column) are the fraction of discharges covered by each payer, calculated from table 2.1. For comparison, observed changes are calculated from table 2.1

While there were a great number of changes that occurred between 1980 to 1986, no simple relationship between those changes and rates of hospital admission is suggested. It seems very clear (eg from figures 2.4 and 2.5) that changes in Medicare policy--though highly visible, and almost certainly important--cannot reasonably be invoked to explain why hospital admission trends reversed after 1983. That declines occurred among persons covered by insurance other-than-Medicare; that those declines were both larger and more pronounced; and that they occurred as early as, or earlier than, those that occurred in the Medicare population all argue

¹⁵Inclusion of those whose care is described as "self pay," or "no-charge," into the privately covered group changes the decline in that group to 14.6%. Inclusion of all "other" persons (that is, persons whose care was not Medicare, Medicaid, or workman's compensation) into the privately insured group reduces that to 13.2%. Thus, estimates of changes in the rate of care delivered to persons with private hospitalization insurance cannot be adequately explained on the basis, for example, of more accurate identification of other sources of payment.

¹⁶I use (1.0) as the elasticity for "health insurance penetration." The value in table 1.9 (0.39) was based on total population--not payer-specific populations; total population demand will decline less than payer specific demand, as hospitalization of those with no insurance will be counted as part of the total, but not as part of any of the payer-specific subsets I have analyzed.

that Medicare policy is unlikely to have been primarily important.

Although aggregate declines in hospital discharges after 1983 are reasonably well accounted by changes in the various parameters of interest (chapter 1, and right hand column of table 2.3¹⁷), payer specific declines are less well so. For example, table 2.3 predicts that decline in Medicare admissions should have been substantially greater than it was, and greater than the decline in admissions for those covered by private hospitalization insurance. Similarly, the predictions fail to account for the very large differences in fractional declines among the Medicaid and privately insured.

Furthermore, the temporal pattern of decline predicted varies from that observed. Had these parameters the impact suggested, declines should have been manifest in all populations prior to 1983. In addition, declines among those privately insured should have been as large between 1980 and 1983, as between 1983 and 1986.

These issues are somewhat less problematic, if one assumes that some of the parameters do not have the effect attributed them--that is, if the table is used to isolate important parameters, rather than to estimate effects based on them. Thus, the table suggests that changes in copayments must have much less of an effect on the demand for hospital care than was attributed to them in chapter 1; rejecting the importance of changes in copayment reduces the predicted declines for the earlier interval, and serves principally to bring the estimated decline for Medicare discharges to a level more nearly equal to those for Medicaid and private payers. It seems likely that the

¹⁷The small differences between effects calculated in table 1.9 and in table 2.3 are accounted for by the use of payer-specific estimates in some of the calculations of table 2.3, and the use of different weights to calculate total effects: in table 1.9, totals are calculated using 'fraction of covered population;' in table 2.3, using 'fraction of covered discharges.'

importance of changes in copayment has been overestimated.¹⁸ In subsequent chapters, I will use lower figures--calculated from aggregate copayment data presented in chapter 1--to estimate the increases in copayment faced by insured persons over time.¹⁹

However, assuming that the critical determinants to hospital admission are the number of persons at risk (covered), and the impact of those programs identified in chapter 1--and again here--to be most credibly related, it remains difficult to account for the logic of the changes that are observed in rates of admission over time. In particular, it is difficult to explain why the rate of hospitalization per privately-insured beneficiary did not fall to a greater extent than it did prior to 1984, and why it fell as much as it did after.

It is possible to account for these, if "elasticities" are allowed to vary among the different beneficiary groups. Thus, proportionately larger changes among the privately insured after 1983 may be a consequence of greater sensitivity of that group to utilization review;²⁰ proportionately smaller changes among the Medicare population after 1983 may reflect lesser sensitivity of that population to differential prices for inpatient and outpatient care. Where possible, variation that was known to exist conditioned estimates of elasticities in chapter 1; conceivably, too little is known about the magnitude of that variation to permit necessary refinement. Variation in the sensitivity of various covered populations to the effect of changes

¹⁸In particular, it seems likely that the magnitude of the change in copayment has been overestimated.--rates as high as 40%-47% seemed unlikely at the outset. The use of a figure such as 3%--that calculated from aggregate copayment changes in chapter 1--serves to bring the magnitude of the estimated impact to a more credible level. Thus, it is likely that changes in copayment are important, but quantitatively less so than has been estimated.

¹⁹For increases between 1980 and 1983, 14.3% $[(9.1-7.8)/7.8] \times 100$; for increases between 1983 and 1986, 3.2% $[(9.4-9.1)/9.1] \times 100$.

²⁰or the greater effectiveness of private UR programs

in these variables is considered below, and assessed chapters 3 and 4.

Alternatively, it is possible that important interactions have not been considered; for example, between programs, or between groups. Thus, changes in the pricing structure to motivate outpatient care may be more effective at achieving reductions in hospital use, when coupled to second surgical opinion programs which require planned inpatient surgery to be re-evaluated; or the expansion of utilization review to the Medicare population after 1983 may have increased the impact of utilization review among other populations. The latter is especially reasonable, if a critical level of UR in the larger population is necessary to condition health care decision making, or if physicians allocate hospital care indiscriminately with respect to the nature of the insurance (hence the specific incentive structure of that insurance) that covers the patients that they serve.²¹ Such program interactions have been observed.²²

Finally, it is possible that there is some other factor--a "third factor"²³--which is important and has been overlooked; in particular, it is possible that changing medical technology can reasonably account (or account in concert with what has already been discovered) for the decline in hospitalization rate for persons with different sources of hospital coverage. I have suggested, in the simple model in chapter 1, that technology may affect the supply of hospital

²¹ Although physicians can easily differentiate patients by age, which is an excellent proxy for insurance carrier; and the patient will always be aware of the particulars of his/her insurance environment, so can condition the physicians decision.

²² Zuckerman, for example, demonstrates that prospective reimbursement for Medicaid was effective at reducing cost increases only in those states in prospective payment involved other payers than Medicaid. See Zuckerman, S: Medicaid Hospital Spending: Effects of Reimbursement and Utilization Control Policies. Health Care Financing Review 1987; 9(2): 65.

²³ I have borrowed the use of Sloan's term. See Sloan F, Morrisey M, Valvona J: Effects of the Medicare Prospective Payment System on Hospital Cost Containment: An Early Appraisal. Milbank Quarterly 1988; 66(2):191.

care, either by introducing lower cost modes of production which stimulate revision of the hospital product line or (more likely) by introducing the possibility of new hospital products; and that it may affect the demand for hospital care, by changing the distribution of persons across preference states, or by creating the option for new types of care for which latent preferences exist. To begin to analyze the validity of such a model, it is necessary to discriminate among persons, and products, to a greater extent than has been possible to date. In particular, it is necessary to find some characteristic which meaningfully relates to hospital supply, or consumer demand, more discriminately than does the heterogeneous "hospital admission."

The use of clinical information, to further inform this analysis, is an appropriate next step. In particular, I suggest that the use of (principal) discharge diagnosis (that being the "condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care") provides a reasonable means by which to begin to evaluate changes in hospital product/consumer preference. The reasonableness of such an analytic plan derives from the fact that changes in hospital "product" may be more or less feasible, and more or less attractive, on a clinical-product specific basis; and that changes in consumer demand for hospital care will be more or less sensitive to other factors, on a condition-specific basis. The logic of the former may be clear: the tendency for a hospital to allocate resources to outpatient services will vary depending on whether those resources are being committed to develop an ambulatory product for the care of ischemic heart disease or of damaged knees. That tendency will vary, because the financial incentives to the hospital will be different; the costs of developing that capacity will be different; and the technologic feasibility of one or the other will be different. Similarly, variation in demand for hospital inpatient services will depend upon whether a patient has ischemic heart disease, or a damaged knee. The sensitivity of a patient with the former to changes in the net price of hospital care, for example, is expected to be much

less than the sensitivity of a patient with the latter. And demand for hospital care for the former is likely to be affected very differently (in the long run) by changes in exercise patterns than will be demand for care for the latter.

I proceed, therefore, to analyze NHDS data by "category of first-listed (discharge) diagnosis," as defined in the publications of the NHDS. In the next section, I disaggregate the decline in hospital admissions that occurred between 1983 and 1986, and define a set of conditions which are quantitatively important to understanding the aggregate decline. In subsequent chapters, I review trends in those factors which may be important to understanding why the supply of, or demand for, care for those conditions has declined so markedly. I expect that an understanding of the reasons behind the decline for these conditions will be important, both because they are quantitatively important to understanding the larger phenomenon, and because the cases may provide insights into the general matter. In any event, though, selection of specific cases on the basis of quantitative importance implies that any understanding which derives from the analysis will not be irrelevant to our understanding of the larger issue which motivates the work.

ACCOUNTING FOR DECLINING HOSPITAL ADMISSIONS

Table 2.4 disaggregates the decline in hospital admissions that occurred between 1983 and 1986 according to NHDS "category of first-listed (discharge) diagnosis."

Several things are clear from brief inspection of that table. First of all, the decline in hospitalizations is not limited to a very small number of conditions--declines are seen for a large number, and not all declined. However, a relatively small number of conditions can

account for a large fraction of the decline between 1983 and 1986: in fact, nearly 20% of the decline can be attributed to three conditions, and more than a quarter of it to only five.

Second, it was not care only of a given sort that declined--while cataract, the quantitatively most important, is a problem which frequently leads to hospitalization for elective surgical care, delivery (next most important) is neither elective nor (strictly speaking) surgical, and diabetes rarely is either. Finally, none of the conditions is exclusive to any insured population--while it is probably true that cataract care is most common among those covered by Medicare, delivery is a common reason for hospitalization both among those covered by Medicaid, and those covered by employer-provided insurance, and diabetes is a condition which almost certainly is prevalent in all populations.

These suggest that further analysis may be fruitful. Of the three conditions which are quantitatively most important to the accounting for the aggregate decline, one (delivery) has declined insignificantly.²⁴ While the lack of statistical significance to this finding does not establish its lack of importance, there is, in fact, reason to believe that deliveries have not declined. Data from vital statistics sources do not corroborate declines in hospital, or total,

²⁴Which is not to imply that deliveries have not declined; rather, only that the decline is insufficient to exclude (with $p < .05$) randomness of sampling as an explanation. However, other data suggest that the decline in hospitalizations for delivery is in fact not real: vital statistics (from the US National Center for Health Statistics, Vital Statistics of the United States, reported in Statistical Abstracts of the United States 1989; 109th edition, US Department of Commerce Bureau of the Census, 1989) fail to corroborate the decline in hospital births. Furthermore, there was at best a very small increase in the number of out-of-hospital births (NEJM); not nearly to explain the decline observed in the NHDS. Thus, although further evaluation of maternity care might provide additional insight about the relationship between hospital care and its substitutes, that evaluation is irrelevant to the focus of this work--hospital admissions decline; that evaluation is proposed as an extension to the current work.

births,²⁵ or birth rate;²⁶ although ambulatory alternatives to hospital birth exist, their growth has been sluggish, and recent estimates suggest that there were little more than 20,000 births in all such facilities between mid-1985 and 1987.²⁷ On the other hand, cataract (an illness primarily of the elderly), and diabetes (an illness prevalent in both the elderly and the young) are conditions which have changed significantly. That UR (or PPS, or any other policy variable or variables) may account for the changes in frequency of hospitalization for these two conditions remains a tenable hypothesis. Therefore, the analysis focuses on these two conditions: investigation of the decline in rates of hospital use for cataract and diabetes--and especially the role that changing technology may have played to effect that decline--comprises the work of the next two chapters. The final chapter attempts to synthesize from the cases an understanding of why hospital admissions have declined, and what that implies about the importance of technology to understanding changing behavior in the health care industry.

²⁵data from US National Center for Health Statistics, Vital Statistics of the United States, as reported in Statistical Abstracts of the United States 1989: 109th edition. US Department of Commerce Bureau of the Census. 1989.

²⁶which was 15.9 per 1000 in 1980, 15.5 per thousand in 1983, and 15.6 per thousand in 1986. Vital Statistics data, see note 25 for source.

²⁷Rooks JP, Weatherby NL, Ernst EKM, Stapleton S, Rosen D, Rosenfield A: Outcomes of Care in Birth Centers. The National Birth Center Study. *New Engl Journ Med* 1989;321:1804. The authors report 11,814 women admitted to 84 birth centers in that interval; they estimate that those 84 centers comprise 52.5% of centers operational in that period.

CHAPTER 3

DECLINING HOSPITAL CARE FOR CATARACT

INTRODUCTION

In chapter 2, I show that cataract is the condition which is quantitatively most important to understanding why admissions to community hospitals have declined, and suggest that more than 10% of the decline in hospitalizations that occurred between 1983 and 1986 can be accounted for by changes in the number of persons hospitalized for the care of this condition alone. Furthermore, I point out that, between 1983 and 1986, the number of hospitalizations identified as "for the care of cataract" declined more than 80%. Given the large number of persons hospitalized for cataract in 1983 (more than half a million; and 1.5% of all persons discharged from community hospitals), a decline of this magnitude implies a significant and substantial change in the behavior of a large number of persons. Attempting to understand the forces that have been responsible for such a substantial change would seem a worthwhile effort in its own right. Clearly, it is evident that something should be learned about what has affected the use of the hospital, generally, by attempting to understand what has changed the way the hospital is used by this subset of patients.

The time course of the decline in hospitalizations for cataract is described in detail in figure 3.1. Discharges for the care of patients with cataract followed the pattern of aggregate discharges displayed in figure 2.2; namely, discharges rose between 1980 and 1983 quite regularly, and then declined. Between 1983 and 1986, cataract discharges fell from 593,540 to 103,727; nearly 83%.

Before discussing the reasons for that decline, it will be valuable to briefly introduce the condition and its clinical management, and summarize what have been the important changes

in the economic milieu that are especially relevant to understanding changes in the use of the hospital for care of this condition. Following that, I will present data that permit testing of a number of hypotheses relevant to an understanding of the phenomenon, and will consider how well each accounts for what is known. Finally, I will suggest that the decline in inpatient cataract care involves the interaction of a series of events, and cannot be understood without considering the impact of changing medical technology.

The nature of cataract

Normal vision is a process which requires the proper function, and integration, of a number of ocular and neurologic components. Among these is the ocular lens, an organ which focuses incoming light onto the retina, for conversion to sensory input signals by specialized receptor cells there. Derangement of the shape of the lens may compromise the ability of the lens to focus, and lead to blurring of visual images. Derangement of the composition of the normally transparent lens may interfere with the ability of the lens to transmit light at all, or may cause its untoward diffraction. These, too, may lead to blurring of visual images.

Cataract describes that condition in which part of the ocular lens is opacified; that opacification impairs the ability of the lens to transmit light, and distorts vision. Opacification of (some part of) the lens implies some change in the composition of the lens; the nature of that change in composition specifies the nature of the cataract. Far and away the most common type of cataract is so-called "senile"; that is, the cataract that comes with age. Cataracts may, however, be congenital (that is, apparent at birth), or a consequence of trauma, of the use of certain drugs, of exposure to toxins or to x-irradiation, or of the existence of some other illness. The nature of cataract is reviewed elsewhere in great detail.¹

¹ for example, in Maisel, Harry: The Ocular Lens: Structure, Function, and Pathology. Marcel Decker, Inc. New York, NY. 1985.

The management of cataract

The management of cataract is predictable from consideration of the nature of the problem. Given that the visual impairment in the cataract-affected lens is a consequence of that lens abnormality, and given (as well) that lens function can be replaced, the management of cataract commonly proceeds by removal (extraction) of the opacified lens, and replacement with a man-made alternative.² Cataract surgery is truly an ancient procedure, having first been reported in the *Susruta Sanhita* (written about 1000 BC).³ Surgery evolved from lens "couching" (dislocation of the lens posteriorly, into the vitreous of the eye) to true lens extraction in the early 18th century; lens extraction remains the standard treatment for the patient with visual impairment as a consequence of cataract. Elimination of the opacified lens leaves the ("aphakic") eye without a focusing mechanism. Restoration of quality vision requires the functional replacement of this lens with a man-made device.

Surgical extraction of the lens may proceed by one of two approaches; more than one technique exists for either approach. So-called "intracapsular cataract extraction" (ICCE) involves removal of the crystalline lens with its surrounding membranous capsule intact: if one imagines the lens as a disc held in place by a capsular "wrapper," then intracapsular extraction involves removal of the disc with the "wrapper" intact. Extracapsular extraction (ECCE), on the other hand, involves incision of the anterior (forward) surface of the lens capsule, and extrusion of the lens from the capsule. The lens is removed, with most of the capsule left intact. Removal of the lens from an extracapsular approach can occur with the lens intact (by extrusion of the

²Non-surgical (pharmacologic) management of cataract is reviewed by P.F. Kador (Overview of the current attempts toward the medical treatment of cataract. *Ophthalmology* 1983; 90: 352) and by L.T. Chylack and H.-M. Cheng ("Clinical Implications of Research on Lens and Cataract" in Maisel, op cit).

³Dutt KC: Cataract operations in the prehistoric age. *Arch Ophthalmology* 1938; 20:1.

lens through the opening in the anterior surface of the capsule). Alternatively, the lens can be disrupted first--for example, ultrasonically--and then extruded as a semisolid. Lens disruption during the course of extracapsular extraction is referred to as "phacoemulsification." The choice of ICCE or ECCE is driven in part by technical considerations related to complications of the procedures, and in part by the type of lens that is to be used to replace the native lens. Historically, ICCE was associated with lower rates of some of the more serious complications that could develop after lens extraction--namely, inflammatory and glaucomatous complications related to the retained lens fragments that could result from extracapsular extraction. With the development, for example, of techniques for phacoemulsification, complications related to retained lens fragments were reduced, and ECCE has again become popular. The changing approach to cataract extraction will be considered in more detail subsequently.

Three approaches to lens replacement follow surgery. The native lens may be replaced by a prosthesis placed extraocularly (eyeglasses), on the ocular surface (a contact lens), or intraocularly (an intraocular lens, or IOL). IOL's offer considerable cosmetic advantage over eyeglasses (which require very thick--"Coke bottle"--lenses), and cause less visual distortion, and considerable ease-of-use advantage over contacts, especially among the elderly for whom manipulation of contact lenses may be especially difficult. Multiple types of intraocular lenses exist; significantly, IOLs differ with respect to anatomic location, and placement depends to a large extent upon surgical approach (or *vice versa*). Thus, lenses may be placed in the anterior chamber; this may proceed after intracapsular or extracapsular extraction; they may be anchored to the iris after ICCE or after ECCE, or they may be fixed in the posterior chamber. In the latter case, ECCE is much the preferred approach, as it permits anchoring of the lens to the posterior lens capsule; placement of a lens in the posterior chamber in the absence of a lens capsule provides little support for the lens, and is associated with a high probability that the lens will dislocate posteriorly (into the vitreous), and damage the retina. In fact, then, the

choice of IOL position to a large degree determines the choice of surgical approach: iris-fixation is rare; anterior placement usually follows ICCE; and posterior placement almost always follows ECCE. Again, changing preferences with respect to IOL placement are considered subsequently.

Changes in the economic milieu, 1980-1986

The economic variables which are relevant to understanding changes in the use of the hospital have been described, and reviewed in general, in the first two chapters. Some special issues, however, are relevant to this discussion of the use of the hospital for management of cataract.

Supply side

As described in chapter 1, there was a small contraction in the number of hospitals, and hospital beds, between 1983 and 1986; not nearly sufficient to account for the decline in hospital admissions, nor especially to account for the (fractionally much greater) decline in admissions for cataract. There is no evidence that there was selective reduction in the number of facilities capable of providing care for cataract; rather, there is considerable evidence that there was increased supply of care which was alternative to inpatient hospital care.

Analysis of the site of cataract care is complicated by the paucity of data that exist to describe outpatient care prior to 1985. It is necessary, therefore, to assert that cataract care was provided almost exclusively in the inpatient hospital until 1982. The reasonableness of such an assertion is high, given that Medicare--the primary source of payment for the surgical care of cataract--did not agree to pay for surgical cataract treatment anywhere but the inpatient hospital until 1982. Data which support this, indirectly, will be presented in a subsequent section of this chapter.

There is considerable evidence, however, that cataract care was provided in outpatient sites after 1983. Data from the CPHA indicate that approximately 70% of lens extractions⁴ performed in CPHA hospitals in 1985, and nearly 80% performed in 1986, were done in those hospital outpatient departments: that is, by 1986, less than 20% of surgical cataract care provided in the hospital was done in an inpatient setting.

Other evidence indicates that freestanding outpatient surgery centers (ambulatory surgery centers, or ASCs) increasingly supplied cataract care after 1983. In 1983, there were approximately 303 freestanding outpatient surgery centers, which accounted for approximately 371,513 surgical operations.⁵ The fraction of these that were cataract operations is unknown, but can be estimated to be no more than 5% of the total⁶ (approximately 20,000 procedures). In 1984, SMG reported that ophthalmologic procedures (now reported separately) accounted for 4.2% of the estimated 517,851⁷ procedures performed in freestanding facilities; that is, approximately 21,750 procedures. By 1985, ophthalmologic procedures accounted for 23.1% of the estimated 783,864 (or 181,100 procedures), and by 1986, 24.0% of 1,100,240 (or

⁴more precisely, 70% of abstracts where "lens extraction" was identified as the principal procedure.

⁵SMG Marketing Group, Inc. reported in Same Day Surgery/July 1984. page 81.

⁶the 1983 data of SMG marketing, which produces an annual report on outpatient surgical care, accounts for the most common 91.5% of all procedures; the set of specified procedures which accounted for the fewest but was reported specifically accounted for 5.1% of the total. It is reasonable to suggest, therefore, that cataract procedures (because they were not specifically accounted in 1983) comprised less than 5.1% of all procedures in ASCs. See Henderson, JA: Freestanding Outpatient Surgery Centers. SMG Marketing Group, Inc. Chicago, 1985.

⁷Henderson, JA. Freestanding Outpatient Surgery Centers. SMG Marketing Group, Inc. Chicago, 1985.

about 264,100 procedures).⁸ These data speak to the rapid growth of ophthalmologic surgery in the freestanding surgical center, but do not speak directly to the growth of cataract surgery in those sites. In a survey of members of the Federated Ambulatory Surgery Association (FASA) done in 1987, however, cataract surgery was identified as one of the five procedures done most frequently in more facilities than any other procedure, and was identified as one of those five most frequent procedures in more than half (55 of 105) of the centers that responded to the survey.⁹ These data suggest, therefore, that there was increasing capacity to provide cataract care outside the hospital, as well as in hospital outpatient departments.

There were also important changes in the supply prices for cataract care; particularly for Medicare patients, who comprise far and away the largest group that is hospitalized for this condition. In particular, with the implementation of the provisions of the Omnibus Budget Reconciliation Act of 1980 (late in 1982), HCFA added to its list of covered benefits the facility fee for cataract procedures performed in Medicare-certified outpatient facilities, including ambulatory surgery centers. At the same time, HCFA established a prospectively set rate for ASC care, based on categories which attempted to make reimbursement consistent with resource costs: for lens extraction, the prospective rate was \$336 (multiple procedures, including lens extraction with lens insertion, were reimbursed at 150% of the rate appropriate to the most complex procedure; for such cataract surgery, the rate was, then, \$504).¹⁰ Care in hospital outpatient departments--including cataract care--continued to be paid on a (reasonable) charge basis. Estimated reimbursement for facility fees for outpatient cataract range from

⁸SMG Marketing Group, Inc: Freestanding Outpatient Surgery Centers. Chicago, 1987.

⁹---FASA Facility Member Profile. FASA Update IV(5): pp21-22 (Sept/Oct 1987).

¹⁰Richard P. Kusserow, Inspector General: Medicare Certified Ambulatory Surgical Centers--Cataract Surgery Costs and Related Issues. December 1987.

\$1300 to \$3800.¹¹ Then, with the implementation of DRG-based hospital reimbursement (PPS) late in 1983, HCFA established prospective rates for hospital-inpatient cataract surgery; the prospective rate for lens extraction (DRG 39) was set at "roughly \$1200."^{12,13} Thus, the effective supply price for outpatient lens extraction rose--in both the hospital outpatient setting and in the freestanding facility--with the implementation of OBRA, and the supply price for inpatient lens extraction declined relative to hospital outpatient lens extraction with the implementation of PPS.

There are, unfortunately, no data that describe in detail changes in the pricing of cataract care among those covered by payers other than Medicare. It seems reasonable to assume that other payers which used DRG-like prospective reimbursement systems to pay for inpatient care used prices (eg for inpatient cataract surgery) that were comparable to those used by Medicare. Other aspects of pricing behavior (such as coinsurance differentials) are more relevant to the discussion of demand-side forces; and will be considered there. The extent to which payers other than Medicare were using DRG's after 1983 is reviewed in chapter 1.

¹¹ Subcommittee on Health and Long-Term Care of the Select Committee on Aging, US House of Representatives: Cataract Surgery: Fraud, Waste, and Abuse. US Government Printing Office. Washington, DC. 1985.

¹² Subcommittee on Health and Long-Term Care of the Select Committee on Aging, US House of Representatives: Cataract Surgery: Fraud, Waste, and Abuse. US Government Printing Office. Washington, DC. 1985.

¹³The Office of the Inspector General reported average Medicare payment to be \$1386 for hospital inpatient, and \$1655 for hospital outpatient, facility and lens. Total reimbursement for outpatient care ought to have included an additional sum (to be collected from the beneficiary--the copayment due under part B), so that average outpatient reimbursement can be estimated to have been \$2069. source: Office of the Inspector General: Medicare Cataract Implant Surgery. Washington, DC. March 1986.

Demand side

As suggested in chapter 1, population demand for care is a function of the number of persons in the population (with preferences of a given sort) as well as the economic parameters which condition the demand of each person with a given set of preferences. Although the number of persons with health insurance is especially relevant to estimates of population demand, clearly the number of persons with cataract will be especially important to estimating the demand for hospital care for cataract.

Data from the National Health Interview Survey¹⁴ permit evaluation of the prevalence of (self-reported) cataract in the population. Relevant data are summarized in figure 3.2; that data suggest that the number of cataract cases was stable--or increased slightly--between 1983 and 1986. Figure 3.3 shows that the decline in hospital discharges for the care of cataract is well understood as a decline in the probability of hospitalization, given cataract.

It is, of course, possible that the decline in cataract care in the hospital is the result of declining cataract incidence: or rather, a decline in the number of prevalent cases yet untreated. Clearly, as the rate of cataract care increased as it did during the early 1980's, it is formally possible that the number of persons with untreated cataract declined. Data will be presented subsequently to show that the rate of total cataract care did not, in fact, decline after 1983.

Finally, it is possible that the decline in rates of cataract care reflect a declining severity of illness (among those with cataract). Severity of illness is not directly accessible to this analysis; however, age is a conventional proxy for severity of illness. Figure 3.4 indicates

¹⁴National Center for Health Statistics: Prevalence of Selected Chronic Conditions, United States, 1979-1981. National Center For Health Statistics Series 10, No. 155. NCHS: Current Estimates from the National Health Interview Survey, 1982, 1983, 1984, 1985, 1986. Series 10, No. 150, 154, 156, 160, and 164. Hyattsville, MD.

that age-adjusted discharges for cataract have declined even more substantially than have raw discharges; suggesting that changes in the age structure of the population reinforce (rather than reduce) the significance of the decline.

The importance of health insurance to the demand for hospital care has been suggested in chapter 1; changes in the extent of coverage for persons with Medicare are especially relevant, for (as will be shown), Medicare beneficiaries are by far the largest group that receives care for cataract. As table 1.2 shows, there was no decline in the number of persons covered by Medicare to explain a contraction in the demand for cataract care. Per-beneficiary rates of hospitalization are considered subsequently.

There were several changes in the structure of health insurance that are particularly relevant to understanding the extent to which the demand for cataract care is likely to have changed. With the implementation of OBRA, Congress waived the Medicare beneficiary's part B deductible and copayment for the facility fee for surgery--including lens extraction--performed in an approved outpatient setting, and agreed to pay 100% of the physician's part B (reasonable) charge when a physician accepted assignment. Care in hospital outpatient departments continued to be paid on a (reasonable) charge basis; with Medicare reimbursement for 80% of charges after the deductible, and beneficiary responsibility for the remaining 20% (copayment). Inpatient care, of course, continued to require a deductible, but in general no coinsurance¹⁵ The effect of these changes was to decrease Medicare beneficiary copayment for cataract surgery in a freestanding facility, relative to hospital-based (inpatient or outpatient department) care, and to make the hospital outpatient department the most expensive place for cataract care. However, beneficiary payments for hospital-based outpatient cataract surgery

¹⁵until the 61st day of care.

typically were waived (by the hospital),¹⁶ so that the net price to the Medicare patient of care provided in that facility was competitive with the price in an ASC. The extent to which other payers offered similar benefits for such care is unknown; it is unclear that other payers were as willing as Medicare to introduce payment, or coinsurance differentials, for outpatient cataract surgery. While the motivation to do so may seem clear, that lens extraction was rarely offered to Medicaid and those privately insured may imply that there was some inertia in the policy-making of those payers. At least one Blue Cross plan published a list of reimbursable surgical procedures deemed "medically safe to be performed on an outpatient basis;" which list did not include lens extraction.¹⁷

Clearly, lens extraction--as an elective, and surgical, procedure--was especially likely to be targeted by all programs which focused on hospital procedural care. Thus, Medicare UR was directed toward review of cataract surgery--at least 37 of 54 PROs reviewed lens procedures prospectively or retrospectively.¹⁸ The extent to which other payers reviewed cataract surgery is less clear; it should not be presumed that other payers reviewed it as frequently as did Medicare. At least two Blue Cross plans which have published lists of surgical procedures requiring pre-authorization have not included lens extraction on those lists,¹⁹ and Lindsey reported that only five state Medicaid programs (out of 44 responding, and out of 13 with

¹⁶see "Cataract Surgery: Fraud, Waste, and Abuse," note 12 and "Medicare Cataract Implant Surgery;" note 13.

¹⁷"Capital Blue Cross lists 100 reimbursable SDS procedures." *Same Day Surgery*, December 1983, pages 151-152.

¹⁸*Modern Healthcare*, January 18, 1985.

¹⁹Capital BC/BS in Harrisburg, PA, and Northern Ohio BC/BS in Cleveland have published lists of surgical procedures which would require additional documentation to establish the necessity for inpatient admission. Lens extraction (or other cataract procedures) were not on those lists. (*Same-Day Surgery* December 1983: pp151-152; *Same-Day Surgery* October 1984: 126-127).

mandatory second surgical opinion programs) reviewed cataract extraction.²⁰

Changes in technology

There were important changes in the technology of cataract care which occurred in the 1980's: in particular, in a very real way, the "production function" which describes cataract treatment was changing, and changing radically.

First of all, there was a rapid increase in the use of intraocular lenses. Figure 3.5 demonstrates that there was a rapid increase in the number of IOLs implanted after 1980, with doubling between 1980 and 1982, and then nearly again between 1982 and 1985. This obviously implies a change in the post-operative management of the patient with cataract; it reflects, in fact, a change in the surgical management of the problem.

Table 3.1 demonstrates that the surgical management of cataract changed in the hospital after 1980. In 1980, the majority of persons hospitalized for the care of cataract received one surgical procedure. By 1984, nearly all persons hospitalized for cataract received at least two. Table 3.2 demonstrates that these changes reflect movement from lens extraction, to lens extraction with secondary (intraocular) lens insertion: between 1980 and 1983, the fraction of persons hospitalized for the management of cataract that had both procedures doubled, so that far and away the commonest therapeutic strategy in 1983, and thereafter, involved the insertion of an intraocular lens during the hospitalization at which the cataract-affected lens was extracted. Thus, the period between 1980 and 1983 was one during which the approach to the patient with cataract was changing--from lens extraction (and discharge, for eyeglasses or contact lenses), to lens extraction with IOL insertion. Data from the CPHA (not shown)

²⁰Lindsey, PE: Medicaid Utilization Control Programs: Results of a 1987 study. Health Care Financing Review 1988; 10(4): 79.

indicate that outpatient cataract surgery was virtually identical--more than 99% of persons undergoing lens extractions in hospital outpatient departments had secondary IOL insertions in 1985.²¹

There was also movement towards extracapsular approaches to lens extraction. Figure 3.6 shows that the technique of lens extraction changed markedly in the early 1980's--in 1980, the most common technique for lens extraction (accounting for approximately 80% of lens extraction procedures) was intracapsular extraction; by 1983, extracapsular techniques (including phacoemulsification) accounted for more extractions than did the intracapsular approach. By 1986, almost three-quarters of (hospital inpatient) lens extractions were via extracapsular approaches. CPHA data²² suggest that an even higher percentage of outpatient lens extractions were via extracapsular approaches.

There were also changes in the type (positioning) of the IOL used after lens extraction. In 1978, approximately 52% of the intraocular lenses implanted were fixed to the iris;²³ approximately equal numbers of lenses were placed in the anterior chamber, and in iridocapsular positions; and only 4% were placed in the posterior chamber. By mid-1982, lens placement had changed markedly: nearly half of all lenses were placed in the posterior chamber; nearly half in the anterior chamber, and iris-fixed and iridocapsular lenses were extremely rare.

²¹CPHA data are not available for hospital outpatient surgery prior to 1985. Data from CPHA National Outpatient Profile; "supplied by Healthcare Knowledge Systems (HKS), Ann Arbor, Michigan. Any analysis, interpretation or conclusion based on these data is solely that of the authors, and HKS specifically disclaims responsibility for any such analysis, interpretations, or conclusion."

²²in 1985, 8.6% of outpatient lens extractions were ICCE; 18.65% were via phacoemulsification, and 72.75% were by ECCE. CPHA data from HKS, Ann Arbor.

²³Data on IOL placement are from Stark WJ, Whitney CE, Chandler JW, Worthen DM: Trends in Intraocular Lens Implantation in the United States. Arch Ophthalmol 1986; 104: 1769.

Between then and early 1986, preference for posterior chamber placement had increased further, so that approximately 86% of IOLs were placed in the posterior chamber; about 14% were placed anteriorly, with less than 0.1% accounted for by iris-fixed and iridocapsular placements.

There were, then, many changes that took place in the environment in which cataract care was delivered, which might have had an impact on the use of the hospital for the delivery of necessary care. In particular, there is evidence that the supply of care at alternative sites increased; whether total rates of care declined, or were stable, is clearly important to understanding the meaning of the change in hospital use. Similarly, there may have been important changes in the prices relevant to the purchase of care by different persons, and at different places; the relationship between changes in these prices, and rates of care at different sites, is accessible through evaluation of rates of change in groups, the nature of whose insurance changed at different rates. Finally, there were significant changes in the nature of the commodity that was purchased--in that "cataract care" in 1986 was apparently very different from cataract care in 1980. These considerations suggest a number of hypotheses, the evaluation of which promises to increase understanding of the relevance of each of the many economic variables which was in flux.

DATA

"Discharges for cataract" are NHDS records (inflated to give national estimates) in which the first-listed diagnosis code is ICD-9-CM code 366. Lens extraction procedures are as described in the ICD-9-CM. The "principal" lens extraction procedure is that which was first-listed in the NHDS record.

Data on inpatient and outpatient hospital utilization after 1984 was obtained from CPHA

through MKS, Inc. and is used with their permission.

Data from other sources are described in the text.

RESULTS

Was the decline in hospitalizations for cataract a decline in rates of cataract care, or a substitution of outpatient care for inpatient care?

Evidence already cited suggests that the total volume of care provided for the management of cataract was in fact stable, or increased, over the period during which inpatient care was contracting. First of all, data from the CPHA suggest that the fraction of lens procedures done in the outpatient hospital in 1986 was virtually identical to the fractional decline in inpatient lens procedures between 1983 and 1986.²⁴ Next, the data on ASCs, cited above, suggests that the number of ophthalmologic procedures²⁵ done in ASCs increased from less than 20,000 in 1983 to more than 264,000 in 1986--which growth alone could account for more than half of the decline in inpatient cataract care after 1986. Other data speak to the movement of inpatient ophthalmologic care to other sites, albeit for Medicare patients only. A recent report²⁶ notes that the rate of ambulatory ophthalmologic procedures per 1000 Medicare enrollees increased substantially in a variety of outpatient settings between 1983 and 1985: in hospital outpatient departments, from 5.8 to 18.6; in ambulatory surgery centers, from 0.1 to 0.9; and in

²⁴this implies that the total number of cataracts done in 1986 was the same as the total number done in 1983, if and only if (1) no outpatient department cataract procedures were done in hospital outpatient departments and (2) CPHA data are nationally representative. Neither is certain.

²⁵but not necessarily the number of cataract procedures.

²⁶Leader S, Moon M: Medicare Trends in Ambulatory Surgery. Health Affairs 1989; 8(1): 158.

physician's offices', from 11.5 to 13.9.²⁷ While that work assays rates of ophthalmologic care very differently than I do here, these data suggest that it is credible to assert that the substantial decline in rates of hospitalization for Medicare patients for the care of cataract could be adequately accounted for on the basis of movement of that care to outpatient sites.²⁸ Finally, the data on IOL insertions (figure 3.5) suggest that absolute rates of cataract care increased over time.²⁹ Multiple lines of assay, therefore, suggest that the total volume of care provided to persons to attend to the problem of cataract did not decline between 1983 and 1986; rather, care moved from the inpatient hospital to the outpatient hospital and to freestanding ambulatory sites.

Were changes in rates of inpatient care related to insurance programs which might have affected the demand for care?

Differences in the extent to which suppliers of cataract care might have been motivated to supply that care, or that (and where) persons with cataract might have been motivated to seek it, can be imputed from consideration of the changes in insurance programs relevant to cataract care as discussed above. Because these program changes occurred at different rates among the different payers, it is possible to infer what impact these changes may have had on the volume of care delivered, by relating payer-specific rates to rates of program change.

²⁷ discharge rates for Medicare beneficiaries with cataract fell from 16.24 per 1000 in 1983 to 4.39 per 1000 in 1985.

²⁸ It is likely that the high rate of bills submitted for ophthalmologic care in doctors offices, even in 1983, was a consequence of ophthalmologic care other than cataract care, and the provision of procedures less invasive than lens extraction.

²⁹ to the extent that IOL implants were tightly linked to lens extractions. Clearly, I have already argued that that linkage tightened over time. By implication, figure 3.5 cannot be used in isolation to establish that total rates of lens extraction were increasing over time.

Data that describe payer-specific changes in rates of hospitalization are summarized in tables 3.3 and 3.4. Medicare has been the most important payer for cataract care; in 1983, 81% of persons discharged from NHDS hospitals after care for cataract had that care covered by Medicare.³⁰ Private and commercial sources (including Blue Cross/Blue Shield) accounted for slightly more than 15% of cases; Medicaid accounted for 2.0%; and other sources (workmans compensation, self-pay, etc.) accounted for less than 2%.

Between 1980 and 1983, cataract discharges increased. Medicare-covered hospitalizations rose more than 54%, and those covered by private carriers rose about 1.0%. The relatively small number of Medicaid admissions declined almost 20%. Discharges declined sharply after 1983: between 1983 and 1986, aggregate declines among the various covered populations were quite 84%, 78%, and 71% for these payers respectively. These are not significantly different from one another; all represent significant declines.

Rates of hospitalization among those covered by the major payers are presented in table 3.4. Medicare admission rates rose 46% between 1980 and 1983, while rates for the other carriers were flat or fell. All rates declined significantly after 1983: cataract discharges per beneficiary fell 85% for Medicare, 72% for Medicaid, and 77% for those covered under private and commercial plans. These trends are summarized graphically in Figures 3.7a and 3.7b.

DISCUSSION

Consideration of the data above make it clear that the early 1980's was a period of rapid change in the environment in which cataract care was delivered, and suggest the complexity that attends any attempt to assign primary cause to any of those forces, in isolation from the others.

³⁰reflecting the much higher prevalence of cataract in the elderly population.

Even so, it is possible to begin to tease out that which may have been causally related from that which was not.

To do so, however, will clearly require revision of some of the "elasticities" which have been presented in earlier chapters. The population at risk for hospitalization, by virtue of the need for cataract care, is unusual, and is expected to be other-than-average with respect to the extent that it may respond to changes in the variables that may have explanatory power. There seems no basis for adjusting the demand price "elasticity," as evidence has not been presented to suggest that cataract patients are more, or less, sensitive than average to the price that they face for hospital care. Similarly, there is no reason to believe that persons with cataract are more, or less, sensitive to demand constraints imposed by HMOs. Important changes over time in the effects of these variables, and important differences in the pattern of change among covered populations, is attributed the magnitude of change (and difference) in the extent of these parameters.

Cataract surgery, however, is an elective surgical procedure, and one which clearly was subject to utilization review. As such, it is expected to be more-than-average sensitive to UR. Similarly, it would be unusually sensitive to second surgical opinion programs, and to programs which introduce price incentives to substitute outpatient care for hospital care. I revise the elasticities for these variables upward to account for this. I choose elasticities of (-0.85) for UR and price differential programs; I expect these programs to be very effective, as cataract surgery is easily identified before the fact, elective, and not inexpensive, but I submit that there is an irreducible fraction of care (10-15%) which must remain in the hospital by virtue of other medical illness. I use an elasticity of (-0.38) for SSOPs. I use a value greater than that used in chapters 1 and 2 (-0.058) because I expect these programs to be more effectively applied to cataract care than to hospital care in general (because virtually all cataract

care is surgical care); I use a value lower than that for UR, because I expect SSOPs to be less effective than precertification. Somewhat arbitrarily, I assume that the effectiveness of SSOPs at reducing hospitalization for cataract care will be the same, relative to UR, as it is to hospital care in general; the ratio of the elasticities for UR and SSOPs is maintained. The sensitivity of conclusions to assumptions about these values is directly accessible.

Evaluation of supply effects is especially problematic, because there is evidence that changes in the pricing of substitute (that is, outpatient) cataract care are relevant to the analysis. I have not included ambulatory supply-capacity as an explicit parameter (so I will not adjust the hospital supply capacity elasticity or parameter estimate); the impact of changes in the supply of cataract care are discussed below. There are no considerations that require revision of the prospective payment supply elasticity for inpatient cataract care; again, there may be an important effect on outpatient care which has yet to be captured.

These elasticities permit estimate of the impact of the variables which have been reviewed on patterns of change for persons seeking hospital care for cataract. These estimates are in table 3.5.

The shift of cataract surgery out of the hospital after 1983 cannot unambiguously be assigned to any single factor. Aggregate changes (right hand column) are well accounted for both by the expansion of hospital precertification utilization review, and by the diffusion of programs that introduced copayment differentials for outpatient and inpatient cataract care. However, neither accounts well for the pattern of change seen across payers--the diffusion payment differential programs appear more predictive of changes in rates of use by Medicaid patients with cataract; the expansion of UR appears better to account for changes in rates of use by private patients with cataract. The two appear equally effective at explaining the decline among Medicare

patients; as Medicare accounted for more than 80% of all cases in 1983, the two are equally effective at accounting for the aggregate change.

The diffusion of these programs very poorly accounts for observed changes in rates of cataract use before 1984. Both UR and copayment differential programs were increasingly prevalent through the earlier interval; the downward pressure on hospitalization for cataract that they would have been predicted to exert, however, was not evident.

It is not difficult to account for the failure of these incentive programs to reduce hospital use for cataract, taking account of the data that have been presented (above) that describe the growth of outpatient cataract care. These data suggest that the capacity to deliver cataract care out of the hospital was constrained, until the implementation of OBRA and/or PPS; and with them the introduction of (supply-price) incentives to hospitals and to ASCs, to supply ambulatory cataract care. From this perspective, the movement of cataract care from the hospital after 1983 began with the introduction of incentives to suppliers before 1984. The release of a constraint on the supply of outpatient care permitted consumer preferences--which might have existed latent before 1983--to be revealed. Consequently, cataract surgery moved from the hospital at a precipitous rate.

The existence of a constraint on the supply of outpatient care implies that there may have been "pent-up" demand for outpatient care prior to 1984. Of course, that pent-up demand could account for the predicted decline in cataract hospitalizations that did not occur before 1984. Insofar as it does, variable impacts are likely to predict total change through 1986 more accurately than interval changes between 1980 and 1983, and 1983 and 1986. Review of table 3.5 reveals that the total decline (1980 to 1986) predicted by the diffusion of UR is about 79%; that for price-differential programs, about 83%. The former, however, poorly accounts for

payer-specific declines over the longer interval (predicting declines of 85%, 56%, and 43% for Medicare, Medicaid, and private carriers respectively, while declines of 84%, 71%, and 78% are observed). Copayment differential programs, however, appear to predict total changes quite well (projecting declines of 85%, 85%, and 62% respectively). Thus, it appears that it is possible to account (and to account accurately) for the magnitude, and the timing, of changes in rates of cataract care, through the interaction of demand-side programs which offered price incentives to patients to seek care out of the hospital, after Medicare policy was revised to stimulate the supply of outpatient care.

Were (or how were) changes in the technology of cataract care relevant? Recall that, in 1980, slightly more than one third of patients who received cataract care in the hospital had an intraocular lens implanted; by 1983, that fraction had doubled, and there is every indication, as care moved out of the hospital, that that fraction continued to increase. In 1980, anterior chamber lenses, posterior chamber lenses, and iris-fixed lenses were about equally commonly used when IOL insertion followed lens extraction; by 1986, posterior chamber lenses had virtually supplanted other types. Finally, as the frequency of posterior chamber lens insertion increased, so too did the use of extracapsular approaches for lens extraction. How are these related, and to what extent might they account for the shift in site of care?

In order to understand the relationship between these various elements of cataract care, and the site at which that care is delivered, it is necessary to consider in somewhat more detail the management of the patient with cataract. It is not difficult to account for the popularity of intraocular lenses in general--the acuity gains that follow the use of an IOL are superior to those that attend the use of eyeglasses, and they are so much easier to use than are contacts, especially among the visually impaired. But the more widespread use of IOLs had implications for the surgical approach to lens extraction; this, in turn, had implications for the

choice of lens. These are best understood by reconsidering the nature of extracapsular and intracapsular lens extraction.

Until 1980--that is, before the widespread use of IOL's-- ICCE was the preferred approach to lens extraction, except in patients at high risk for vitreous and retinal complications.³¹ This was largely a consequence of the high rate (20-40%)³² at which so-called "after-cataracts"³³ developed after ECCE. These after-cataracts required additional surgical "discission." So long as after-cataract was a frequent and troublesome complication to ECCE, and until IOLs routinely were used, ICCE remained the procedure of choice for lens extraction.

There were a number of improvements in the techniques of surgical care which facilitated the substitution of ECCE for ICCE.³⁴ Important among them was the introduction of the Nd:YAG laser for posterior capsulotomy for after-cataract, in 1981.³⁵ The simple, safe, and non-invasive management of after-cataract that was feasible with the Nd:Yag laser made that complication of ECCE substantially less daunting; that is, made planned ECCE appreciably more acceptable.

³¹ Vaughn D. and Asbury T. General Ophthalmology 9th edition. Lange Medical Publications, Los Altos, CA. 1980.

³² Allen AW, Hui-rong Z: Extracapsular Cataract Extraction: Prognosis and Complications With and Without Posterior Chamber Lens Implantation. *Annals of Ophthalmology* 1987; 19:329.

³³ after-cataracts are synechiae--fibrous 'scars'--that develop around retained fragments of lens material, as commonly remain after extracapsular extraction; these "after-cataracts" are opaque, and may interfere with vision as do cataracts.

³⁴ Jaffe, NS: The outlook for intraocular lenses through 1990. *Journ Cataract Refract Surg* 1986; 12:267.

³⁵ Aron-Rosa D, Griesemann J-C, Aron, J-J: Use of a Pulsed Neodymium Yag Laser (Picosecond) to Open the Posterior Lens Capsule in Traumatic Cataract: A Preliminary Report. *Ophthalmic Surgery* 1981; 12(7): 49

The development of IOL's, however, was likely the primary stimulus for the adoption of the extracapsular approach to lens extraction. This is best understood in the context of the preference for posterior placement of the intraocular lens. The advantage to the posterior chamber lens is both theoretical and empiric--posterior chamber placement is more "physiologic," and anterior chamber and iris-fixed lenses have been associated with relatively high rates of serious complications.³⁶ Where a posterior lens is to be placed, extracapsular extraction is clearly to be preferred over intracapsular extraction--if the capsule is removed (as in the ICCE procedure), the posterior chamber lens would be placed directly against the vitreous, where it would be at high risk to dislocate into the vitreous, and damage the retina. Thus, preferences for posterior chamber lenses imply preferences for extracapsular extraction; the parallel increases in the relative frequencies of extracapsular lens extractions and of PC lens insertions are logically related.

How might these bear on the supply of outpatient cataract care? First of all, the change in the approach to lens extraction made ambulatory surgery safer. The need for hospitalization after lens extraction has been in large part the need to reduce those stresses (including walking) which may increase intraocular pressure and thereby jeopardize healing of the ocular wound. The use of the extracapsular approach can reduce the duration that a patient is not ambulatory,³⁷ and thereby facilitate return home after the procedure. Other improvements in technology (including the development of phacoemulsification, and finer sutures and knives) have reduced the size of the incision necessary to effect lens extraction, and have therefore increased the safety of ambulation (and home convalescence). While intracapsular extractions are (occasionally) done in hospital outpatient departments--so that one cannot argue that

³⁶Safir A: How Ophthalmology Has Changed During My Career. Paper for the Office of Technology Assessment of the US Congress. 1983.

³⁷the retained lens capsule reduces the likelihood that vitreous will leak.

extracapsular extraction is a necessary condition for outpatient lens extraction in every case-- the widespread acceptance of outpatient surgery could not have evolved except in the setting of a series of changes that made lens insertion possible, and return home safe.

Insofar as this is true, the developments which made outpatient lens extraction routinely possible are, at a most fundamental level, responsible for the those events that followed. In more classic economic terms, it was necessary that an ambulatory product be feasible, before it could be supplied. The presence of a binding constraint on production limited care to the inpatient hospital, until sometime in the late 1970's when that constraint was released. However, release of that constraint--which made ambulatory care possible--created only slack, until price incentives were offered to suppliers to provide that feasible care. When that occurred--around 1983 with the implementation of OBRA--preferences for outpatient care--which may have been latent, under pricing schemes which offered incentives for that care--were manifest, and inpatient care dropped precipitously.

There may have been another, more subtle, effect of these changes in technology on the supply of outpatient care. Improvements in IOL technology clearly stimulated the more widespread use of IOLs;³⁸ they are likely to have stimulated the more widespread use of lens extraction to treat cataract as well. It is tempting to suggest--but remains to be established--that better results from lens extraction after IOL insertion increased the number of persons to whom lens extraction offered benefit, and that it was, therefore, an important force driving demand for hospital care for cataract up before 1984. Of course, increases in the volume of cataract surgery may have been part of the reason that incentives were created to supply ambulatory

³⁸ that is, increased the probability that a patient would have a lens inserted, given cataract surgery. That this increased after 1980 follows from estimation of the ratio of IOL implants (figure 3.5) to cataract admissions, at least through 1983.

care. The role that changing technology may have in affecting population preferences for hospital care is considered in the next chapter. The ramifications to the "technology constraint" introduced above will be reconsidered in the final chapter.

CHAPTER 4

DECLINING HOSPITAL CARE FOR DIABETES

INTRODUCTION

In chapter 2, I show that admissions to short term general ("community") hospitals declined markedly and significantly between 1983 and 1986, and that a decline in the number of admissions for the care of diabetes mellitus (DM) is quantitatively important to accounting for that decline. Figure 4.1 demonstrates that the temporal pattern of the decline for DM is like that seen before. Admissions for the care of diabetes declined from a peak of 674,709 in 1983 to a minimum of 479,789 in 1985; the decline between 1983 and 1986 was more than 27%, and was highly significant. This decline in admissions for diabetes accounts for more than 4% of the total decline described in chapter 2.

In this chapter, I consider what might be responsible for the pattern of change seen for diabetes. Before addressing this, though, I attempt to provide a context for analysis; thus, I first review what are the salient issues of biochemistry, pathophysiology, clinical presentation, and management in the patient with DM, and then review the environmental changes discussed earlier may have been especially important to understanding changing management of the patient with diabetes. Following that, I present data to explore a number of possible explanations for the phenomenon described in figure 4.1, and consider the logic and reasonableness of those explanations. Ultimately, I will suggest that the best explanation for the decline in the use of the hospital for the management of patients with diabetes involves an important change in the technology of diabetes care.

The biochemistry of diabetes

Carbohydrates (sugars and related compounds of carbon, hydrogen, and oxygen) are the

primary source of energy in man; normal human physiology has evolved a complex mechanism to store carbohydrate when excess is available, and release stored carbohydrate when metabolic demand requires. The polypeptide hormone insulin, synthesized by the "beta" cells of the normal pancreas, serves largely to facilitate carbohydrate storage. In the face of high levels of serum carbohydrate (especially the simple sugar glucose)--as occur, for example, after a meal--insulin is released from the pancreas, and stimulates cellular mechanisms for glucose uptake and storage.

Diabetes mellitus is a disorder of carbohydrate metabolism. In patients with "Type I," or "juvenile-onset" type diabetes, insulin production is impaired. In the more common "Type II," or "adult-onset," type diabetes, there is end-organ insensitivity to insulin action. In either case, relative insulin deficiency leads to intolerance to dietary carbohydrate; in particular, to extraordinarily, and persistently, high levels of serum glucose. This hyperglycemia is the cardinal metabolic problem in patients with DM.

pathophysiology

The immediate physiologic derangements that follow from relative insulin deficiency are predictable. Serum hyperglycemia implies a higher rate of glucose delivery to the kidney; in diabetics who are "poorly controlled," the rate of glucose delivery to the kidney is incompatible with complete reabsorption of glucose, so that glucose "spills" into the urine. "Glycosuria" is a classic finding in the diabetic. Importantly, a consequence of the increased solute load to the kidney is a glucose diuresis -- high levels of filtered glucose increase the rate at which water is eliminated from the body, so that diabetics who are poorly controlled not only produce glucose-containing urine; they produce urine at an abnormally high rate. High urine flow rates imply frequent urination and high urine volumes; the thirst that follows implies a high rate of fluid intake; and the inability to store carbohydrate for future use implies a constant need to provide

energy through food ingestion. This triad -- "polyuria," "polydipsia," and "polyphagia" -- is the classic symptom complex that describes the undiagnosed (or inadequately treated) diabetic.

clinical manifestations

These symptoms may have important clinical consequences; in particular, difficulties meeting the fluid intake requirements which poor glucose control implies can lead to clinically important dehydration, and high glucose concentrations, as well as high concentrations of the secondary products of deranged glucose metabolism, can produce profound and life-threatening hyperosmolar states. Ketone, and keto-acid production, can also lead to "diabetic keto-acidosis" (DKA), a condition, rare in type II (insulin resistant) diabetics but common among those with type I (insulin deficiency) disease, which may produce life-threatening derangements of acid-base balance.

The major clinical manifestations of diabetes, however, are not the acute, short-term complications of relative insulinopenia (namely: hyperglycemia, fluid and electrolyte disorders, and keto-acidosis). Rather, it has been well established that some aspect of chronic hyperglycemia -- or, more precisely, "the diabetic state"--promotes the development of vascular disease; much of the symptomatology of diabetes is a consequence of the vascular complications which seem inevitable in those with longstanding DM. Diabetic vascular disease is not peculiar to any organ or organs; although the specific pathology may vary from organ to organ, diabetics suffer from nephropathy (kidney disease) and retinopathy (eye disease) directly attributable to their diabetes, and may suffer from vascular disease in other organ systems (particularly the heart, and peripheral extremities) through a process of accelerated atherosclerosis in part attributable to their diabetes. While the development of symptoms attributable to these conditions is more gradual and occasionally less directly related

to diabetes than are, for example, the symptoms that follow from hyperglycemia or ketoacidosis, these sequelae of diabetes are just as much the reason for attempting to manage the disease as are the more acute metabolic problems described above.

Finally, it is important to note the relationships that exist between diabetes and other illnesses, especially infectious illnesses. On the one hand, it is clear that diabetics are more susceptible to some types of infections than are non-diabetics.¹ On the other hand, and more germane to this discussion, diabetic control may be lost in the setting of an acute illness (especially an infection).² In the fragile diabetic, this loss of control may be more evident, and clinically more significant, than the infection from which it results.

management of the patient with diabetes

Given that the basic biochemical abnormality in the patient with DM is relative insulinopenia, the therapeutic strategy is straightforward. In the truly insulin deficient diabetic (the rarer person with "juvenile-onset" type disease), the strategy is to attempt to replace insulin on a schedule which is as nearly physiologic as possible. In the type II diabetic, whose disease is a consequence of "relative" insulin deficiency, therapies are directed at improving the sensitivity of cells to insulin action, as well as supplementing endogenous insulin production with exogenous insulin. Strategies to increase insulin effectiveness include weight loss (in the -- typically --overweight type II diabetic), dietary control (to facilitate weight loss, but also to

¹It is unclear that this susceptibility is a consequence of an immune system deficit; rather, it may be that non-immune defenses are impaired, which limit the ability of the immune system to operate as it should. For example, diabetic microvascular disease, which limits tissue oxygenation, predisposes to anaerobic bacterial infection (of, for example, the foot). Similarly, diabetic neuropathy, with loss of sensation, predisposes to repeated trauma, skin breakdown, and infection. Predisposition to infection of this sort does not imply immunologic deficit *per se*.

²as a consequence of the release of the hormone cortisol in response to the physiologic stress of infection, which hormone antagonizes the actions of insulin.

provide the optimum mix and schedule for carbohydrate and non-carbohydrate foods), and exercise (to facilitate weight loss; there is, however, a literature to suggest that exercise itself may promote insulin effectiveness). In addition to these, there are pharmacologics--a variety of so-called "oral hypoglycemics"--which facilitate the action of endogenous insulin. There remains some debate about exactly how these agents work; for purposes of this discussion, it is sufficient to suggest that they either increase the sensitivity of cells to insulin, or they facilitate the release from the pancreas of pre-formed insulin. In type II diabetics who cannot be managed by some combination of these therapies, insulin supplementation may proceed as well. Typically, because type II diabetics are (by definition) insulin resistant to some degree, insulin supplementation is not as effective as in type I diabetics, and often very large doses of insulin are required.

Effective clinical management of the patient with diabetes clearly requires some mechanism for feedback of therapeutic effect: if the goal of therapy is to restore glucose metabolism as nearly to normal as possible, then information must be collected to establish how disordered that metabolism remains after a therapy has been initiated. Given the wide variation -- both over the course of a day, and day-to-day -- in dietary intake of carbohydrate and of calories on the one hand, and of carbohydrate and calorie needs on the other, considerable variation in serum glucose is expected to occur with any therapy. As a result, there is the need to monitor (and conceivably to adjust) therapy continuously. Although strategies for continuous monitoring and adjustment of therapy in fact exist, it is impractical to use them in most cases. Even so, daily, and often four-times-daily, monitoring of therapeutic efficacy in patients with diabetes has for some time been the preferred way to inform therapeutic decision-making.

Monitoring of blood sugar can occur a variety of ways. Self-reporting of symptoms is an excellent, and inexpensive, method to determine gross therapeutic effect -- the diabetic who

reports persistent polyuria and polydipsia is not well controlled, and the diabetic who reports a decline in these symptoms, in the face of apparent stability of blood pressure, probably has begun to respond to therapy. However, symptoms of this sort--though perhaps predictive of stability or instability with respect to the acute metabolic consequences of DM -- are insensitive to mild or transient hyperglycemia, which will, if persistent, almost inevitably lead to the development of the long term complications of the disease. Thus, patient self-reporting is a relatively ineffective modality for monitoring of glucostasis.

Because glucose "spills" into urine, the concentration of glucose in urine is some measure of serum glucose, and therefore of diabetic control. Urine monitoring for glucose is painless, inexpensive, and easy, and remains standard practice (when done with periodic checks of blood glucose or Hemoglobin A_{1c} -- see below) among most of those who care for diabetics. However, because the "threshold" at which glucose spills into the urine is not the same among all patients; because it is expected to vary with renal function, which itself may change over time in patients with diabetes; and because urine testing is insensitive to low blood sugar, which may be a serious complication of treatment, improved methods for monitoring blood sugar were sought. Techniques for the self-monitoring of blood glucose (SMBG), through colorimetric analysis of a drop of blood (usually obtained by fingerstick by the patient), were developed in the mid- to late-1970's, and have increasingly been used in addition to, or instead of, urine testing. This new technology is considered in somewhat more detail subsequently.

In addition to measures to determine the quality of diabetic control acutely, methods exist to gauge the average quality of control over weeks to months. This is not important, in general, to the prevention of the short term (metabolic) complications of DM, but is felt to be critically important to prevention (or at least amelioration) of the long-term (particularly vascular) sequelae of the disease. A simple, but unfortunately inaccurate, method for assessing the

adequacy of control over longer timeframes is, of course, to review the record of short-term control that a diabetic keeps. Obviously, the sensitivity of such a method is no better than the sensitivity of the method used to assess short-term control; the use of patient records of the results of daily urinary tests is, therefore, of quite limited efficacy. The more widespread use of SMBG has not improved the sensitivity of patient test-diaries as much as might have been expected, for, among other reasons, it has been observed that patients do not accurately record their test results.³ Similarly, the confidence that a physician may have that serial (office) tests of glucose legitimately reflect the state of control over time is limited by the knowledge that patient compliance (with medication and/or diet) is liable to be very different on the day of an office visit, and on any other day. The introduction of a simple blood test (for the blood protein Hgb A_{1c}) which reliably measures average control over months increased enormously the quality of the information base for evaluation of long term control. The use of the Hgb A_{1c} assay is considered subsequently.

Changes in the economic milieu, 1980-1986

The economic parameters relevant to understanding changes in the use of the hospital have been reviewed in chapter 1. Special issues which are relevant to understanding changes for patients with diabetes are discussed below.

Supply side

There were no changes in the capacity to supply care for patients with diabetes, that could not be predicted from consideration of the changes in total hospital (and bed) supply that were reviewed in chapter 1.

³Mazze R, Shamon H, Pasmantier R, Lucido D, Murphy J, Hartmann K, Kuykendall V, Lopatin W: Reliability of Blood Glucose Monitoring by Patients with Diabetes Mellitus. *Amer Journ Med* 1984; 77:211.

On the other hand, the introduction of prospective hospital pricing, under Medicare's PPS, may be especially important to understanding changes in the supply of hospital-based diabetes care. That is so because, under PPS, reimbursement rates for diabetes care came to depend upon discharge diagnosis (rather than the nature of the care delivered); because diabetes care can conceivably be described by a variety of principal discharge diagnoses, an opportunity was created to capture higher payment rates through adjustment of discharge diagnosis codes.⁴ To the extent that several alternative discharge diagnoses might have been credibly applied to a patient admitted for the care of diabetes, and to the extent that payment rate might have varied, depending upon the principal discharge diagnosis chosen after the implementation of PPS, the impact of PPS might have been to introduce an apparent change in the rate of hospitalization for the care of diabetes, which change was no more than a change in the rate of assignment of various diagnostic labels to care which was in fact diabetes care. Because most of the DRGs to which persons assigned discharge diagnoses which might substitute for diabetes were reimbursed at higher rates than the DRGs for diabetes,⁵ the incentive under Medicare's PPS--and other prospective payment systems with rates like Medicare's--was to substitute alternative diagnoses for "diabetes mellitus." The impact of that substitution on apparent rates of discharge for diabetes would be, of course, to cause them to decline.

Furthermore, the implementation of PPS has stimulated hospitals to attend to diagnosis data, as discharge diagnosis now determines payment rate. As a result, there may have been systematic improvements in the quality of discharge diagnosis data--so that errors prevalent before the

⁴although strict rules apply for the assignment of discharge diagnosis codes under the ICDM. The point is not that discretion existed; rather, that the opportunity for manipulation existed.

⁵see Prospective Payment Assessment Commission: 1986 Adjustments to the Medicare Prospective Payment System. Report to the Congress. Washington, DC. November 1985; and Bransome Jr: Assessment of Impact of Medicare Prospective Payment System on Care of Persons with Diabetes Mellitus. *Diabetes Care* 9(4): 415.

introduction of PPS may have been eliminated. If it were true that DM were too frequently assigned as discharge diagnosis in years before 1984, then apparent declines in rates of discharge would follow simply from quality improvements in data management.⁶

Demand side

It is necessary to consider whether there may have been changes in the size of the population at risk for hospitalization for diabetes, either by virtue of changes in the prevalence or severity of the disease, or changes in the penetration of health insurance among those with the disease.

There is reason to suggest that there might have been changes in the prevalence or severity of diabetes, as the 1980's was a period during which important changes in lifestyle were occurring, which changes may have affected the expression of diabetes. However, data from the NHIS, summarized in figure 4.2, do not suggest that the prevalence of the illness declined after 1983. Figure 4.3 illustrates that the decline observed in the number of admissions for DM is well understood as a decline in the rate of admission per case.

Of course, it is possible that there were changes in the distribution of diabetics, from generally more severe clinical states to generally less, despite the stable prevalence of the disease. I have already suggested that there are two well-defined subpopulations of diabetics (those with type I disease, and those with type II), which subpopulations almost certainly have different intrinsic rates of hospitalization.

Because type II diabetes is highly prevalent among the elderly, and type I among the young, it is possible to estimate the extent to which the distribution of diabetics changed over time by

⁶although the NHDS does not, in fact, depend upon Medicare billing data for diagnosis. See chapter 2.

reviewing age-adjusted rates of care. Such age-adjusted rates also account for other age-related factors which may affect the rate of hospitalization--such as higher rates of comorbid illness among the elderly, and lesser social independence. Figure 4.4 shows, however, that age-adjustment does not reduce the magnitude of the decline in discharges for diabetes. Thus it is unlikely that changes in the age-distribution of diabetes cases was operating to increase conditional demand.

Finally, it is possible that changes in lifestyle may have improved the condition of prevalent diabetics during the 1980s, and thereby reduced the demand for hospital care. It is well known, for example, that obesity is far and away the greatest risk factor for type II (adult-onset type) diabetes; often type II diabetes can effectively⁷ be "cured" by effecting weight loss through some combination of calorie restriction and exercise. This makes consideration of the impact of changing patterns of lifestyle relevant. In particular, given the "exercise boom" which appears to have moved through the early 1980's, it is formally possible that adult-onset diabetes was a milder disease after 1983 than it was before.

Survey evidence, however, suggests that lifestyle changes are unlikely to have had an impact on the prevalence of diabetes, or on its severity among prevalent diabetics. In particular, the Alcohol and Health Practices Survey (AHPS) component of the National Health Interview Survey includes elements that address diet and exercise habits of respondents. Evaluation of AHPS results⁸ in 1977 and in 1983 reveals that the proportion of persons identifying themselves as more than 30% overweight was 10% greater in 1983 than in 1977; the

⁷though not nominally; thus, a weight-controlled type II diabetic would continue to be counted as a case in the NHIS.

⁸Schoenborn, C.A. and Cohen, B.H: Trends in Smoking, Alcohol Consumption, and Other Health Practices Among U.S. Adults, 1977 and 1983. Advancedata #118. June 30, 1986.

proportion identifying themselves as "less physically active than contemporaries" was 12% greater. This is not a compelling picture of a nation increasingly committed to weight control and fitness, and does not suggest a nation of fewer diabetics. Among diabetics, weight and exercise patterns were poor--health behaviors among diabetics were reported separately in the 1985 NHIS,⁹ and diabetics were less likely than non-diabetics of the same age to have participated in an exercise, sport, or physically active hobby in the two weeks before the survey; were less likely to describe themselves as exercising or playing regularly; and were more likely to indicate that they do not exercise regularly, regardless of age. These data do not suggest that lifestyle changes are likely to have been very important to improving diabetic health.

I have already shown (in chapter 2) that there were only small changes in the extent to which the population was insured against hospital care. Taylor has presented evidence that the coverage of the diabetic population is very similar to that of the general population.¹⁰ There is no reason to believe that changes in the rate of coverage among diabetics was different from those changes that have already been discussed; or that the loss of health insurance among diabetics was particularly important to understanding changes in the demand for hospital care.

Among the changes in the structure of health insurance policies, UR is particularly relevant to consideration of the changes that occurred in rates of care for diabetes. There is no evidence to suggest that diabetics were particularly sensitive to changes in the price of hospital care.

Second surgical opinion programs are not relevant to hospitalization for the care of diabetes.

⁹Drury TF, Shannon, II: Health Practices and Perceptions of U.S. Adults with Noninsulin-Dependent Diabetes: Data from the 1985 National Health Interview Survey of Health Promotion and Disease Prevention. *Advancedata* #141. September 23, 1987.

¹⁰Taylor AK: Medical Expenditures and Insurance Coverage for People with Diabetes: Estimates from the National Medical Care Expenditure Survey. *Diabetes Care* 1987; 10:87.

Although the capacity to substitute outpatient diabetes education for a similar inpatient service¹¹ has existed for some time, payers resisted coverage for that; by 1986, only 14 (of 62) Blue Cross/Blue Shield plans, Medicare carriers in 15 states, Medicaid programs in 6 states, and commercial payers in 9 states reimbursed for outpatient education.¹² There were, however, UR initiatives which are especially relevant to understanding the use of the hospital for diabetes care.

Diabetes care was aggressively monitored by Medicare's PROs.¹³ PROs in five states required preadmission approval for all elective medical admissions (including elective admissions for diabetes); in another 6, admissions to those DRGs (294 and 295¹⁴) into which diabetes care (ICD-9-CM codes beginning with 250) fell required precertification. PROs in another 7 states reviewed, retrospectively, all cases in DRGs 294, or 294 and 295, and in 33 other states reviewed discharges with the principal diagnoses 250.00 and 250.01.^{15,16} The PRO serving Mississippi reviewed all discharges with the principal diagnosis diabetes (250.xx); only in

¹¹I am speaking here of outpatient education as an alternative site for the delivery of specific services. Diabetes education may be considered to be an alternative diabetes care technology; as such, it may substitute for other services as well.

¹²American Diabetes Association: Diabetes Outpatient Education: The Evidence of Cost Savings. Alexandria, VA. 1986.

¹³The data on PRO review of diabetes care is from Bransome Jr, ED: Assessment of Impact of Medicare Prospective Payment System on Care of Persons with Diabetes Mellitus. Diabetes Care 1986; 9(4):415.

¹⁴DRG 294 is "diabetes, age >= 36;" DRG 295 is "diabetes, age 0-35."

¹⁵diabetes without complication, type I or type II.

¹⁶In fact, the "Medicare Code Editor"--an electronic medical review edit required by HCFA of all fiscal intermediaries--identified all cases to which principal discharge diagnoses 250.00 and 250.01 were assigned as "Questionable Admissions." Those bills were to be returned to the hospital to establish whether there was an error in coding; correctly coded bills with those diagnostic codes were to be automatically referred to the PRO for review. source: Medicare Hospital Manual section 417.11. August 1984.

New Mexico were cases of diabetes not reviewed.

The extent to which diabetes care was monitored by other payers is unknown. It is reasonable to assume that policies of other payers were similar to that of Medicare; that is, where care was reviewed, diabetes care was reviewed. Insofar as that is true, then the extent to which there were precertification and retrospective review for diabetes hospital care for other payers is as described, generally, in chapter 1 (table 1.8).

Changing technology

There was, in the late 1970's and early 1980's, a proliferation of new technology relevant to the care of diabetes. These can be understood as proceeding along two fronts: namely, new technology for disease treatment; and new technology for disease monitoring.

treatment

Routine pharmacologic treatment of diabetes changed dramatically in the 1980's (figures 4.5 and 4.6). Insulin was used increasingly;¹⁷ pure (biotechnologically prepared) human insulin was introduced (see figure 4.5); and new oral agents-- glyburide and glypizide--rapidly gained market share over that period when admissions were declining.¹⁸

The early 1980's was also a period in which truly radical therapies for the management of diabetes were introduced (or evolved). Two therapies in particular need be mentioned. Continuous subcutaneous infusion of insulin (CSII) is a therapeutic technology which

¹⁷Martin DB, Quint AR: Therapy for Diabetes, Chapter XXIV in Diabetes in America. US Department of Health and Human Services. NIH Publication #85-1468. 1985; and Anderson RM, Hess GE, Davis WK, Hiss RG: Community Diabetes Care in the 1980's. Diabetes Care 1988; 11(7); 519; and see figure 4.5.

¹⁸and see Kennedy DL, Piper JM, Baum C: Trends in Use of Oral Hypoglycemic Agents, 1964-1986. Diabetes Care 1988; 11(7): 558.

approximates the physiologic state much more nearly than does periodic insulin injection. By continuously infusing insulin, at a rate which depends upon continuously monitored serum glucose (or, more typically, upon calculated hourly need), serum insulin concentration can be adjusted much more finely to anticipated or actual changes in serum glucose concentration. Unfortunately, CSII is associated with frequent, and frequently with serious, side effects; pump failure may leave the insulin-dependent diabetic acutely insulin deficient (and therefore liable to ketoacidosis); insulin overdose (with acute hypoglycemia) is not an uncommon occurrence with CSII; and infections at the subcutaneous site are quite frequent. As a consequence, the insulin pump is recommended therapy only for the most highly motivated diabetic.¹⁹ Although exact counts of users are not available, its use is almost certainly sufficiently rare that it is unlikely to be important to explaining the decline in hospital admissions among diabetics.

The other "radical" new therapy for diabetes treatment which evolved during this period was pancreas transplantation. As the pancreas is the source for endogenous insulin, this is truly physiologic insulin replacement. Pancreas transplantation was, however, highly experimental during the early 1980's (and remains so today); although current counts are difficult to obtain, between 1966 and January 1 of 1985 there were 561 transplants (in 525 patients) reported internationally.²⁰ It cannot, therefore, have been quantitatively important to the decline observed.

¹⁹American Diabetes Association: Policy Statement, Continuous Subcutaneous Insulin Infusion. *Diabetes* 1985; **34**: 946.

²⁰Pozzi G, Secchi A: Pancreas Transplantation in Humans. *Diabetes* 1985. Elsevier Science Publishers B.V., Amsterdam. 1986. (pp 975-980).

monitoring

As suggested earlier, the inadequacy of urine monitoring of glucose as a means by which to achieve feedback for adjustment of therapy was well understood long before 1980; for that reason, technology which enabled the diabetic's self-monitoring of blood glucose (SMBG) -- so called "home blood glucose monitoring" (HBGM) -- was eagerly received by diabetologists following the introduction of strips for home use in the late 1970's, and the more accurate glucometers for home use in the early 1980's. Diffusion of this technology was rapid (figure 4.7), with meter use nearly doubling annually in every year after 1980, and strip sales more than tripling between 1982 and 1985. Surveys of diabetics corroborate the rapid adoption of this technology.^{21,22}

In addition to the development of this (self monitoring) technology to facilitate the evaluation of short term control, there recently has been a profound change in the technology of evaluation of "chronic" ("long term") control. Hemoglobin, the major protein component of the red blood cell, is slowly converted to Hgb A_{1c} (a glucose adduct of hemoglobin), according to a reaction which proceeds at a rate which is linearly dependent on the concentration of glucose in the blood. Because hemoglobin persists in the blood, in its glycosylated (as well as its native) form, for a relatively long time (the half life of the hemoglobin containing red blood cell is between 90 and 120 days), the concentration of HgbA_{1c} in the blood (or the proportion of hemoglobin which is glycosylated) offers a window on the average concentration of glucose in the blood over the prior 90 to 120 day interval. Thus, the introduction into clinical practice, in the late 1970's, of an assay for the determination of Hgb A_{1c} has greatly facilitated the

²¹NFO Research, Inc.. Survey of Self Testing Diabetics, 1985 for Ames, Inc.

²²Michigan Diabetes Research and Training Center: Diabetes in Communities. University of Michigan, Ann Arbor, MI. 1986.

evaluation of chronic control of the "stable" diabetic.²³

Review of the changes in the environment in which diabetes care was provided suggest a number of alternative explanations for the decline in hospitalizations for the care of diabetes. First of all, it is possible that there was in fact little change in the use of the hospital for patients with diabetes; rather, that the incentive to use other diagnostic labels, introduced with prospective payment systems, may have caused an apparent decline where not in fact occurred. Alternatively, the decline may be a consequence of expanded utilization review, or, less likely, some other insurance program(s) which were directed at controlling diabetic hospital use. Finally, given the variety of changes in the technology relevant to diabetes care, it may be that one, or some, of these technologies were able to alter the mode of healthcare production, in a fashion that would have reduced the demand for hospital care. In the sections that follow, a number of hypotheses are presented and tested, in order to assess the validity of each of these explanations.

DATA

"Discharges for diabetes" are NHDS records (inflated to give national estimates) in which the first-listed diagnosis code is ICD-9-CM (or ICD-8-CM, prior to 1979) code 250.

"Secondary diagnoses" comprise all ICD-9-CM codes assigned to a record except the first-listed; there may be as many as seven secondary diagnoses in any NHDS record.

"Admissions" and "discharges" are assumed to be equivalent (or at least exactly equal in number), and the terms are used interchangeably in the text.

²³Jovanovic LJ: The Clinical Utility of Glycosylated Hemoglobin. *Am Journ Med* 1981; 70:331.

Data on discharge diagnosis coding errors were provided by the Iowa Foundation for Medical Care (IFMC), the Peer Review Organization serving Nebraska and Iowa. The IFMC was chosen from a list of PRO's identified by sources at the Health Care Finance Administration, because of their willingness to cooperate.

A list of conditions which might have been used to substitute for diabetes mellitus as principal discharge diagnoses was generated from the list of cross-references to DM in the appendix to the ICD-9-CM. This list was supplemented by diagnoses identified in the IFMC analysis, and by assertion from my clinical experience. The list of these potential substitute diagnoses, and the ICD-9-CM codes which represent them, is in appendix 4.A.

Data pertaining to sales and use of diabetes home care products were provided by: Ames Division of Miles Laboratories (Elkhart, IN), Becton Dickinson (New Jersey), Boehringer Mannheim (Indianapolis, IN), and Lifescan, Inc (Orange, CA). Some producers required anonymity with respect to attribution; all estimates provided by industry sources are, therefore, presented as "producer estimates."

Data from other sources are described in the text and figures.

Was the decline in admissions for diabetes the result of coding changes?

The issue of coding change was addressed in four ways:

If systematic substitution of other diagnoses for DM as a principal diagnosis has occurred since 1983, then re-review of hospital records ought to reveal more records incorrectly assigned principal diagnoses other than DM (which ought to have been assigned to DM) than records incorrectly assigned the principal diagnosis DM.

To review a meaningful sample of hospital records was beyond the scope of this work;

fortunately, such review is done routinely by the Peer Review Organizations in the process of their DRG-validation. Table 4.1 summarizes the experience of the one PRO from which such data were available. Over two years, 102 records were discovered which ought to have been identified as hospitalizations for DM but were not: this suggests that the true number of admissions for DM was higher than reported. However, there were 115 records assigned the principal diagnosis DM incorrectly. Although the numbers are small, the data suggest that the impact of coding error on DM discharge counts is neutral: certainly, there is no evidence from this analysis that DM has been systematically underreported in hospital discharge records since 1983.

If improvements in data quality since 1983 have corrected the overreporting of cases prior to 1983, then review of records prior to 1983 should reveal more cases incorrectly assigned the principal diagnosis DM than cases assigned other diagnoses, that should have been assigned the principal diagnosis DM.

The data above do not, however, speak to the question: Was DM markedly overreported prior to 1983? Insofar as that was true, better coding after 1983 would have the effect of reducing the apparent number of admissions for DM. Because the PRO's were not operational in 1983, it is not possible to attempt a similar analysis using PRO data. Fortunately, two published reports address this matter directly. Connell et al²⁴ reviewed diagnosis assignments in 1978-1979 Medicare discharge abstracts maintained by the Washington (state) Professional Standards Review Organization (PSRO). They found frequent errors of assignment of the diagnosis diabetes; the net effect of overcoding errors and undercoding errors was unambiguously, however, to decrease the apparent number of patients admitted for the care of diabetes. Restated, had the (abstract) data evaluated by this group in 1979 been error free, the number of reported admissions for diabetes would have been higher; by extension, any effect

²⁴Connell FA, Blide LA, Hanken M.: Ambiguities in the Selection of the Principal Diagnosis: Impact on Data Quality, Hospital Statistics, and DRGs. *Journ Amer Med Record Assn* 1984; February: 18.

that Medicare's PPS may have had to improve data coding should have increased the number of admissions reported for DM. In this setting, the decline seen after 1983 in the NHDS data must be viewed as a lower bound to the true decline; by no means should it be too large.

Additional information exists on the state of coding in the NHDS itself, prior to 1983. The Institute of Medicine evaluated data quality in the NHDS in 1980;²⁵ that analysis included re-review of hospital records, to validate (among other items) the principal diagnosis assigned. Raw data relevant to the question at hand are not presented in that report, but summary calculations of admission rates for DM²⁶ indicate that the NHDS estimates were underestimates; corrected rates were more than one-third higher than rates calculated from the NHDS data (28.9 admissions for DM per 10,000 compared to 21.1). Insofar as this is true, improvements in coding in the NHDS after 1983, *per se*, would increase the number of diabetes cases. Again, estimates which indicate a decline must be viewed as under-, not over-, estimates.

If systematic substitution of other diagnoses for DM as a principal diagnosis has occurred since 1983, then DM should be appearing more frequently as a secondary (or "other listed") diagnosis in the NHDS record.

Table 4.2 summarizes trends in the rate at which DM has been assigned as a primary (first-listed) or secondary (other-listed) diagnosis. The decline in admissions assigned the primary diagnosis DM has been associated with increases in the appearance of DM as a secondary diagnosis. However, that increase was consistent with (and was, in fact, proportionately smaller than) increases in the rate of assignment of DM as a secondary diagnosis dating back at

²⁵Institute of Medicine: Reliability of National Hospital Discharge Survey Data. National Academy of Sciences, Washington DC. 1980.

²⁶Table 31 of that report

least to 1980. Thus, that increase might well have been a consequence of other forces which had been operating stably since 1980.

If systematic substitution of other diagnoses for DM as a principal diagnosis has occurred since 1983, then there should be reciprocal increases in the rates of assignment of those substitute diagnoses.

Table 4.3 summarizes trends in assignment rates for those ICD-9-CM codes which comprise the universe of credible substitutes for ICD-9-CM code 250.²⁷ Only those which increased between 1983 and 1985--that is, only those which may have been substituting for code 250 during the interval over which it was less frequently applied--are included in the table. The increase in the frequency with which these potential substitutes appear could explain as many as 149,169 fewer DM counts--that is, as much as 86% of the decline in discharges coded DM during this interval. Even so, among the potential substitutes for diabetes, only one appears to be of quantitative significance. Admissions assigned to "volume depletion" -- ICD-9-CM code 276.5 -- rose from 148,000 to 239,000 between 1983 and 1985, an increase of 91,000 (61.4%) during which time admissions for diabetes declined by some 195,000 cases. Only one other condition--septicemia (code 038.9) accounts for as much as ten percent of the decline.²⁸ It is necessary, therefore, to consider whether "volume depletion" was being used as a substitute for diabetes.

Figure 4.8 describes the time course of admission for "volume depletion," and suggests that the pattern of change for "volume depletion" is somewhat different from that anticipated, if those changes were reciprocal to changes in discharges assigned DM. In particular, discharges for volume depletion increased regularly after 1980, although the rate of increase

²⁷see appendix 4.A

²⁸CM Helms considers the "pseudo-epidemic" of septicemia in: A Pseudo-Epidemic of Septicemia among Medicare Patients in Iowa. *Am Journ Pub Health* 1987; 77: 1331.

clearly accelerated with the decline in admissions for DM.

If substitution of volume depletion for DM as principal diagnosis were occurring for patients admitted with dehydration as a consequence of diabetes out of control, then DM should be appearing in these records as a secondary diagnosis. Table 4.4 analyzes the increase in discharges for volume depletion, by whether or not DM is attached as a secondary diagnosis. It is clear that the large increase in the number of discharges labelled "volume depletion" has been among individuals to whom diabetes is not assigned as a secondary diagnosis. In light of the incentive, under PPS, to code secondary diagnoses when they obtain, this argues strongly that the increase in admissions described as "for volume depletion" is not a consequence of substitution of that diagnosis for diabetes. The fact that this condition is the only one of quantitative importance among the putative substitutes suggests that such substitution is not an important factor to understanding the decline in admissions for diabetes.

Was the decline a consequence of expanded utilization review (or other payer program changes)?

The significant expansion of utilization review initiatives after 1983, and the attention paid to hospitalization for diabetes when those initiatives were in place, suggest that these may have been very important to accounting for the decline in the number of those hospitalizations. The fact that UR diffused to different payers at different rates (see chapter 1), both before and after 1983, permits one to attempt to isolate the effect of UR by examining changing rates of hospitalization across the major payers. Table 4.5 presents data on the number of discharges by payer for each of the payers assayed in the NHDS. Table 4.6 presents data for the major payers (Medicare, Medicaid, and private/commercial including Blue Cross) normalized for changes in beneficiary population size; these data are summarized graphically in figures 4.9 and 4.10 (a and b).

Despite differences in the rates at which UR moved into these populations, Medicare, and privately covered, hospitalizations for DM--which together accounted for more than 80% of hospitalizations for DM--moved virtually in parallel between 1980 and 1986. Between 1980 and 1983, Medicare admissions for DM increased 3.0%; private admissions 4.1%. Between 1983 and 1985, Medicare admissions declined 33.1% (29.1% between 1983 and 1986); private admissions 31.5% (37.1% between 1983 and 1986). The trends diverge only between 1985 and 1986. Medicaid admissions--comprising about 10% of admissions in any year--declined somewhat less: about 20% between 1983 and 1985, and about 12% between 1983 and 1986.

On a per-beneficiary basis,²⁹ Medicare admissions declined 35.3% between 1983 and 1985 (32.8% between 1983 and 1986); those covered by all private sources declined 29.5% (and 34.7%) in the same interval(s). Medicaid rates declined somewhat less; about 20% between 1983 and 1985, and about 15% between 1983 and 1986. These parallel changes, in the face of different rates of programmatic change, suggest that these program changes do not logically explain the rate declines.

Can the decline in admissions for diabetes be related to changes in the technology of diabetes care?

The basic strategy for managing the patient with diabetes involves a feedback loop: therapy is begun, its efficacy determined, and that therapy is modified (with reevaluation, additional modification, and so on). Hospitalization occurs when therapy requires it; when non-hospital monitoring is inadequate; or when therapy fails. Consequently, changes in therapeutic

²⁹Beneficiary counts are from table 1.2. I assume diabetics are insured as is the population (cf Taylor, note 10).

technology, and in the technology of therapy evaluation, may be critically important to the need for hospital care.

The earlier discussion permits analysis of the relationship between these new technologies and the decline in admissions for DM. Insofar as most of that technology improved the capacity for short term control, or monitoring of short term control, there should be selective reductions in the admission of persons for the care of diabetes "without complications"--that is, those diabetics whom prior work has shown are hospitalized because their diabetes is in poor control³⁰ Insofar as technology increased the capacity to control diabetes more chronically, there should be relative greater declines among those hospitalizations for the care of the complications of diabetes--diabetic nephropathy, ophthalmopathy, neuropathy, vasculopathy, and so on--or comparable declines among the two groups. Of course, non-selective decline cannot rule out the possibility that some factor, less clinically distinctive, is accountable.

The coding format adopted by the ICD-9 permits one to begin to address this question. The fourth digit of the five digit ICD-9-CM code identifies the complication motivating hospitalization. The set of diabetic complications, and the interval change (1983 to 1985) in hospital admissions for each complication, is summarized in table 4.7. It is clear that the entire decline in admissions for DM can be explained by the decline in the group admitted for the care of diabetes "without complication;" in fact, the decline is virtually limited to that group. This is consistent with the hypothesis that improvements in short-term control of diabetes may have reduced the need for--hence the volume of--diabetic hospital care.

³⁰see Anderson RA, Hess GE, Davis, WK, Hiss RG: Community diabetes care in the 1980's. *Diabetes Care* 1988; 11:519; Connell, FA: Epidemiologic approaches to the identification of problems in diabetes care. *Diabetes Care* 1985; 8(supp1):82; Rettig BA, Schraeger DG, Recker RR, Gallagher TE, Wiltse H: A Randomized Study of the Effects of a Home Diabetes Education Program. *Diabetes Care* 1986; 9:173.

DISCUSSION

Attempting to differentiate among those many factors which might be responsible for changes in medical practice is a complex matter. Given the relative simultaneity of recent changes in financing, insurance, and medical technology, the problem of differentiation becomes yet more complex. However, by focusing in detail upon the changes that occurred, it is possible to infer a great deal about the likelihood that some of these changes may be more, or less, important.

I have described the diffusion of relevant program changes and demographic variables in chapters 1 and 2; as before, that diffusion can be used as an instrument to attempt to dissect out cause and effect. However, discussion earlier in this chapter indicates that some of the "elasticities" to be used to estimate variable effects need to be revised.

I have argued previously that the contraction of hospital supply was a response to declining hospital use (not a cause for it); there is no reason to believe that the marked decline in hospital admissions for diabetes was not part of the reason for that supply reduction.

Although a supply-price incentive under PPS might have motivated the substitution of alternative diagnostic labels to care which, before PPS, would have been labelled care for diabetes, there is little to support the argument that such substitution is quantitatively important to explaining this decline. First of all, evidence suggests that coding errors as frequently have been in the opposite direction. Second, evidence suggests that miscoding of diabetes was frequently a problem before 1983, and that improvements in data quality--which might have followed PPS--should have the effect of increasing the apparent number of discharges for

diabetes care. Third, there is little to suggest that there was an increased rate of assignment of diabetes as a secondary diagnosis after 1983, as would have been expected were other conditions replacing it as principal diagnosis in diabetic patients. Fourth, survey of a long list of conditions which might reasonably substitute for diabetes revealed only one--"volume depletion"--which appeared significantly more frequently as diabetes was appearing less frequently. For a number of reasons discussed above, the increase in the frequency with which volume depletion appears after 1983 is likely to be unrelated to the decline in admissions for diabetes.³¹ Finally, work from other sources--using very different methods to count hospitalizations for diabetes (which methods would be insensitive to hospital coding artifact)--speak to these issues, and corroborate the conclusions I have drawn: Weinberger et al³² reviewed charts with "other ICD-9 codes indicating admissions for vague diagnosis (sic) which may have been due to uncomplicated hyperglycemia," and do not discover any cases which ought to have been coded as DM³³ and Anderson et al³⁴ note that patient (self-) reported admissions for diabetes have declined (approximately 41%) in the interval 1981 to 1985. Thus, I do not revise the elasticity for PPS.

There is little to suggest that there were unusual changes in the insurance coverage of diabetics; nor evidence that the population of diabetics was changing remarkably. As before, I assume proportional changes between health insurance penetration and population admission rate.

³¹ preliminary analysis suggests, however, that it may frequently be substituting for a variety of non-specific gastrointestinal diagnoses (nausea and vomiting, gastroenteritis, etc).

³²Weinberger MS, Ault KA, Vinicor F: Prospective reimbursement and diabetes mellitus. Impact upon glycemic control and utilization of health services. *Med Care* 1988; 26:77.

³³of interest, they describe a 40% decline in admissions assigned the principal diagnosis "diabetes without mention of complications" in their study, which spans the interval 1983 to 1984, but do not comment on it.

³⁴ Anderson RA, Hess GE, Davis, WK, Hiss RG: Community diabetes care in the 1980's. *Diabetes Care* 1988; 11:519.

Elements of insurance program change, however, may have had effects on the hospital use by diabetics that were different from their effects in other populations. There is no reason to suggest that diabetics were especially sensitive to price changes, nor that HMOs exerted an especially powerful influence on diabetic hospitalization. I do not revise the elasticities for these variables; as I did in chapter 3, however, I use the lower estimates presented in chapter 2. (14.3% for the interval 1980-1983; 3.2% for the interval 1983-1985/6) to describe the magnitude of copayment increases.

There are reasons, however, that hospital UR, SSOPs, and copayment incentive programs might have affected the diabetic population unusually. Diabetes was especially intensively reviewed--certainly by Medicare; we may presume by other payers as well. Although it is difficult to estimate what the impact of that more intensive review might have been, I suggest that a reasonable first estimate for the elasticity should be (-.30). That estimate derives from two lines of analysis which converge--first, about half of all admissions for diabetes are for "diabetes without complication;" I would suggest that that is an upper bound to the number of admissions that could be prevented through any program. Furthermore, I estimate the efficiency of UR for diabetes to be no more than 50%--a design consequence of the fact that diabetes care (unlike cataract care, for example) is often urgent.³⁵ Second, the decline in admissions for diabetes has been about 30%, and has levelled off. That suggests that the maximum number of hospital episodes that could be prevented is about 30% of the episodes that were provided in 1983. The use of an elasticity of (-0.30) for this reason, of course, is to attribute to UR the maximum effect possible. This serves to bias the analysis toward accepting

³⁵Where a review entity is unable to ascertain whether care is necessary or not, the likelihood that care will be allowed is a function of the seriousness of the consequences, should care be withheld. Because the consequences of disallowing care (before the fact) for diabetes is greater than that for cataract, the probability that marginal care will be approved is higher.

UR as explanatory; to the extent that that is the result, the legitimacy of the use of this elasticity can be further addressed.

Second surgical opinion programs, on the other hand, are rarely relevant to care for diabetes. I revise the elasticity for SSOPs to 0.

Incentive programs to motivate the substitution of care for diabetes are relevant only to the extent that such alternatives exist. Outpatient diabetes education is the only outpatient service which reasonably can substitute for inpatient service; and that can substitute only for low intensity services such as the initiation of insulin. There is little good work that permits empiric assessment of the success of outpatient diabetes education at substituting for hospital care;³⁶ I assume that such programs can reduce about half of those admissions for "uncomplicated" diabetes, or about 25% of admissions for DM. It is important to note that the diffusion of coverage for diabetes education is not the same as the diffusion of programs that offered incentives for outpatient care. I assume that coverage of outpatient diabetes education, when it existed, was always at a rate preferred to inpatient care; in that case, the time course of diffusion of relevant copayment incentive programs is the timing of coverage of outpatient diabetes education. Since that is unknown, I assume that that diffusion occurred only after 1983, and as described earlier in the text: namely, to 30% of persons covered by Medicare, 12% of persons covered by Medicaid, and 20% of persons covered privately.

From these revised elasticities, and the pattern of variable changes described in table 2.2 (or as above), I calculate estimates of impact for each of these variables for the intervals 1980-1983

³⁶the conclusion drawn by Kaplan and Davis in their review of what work there is. see: Kaplan RM, Davis WK: Evaluating the Costs and Benefits of Outpatient Diabetes Education and Nutrition Counseling. *Diabetes Care* 1986; 9(1):81.

and 1983-1985/6. These are summarized in table 4.8.

Of those variables, only hospital UR appears to have the power to explain a significant fraction of the total (right hand column) decline in admissions for diabetes that occurred after 1983. It can account for about two-thirds of the total; diabetes education may have had some smaller impact.

However, hospital UR does not well explain payer-specific variations; in particular, it quite poorly accounts for the large decline in hospital admissions among those privately insured. Furthermore, it predicts declines in rates of hospitalization in both privately covered and Medicaid populations between 1980 and 1983, which declines are not clearly evident.

This motivates a search for another explanation. Given that there were such impressive changes in the technology of diabetes care in the early 1980's, can one logically account for the decline in hospital admissions on this basis? While many of the technologies diffused broadly, it is unlikely that some of them have much potential to alter hospital use. The new sulfonylureas, for example, are probably only marginally more effective than the "first generation" agents that those who produce them would have them replace.³⁷ The more widespread use of insulin seems to be in response to the increased awareness of the importance of "tight" control to the prevention of the long term complications of diabetes; if anything, there is reluctance to use insulin aggressively to control the short term manifestations of diabetes because the risk of hypoglycemia (low glucose)--a serious iatrogenic complication--is so much greater with insulin use. Given that the data suggest that it is short-term control that has improved, it is unlikely that the tendency to use insulin in preference to an oral agent has been

³⁷----- Glyburide and Glipizide. The Medical Letter August 31, 1984; 26 (issue 669): 79 and Kreisberg, RA: The Second Generation Sulfonylureas: Change or Progress? Annals of Int Med 1985; 102(1):125.

important to recent changes in admission for diabetes care.

The introduction of biologically pure human insulin in 1982 implied that diabetics could be treated, finally, with the "physiologically correct" insulin molecule. However, given the physiologically correct activity of both the bovine and porcine products conventionally used prior to 1982 (and still in widespread use today), it is unclear that the introduction of human insulin would be expected to revolutionize diabetes care. In fact, most clinical discussants believe that the major advantage to human insulin is the lower likelihood that (antibody mediated) insulin resistance against it will be induced.³⁸ In addition, there appears to be a lower rate of certain (usually minor) complications of use associated with human insulin. (Obviously, it is the insulin of choice in the rare person allergic to both the bovine and the porcine products.) Given the relatively small clinical advantage of human insulin over insulins obtained from other species, it seems, *a priori*, rather unlikely that the marked decline in hospital admissions can be attributed to the use of human insulin. Nonetheless, it is well to remember that human insulin was rapidly gaining market share during the interval over which admissions to the hospital were declining (compare figures 4.1 and 4.5); this correlation serves to remind one that contemporaneous events need not be causally related.

The diffusion of technology that had the potential to increase the effectiveness of diabetes monitoring, on the other hand, provides a theoretically reasonable explanation for the reduction in hospital admissions for "uncomplicated" diabetes that has been described. In this regard, the diffusion of the HgbA_{1c} assay is less likely to be important than the diffusion of technology for home monitoring of blood glucose, as the former is not effective at assessing the adequacy of acute control, and the latter is designed to do just that. To suggest that the

³⁸Zimmerman BR, Service, FJ: Management of Noninsulin-dependent Diabetes Mellitus. Medical Clinics of North America 1988; 72(6):1355.

diffusion of SMBG technology to diabetics in the early- to mid-1980's increased the efficiency of monitoring of therapy--hence of that therapy--is both satisfying and logical.

One can estimate what the impact of that diffusion might have been, again given assumptions (and some additional data) that speak to its use and its efficacy. The increase in the number of diabetic users of SMBG technology between 1983 and 1985 is unknown. Survey estimates suggest that the number of users in 1981 was about 6%³⁹ of diabetics; the number in 1983 about 16%;⁴⁰ and the number in 1985 about 32%.⁴¹ These seem consistent with the rate of increase implicit in the data of figure 4.7.⁴² Assuming that there were 6,000,000 diabetics in 1985 (see figure 4.2), then SMBG diffused to approximately 960,000 diabetics between 1983 and 1985.

Estimation of the efficacy of SMBG is especially hazardous, for almost certainly its diffusion was not random (so that effects estimated using population averages will be misleading). In

³⁹Hiss, RG editor: *Diabetes in Communities*. Michigan Diabetes Research and Training Center, University of Michigan. 1986.

⁴⁰NFO Research, Inc. *Survey of Diabetic Households for Ames, Inc.* 1983.

⁴¹Hiss, RG editor: *Diabetes in Communities*. Michigan Diabetes Research and Training Center, University of Michigan. 1986.

⁴²One can estimate the penetration and rate of use of these home care products from the data of figure 4.7. That figure suggests that there were about 500,000 meters in use by 1985--hence 8 to 10% of diabetics should have been using meters at home by 1985. As it is almost certainly that many more diabetics read strips manually than visually, this estimate is not inconsistent with my estimate of users (of HBGM technology) in 1985. Similarly, the figure suggests that 250,000,000 strips were used in 1985--or approximately 120 per diabetic user, if 32% of diabetics were using strips. That implies that users monitored their blood glucose at home no more often than about twice a week--probably often enough for HBGM to have the postulated impact on hospitalization rate.

particular, logic (and limited survey evidence⁴³) suggests that the diffusion of home blood glucose monitoring was first to those who were the most brittle diabetics--type I diabetics, and very labile insulin-using type II diabetics--which group accounts for relatively few of those hospitalizations likely to be sensitive to this technology. The next wave of diffusion likely was to insulin-using type II diabetics with less severe (that is, less labile) disease, and type II diabetics not using insulin. In this group, the potential to improve control sufficiently to obviate the need for inpatient care, to maintain outpatient euglycemia, and to adjust or begin insulin therapy out of the hospital, could be realized, and many hospitalizations saved.

Suppose that there are, in fact, two "diabetic states," with different probabilities of hospitalization. Assume for convenience that the state associated with the higher probability of hospitalization is 50% higher than the average, and that with the lower probability 50% less than average, and there are equal numbers of persons in each state at the outset. Assume that the effect of SMBG is to move persons from the higher probability state to the lower probability state. Finally, assume that the diffusion of SMBG between 1983 and 1985 was only to persons in the higher probability state.

From the diabetic population mean rate of hospitalization in 1983 (0.12), we can calculate the state-specific probabilities of hospitalization for diabetes to be 0.18 and 0.06, and the impact of the diffusion of SMBG to be a reduction in the probability of hospitalization for diabetes of

⁴³ see: Anderson RA, Hess GE, Davis WK, Hiss RG: Community diabetes care in the 1980's. *Diabetes Care* 1988; **11**:519; and NFO Research, Inc: Surveys of diabetics conducted for Ames Company, August, September, and October of 1983, and April and May of 1985.

0.12 per new user.⁴⁴ If there were 960,000 new users (as calculated above), then (960,000*0.12=115,200) hospitalizations would have been saved⁴⁵--or about 60% of the decline observed. This is of the order of magnitude of the largest effect seen so far; namely, that attributed to utilization review. While this cannot establish that the diffusion of home monitoring technology accounts for the decline in the use of the hospital for diabetes care, that explanation is both tenable and logical. Unfortunately, absence of data that describe the diffusion of this technology to important subpopulations--those covered by different carriers, or diabetics in different clinical states--limits the current analysis. Clearly, there is opportunity for additional work.

What does this imply about the role of technology in the operation of the health care market? To the extent that SMBG--or some technology related to it--cannot be logically excluded as an important factor in explaining the decline in the use of the hospital for diabetes, it suggests that the manner in which diabetic health was produced changed radically in the 1980's. Further, it suggests that it may be possible to change aggregate demand in a population, in the face of stable prices and stable preferences, by changing the distribution of clinical states prevalent. These more general issues will be addressed in the next chapter.

⁴⁴for purposes of estimation in table 4.8, I calculate the "elasticity" to be -1.0; in this example, diffusion of the technology to 1% of the population reduces the population rate by 1%.

⁴⁵Assume, as well, that the higher probability state population is heterogenous with respect to its sensitivity to an effect of SMBG; that some fraction is susceptible to that effect, and that some is not. Once the "sensitive" group has been saturated, continued diffusion will be only to persons who will not benefit, and hospitalization rate will no longer decline. It is tempting to suggest that this accounts for the flattening of hospitalizations noted in 1986.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

In chapter 1, I show that there was a steep and precipitous decline in the number of admissions to community hospitals in the United States after 1983, at a time when there was tremendous change in the economic environment in which health care was delivered. In chapter 2, I point out that that decline can be adequately--but not necessarily logically--accounted on the basis of the expected impact of changes in many of the economic variables which have been in flux, and define and defend an analysis plan which depends upon disaggregation of hospital episodes according to the clinical condition which describes the nature of the cause for hospital care. In chapters 3 and 4, I investigate in greater detail the changes that have occurred for selected conditions of quantitative importance, and attempt to infer new relationships among economic conditions and the delivery of hospital care. In this chapter, I will try to summarize the conclusions to be drawn from this work, and the implications for the future.

The decline in hospital admissions for the care of diabetes and cataract is primarily a consequence of improvements in technology relevant to the care of these conditions.

At first glance, this work appears to ratify the suggestions of others: namely, that the growth of hospital precertification (including Medicare's Peer Review Organizations) is most important to explaining the decline in hospital admissions after 1983. Review of tables 1.9, 2.2, 3.5, and 4.8 establish that hospital (precertification) review consistently is able to explain the largest fraction of the total change in hospital admission. In every case, that calculated effect is principally attributable to the expansion of UR into the Medicare population.

This is not, however, very satisfying upon reflection. Given the quantitative importance of Medicare-covered hospitalizations to total hospital care, and the rapidity with which utilization

review diffused into the Medicare population after 1983, virtually any observable change in hospital behavior can be correlated to the diffusion of Medicare's UR. That high degree of correlation--which suggests, but does not necessarily establish causation--was, in fact, one of the forces that motivated the present work. Further review of tables 3.5 and 4.8 suggests that a causal relationship between UR and declining hospital admissions is not so satisfying: the decline in admissions for cataract, for example, is as well "accounted" for by the diffusion of programs that changed the relative prices of inpatient and outpatient cataract care as by the expansion of utilization review, and the pattern of payer-specific fractional declines is more accurately described by that diffusion. Similarly, the total decline in admissions for diabetes is as well described by the diffusion of a new technology for diabetes home care, which predicts more accurately the relatively similar declines among the Medicare population and those privately insured. Though these explanations are no better--quantitatively--at explaining the change in patterns of care for these patients, they seem intuitively more reasonable, for they explain quantitative variation among payers better, and total variation just as well.

Why might the importance of these other factors not yet be appreciated? One obvious explanation is that Medicare's prospective payment system has been so much more conspicuous. Given the visibility of PPS, the temporal correlation between PPS and hospital admission rate reversal, and the expectation that PROs would exert downward pressure on hospital admission rates, it is not surprising that efforts to seek other explanations may have been foreshortened. Furthermore, because program changes have been so highly correlated over time, it has been technically difficult to isolate that which is causal from that which is incidental. Finally, the absence of a simple parameter to represent technology has, of course, limited investigators ability to study its relevance.

But the work here suggests more profound, and more important, explanations for the failure to

appreciate the importance of other programs, and other events. This work suggests that the changes that have occurred rarely follow on the heels of economic change; rather, they follow after economic change, after technologic change. Thus, declines in hospitalization for the care of cataract followed changes in the structure of the economic system of incentives to the institutions that supplied cataract care; which incentive to supply outpatient care was effective at reducing inpatient care because of earlier changes in the incentive structure¹ that motivated patients to demand outpatient cataract care. But those incentive programs had the effect that they did, only because antecedent changes in lens extraction surgery--the more widespread use of intraocular lenses, and of extracapsular approaches to lens extraction to facilitate posterior insertion of the intraocular lens--had created an environment which permitted such an effect. Absent changes in the technology relevant to management of the patient with cataract, there is every reason to believe that there would have been no decline in hospital admissions for patients with cataract; and a blunted decline in total admissions, relative to that observed.

Similarly, declines in hospitalization for the care of diabetes are well understood as an expression of preferences for health-maintaining outpatient care to health-restoring inpatient care, which preferences almost certainly existed long before 1984. But this preference had no impact on manifest demand for hospital care, until an effective strategy for home maintenance of diabetic control was available. Corollary to that, utilization review, and incentives to substitute outpatient diabetes care for inpatient care, may have merely gilded a lily; the flowering of which was directly a consequence of improvements in the efficacy of diabetes home care.

¹in particular, the net-price differentials for inpatient and outpatient lens extraction that obtained for Medicare patients after OBRA, and for privately insured patients facing incentive programs to seek outpatient care alternatives to hospital care.

These suggest that changes in medical technology are profoundly important to a qualitative understanding of changes in hospital volume; in particular, that changes in the volume of hospital care delivered to patients with diabetes and cataract can be understood only by consideration of the manner in which changing technology conditioned the expression of economic incentives.² Of course, technology is not important exclusively--it has been the interaction of technology and economic incentives which has been important. Yet there is reason to believe that economic incentives have changed, at least in part as a consequence of changing technology.

Changes in the technology of care appear to be driving economic change

This work suggests, unambiguously, that evolving technology and economic change have acted in concert to affect the volume of hospital care. It suggests, as well, something about the nature of the relationship that has existed between the two.

At least three relationships can be conceived: economic policy may drive technologic change; technologic change may drive economic policy; or technologic change and economic policy may be substantially unrelated. Understanding the true nature of this relationship is important, because efficient policy design may depend upon it. Efficient policy is desirable, because

²The analysis which has proceeded permits a quantitative estimate of the impact of changing technology on the volume of hospital care. Had there been no improvements in the capacity to provide care to patients with cataract and diabetes, then the decline in admissions for care for these conditions would have been only 6% (rather than 54%). The implicit "elasticity for medical technology" is (-0.48)-- very substantial, and comparable to the elasticities for those strictly economic factors which the analysis has suggested have (through interaction with technologic change) exerted significant downward pressure on hospital admissions. For comparison, "blended" elasticities for utilization review and for price-differential programs--calculated as the sum of the elasticities for each (from tables 3.5 and 4.8), weighted by the fraction of cases in 1983 that were diabetes or cataract--are (-0.56) and (-0.53) respectively.

initiating economic change can be extremely "costly."³ Although this work has not been directed specifically at exploring this relationship, in fact considerable insight into the matter can be had.

Consideration of the changes that occurred in patterns of care for patients with cataract and diabetes suggests that improvements in technology were unrelated to economic policy. The technologic change which supported the growth of ambulatory cataract surgery took place before 1983--and diffused rapidly to the inpatient hospital; inpatient cataract care had changed markedly by 1983. Similarly, the home care technology necessary to permit high quality outpatient management of diabetes was developed in the late 1970's, and certainly by the very early 1980's; the diffusion of home blood glucose monitoring in the 1980's can be understood as deriving entirely from an understanding of its clinical utility. In the cases studied in detail, the development and diffusion of important new technology occurred before, and independent of, the implementation of incentive-based policy directed at reducing hospital use.

It is possible, of course, that changes in policy are not systematically related to changes in technology. Changes in economic policy may derive--not from any understanding of changes in what technology has made possible--but rather more or less at random. In such a world, incentives which are introduced into an environment which is fertile for change are effective; those introduced where the ground is more fallow are not. Thus, incentives to substitute

³ Consider, for example, what were the costs of implementing Medicare's prospective hospital payment system. There were measurable--and nontrivial--direct (dollar) costs associated with virtually every aspect of the development and implementation processes: the costs of drafting policy; of training persons to understand it; of the systems required for the implementation of DRGs; of PRO development and review; and so on. There were additional costs as well: the turmoil induced by change thrust upon socially important institutions; the political capital spent to adopt this policy, and negotiate for its success; the as-yet incompletely understood cost of physician disenchantment, which may have implications for physician behavior, and physician supply, which were unanticipated and undesired. The costs of such change imply the need to maximize the return on investment in change--that is, to write policy which will have the desired effect at the lowest total "cost," or to initiate change which will have the greatest desired effect, for a given dislocation to society.

outpatient care may have been written into policy quite generally; but it is only where the clinical environment had evolved to permit such substitution that such policy has been effective. As a result, cataract surgery has moved out of the hospital, but (for example) coronary artery bypass graft surgery has not; diabetes care has moved out of the hospital, but cancer care has not.

But it seems likely that policy-making is not so unrelated to technologic change; certainly, much evidence has been presented to argue otherwise. Changes in the economic incentives for cataract care followed changes in the nature of cataract surgery; furthermore, they are logically related. Thus we see that:

improvements in intraocular lens technology drove efforts to develop superior methods for extracapsular lens extraction. The development of phacoemulsification, and of microsurgical suture material, created the capacity to extract the lens extracapsularly through a smaller incision, and repair that incision more effectively. These improvements made early ambulation possible, and led to widespread acceptance of the safety of early discharge after cataract surgery, and by extension, of the safety of ambulatory surgery. Extension of coverage to outpatient lens extraction followed.⁴

and:

the superior visual result that could be obtained through the use of intraocular lenses led to an explosive increase in the volume of cataract care sought in the hospital (between 1980 and 1983). The total cost of care attributable to lens extraction surgery rose proportionately. In the face of rapid cost escalations, policy-maker responded by extending coverage to outpatient surgery, and offering patients incentives to seek lens extraction at those outpatient sites.⁵

⁴for example, with the passage of OBRA.

⁵again, under OBRA.

and:

hospitals, offered little incentive to shift surgical capacity to the outpatient department, did little; and freestanding ambulatory providers, unable to compete on a price basis with hospitals offering discounts on inpatient cataract care, and unable to compete on the basis of quality with inpatient hospitals, did little to expand their capacity to provide outpatient lens extraction. Continued increases in the rate--and cost--of inpatient cataract care was part of the stimulus for the introduction of Medicare's prospective payment system. The relatively higher rate of reimbursement for (cost-based) outpatient department lens extraction (relative to DRG-based inpatient lens extraction) stimulated the expansion of hospital outpatient department capacity for lens extraction. Finally, patients were able to find sources for quality ophthalmologic care at trusted⁶ sites, and rates of inpatient care began to decline.

Similarly, changes in economic policy relevant to diabetes followed, and can logically be related to, the development of better home care technology:

improvements in the capacity to monitor blood sugar out of the hospital led to understanding among physicians that diabetics would less frequently have the relatively mild complications of their illness, and that rates of hospitalization for these mild complications would fall on their own. With the introduction of Peer Review Organizations, and the requirement for contractual targets for admissions declines, PRO medical directors identified diabetes as a condition for which admissions targets should be set; that is, PRO policy was developed in response to the development and diffusion of home blood glucose monitoring. ⁷

The conclusions drawn from these cases are likely to have general relevance. It must be kept in mind, of course, that the effects of technologic change discovered through

⁶that is, familiar (that is, hospital)

⁷ By extension, one effect of improvements in diabetes care technology was to make it easy for PROs to make intensive review of diabetes appear effective.

the course of investigation of two cases chosen precisely because they were unusual⁸ may not be of general interest. To what extent are the lessons to be learned from the specific cases generalizable?

There are, among those conditions which table 2.4 indicates have declined, many conditions for which improvements in technology are likely to have been important. Thus, for example, the large declines in admissions for "benign neoplasms" and for "disorders of menstruation" can easily be related to the development of, and improvements in, a variety of "scopes"⁹ which may permit ambulatory care, and the subsequent introduction of incentive programs to motivate their use. The large decline in admissions for "inguinal hernia," and for tonsillectomy, have evolved in large part from the development of safer anesthetics and anesthetic regimen,¹⁰ and the incentives to seek outpatient surgery that have followed. It is probable that some part of the decline in abortions is related to preferred new technologies¹¹ for reproduction control, and that declines in hospitalization for essential hypertension are partly related to the introduction of more effective technologies¹² for blood pressure control.

Of course, these are testable hypotheses. Because many of these conditions are more prevalent in populations other than the Medicare population, it would be of interest to examine one or several of them to test the robustness of the conclusions that have been drawn here

⁸recall that cataract and diabetes were chosen for study because they were two of the three conditions for which absolute declines in hospital volume were the largest.

⁹endoscopes, laparoscope, arthroscopes, and so on.

¹⁰see Vandam, LD: A History of Ambulatory Anesthesia. *Anesth Clinics North Amer* 1987; 5(1): 1.

¹¹such as new contraceptives.

¹²such as new antihypertensive drugs.

(from analysis of conditions relatively prevalent in--but by no means exclusive to--that older population). The application of the analytic strategy adopted here to these cases is straightforward; almost certainly, similar relationships would be found to obtain.

These suggest that the issues which relate to cataract, and to diabetes, are not so peculiar that one might not be able to generalize from the lessons to be learned here. It does not follow, however, that the impact always will be the same. In particular, it should be clear from this discussion that improvements in technology might have important effects that will increase the volume of hospital care. I have already suggested that improvements in cataract technology--especially the development and improvement of intraocular lenses--may have made cataract surgery attractive to a larger group of patients, and may therefore have been responsible for the large increase in hospital volume for cataract care that occurred prior to 1984, and for the introduction of a variety of policy changes to motivate that increased volume of care to shift to ambulatory sites. It is probable that improvement in non-surgical methods to manage patients with ischemic heart disease (IHD)--especially the development of percutaneous transluminal coronary angioplasty--has expanded demand for hospital care for this condition; policy to stimulate a shift to outpatient sites will likely follow improvements in that technology. Similarly, improvements in the capacity to manage persons with cardiac rhythm disorders may have increased demand for inpatient care for arrhythmia;¹³ whether incentive policy to motivate the substitution of ambulatory care will follow remains to be seen. More likely, such incentives programs await the development of superior technology than currently exists.

Implications for the future

The major findings of this work are that changes in the technology of care have been important

¹³though this seems less likely

drivers of hospital volume; and important drivers of economic policy. These imply that:

Policy analysis which fails to account for changing medical technology may lead to misunderstanding.

Insofar as technology is responsible for changes in hospital volume, or is the stimulus for the development of programs which are responsible for changes in hospital volume, failing explicitly to consider the role of changing medical technology may lead at least to poor understanding, and likely to misunderstanding. If it is often the case, for example, that program changes follow the introduction of new technical capacity in medical care, and that changes in behavior follow the introduction of that technical capacity, then it will often be the case that a high degree of correlation will exist between the introduction of program changes and those changes in behavior. Yet the two will not be causally related; rather, both derive from a common deeper cause.

Policy development which fails to consider the importance of technology to patterns of medical care may be ineffective and will be inefficient.

Failing to consider the deeper meaning of these relationships can easily lead to the wrong conclusion; when the wrong conclusion leads to the development of new (and poorly informed) policy, that policy will be ineffective or counterproductive. Thus, for example, the conclusion that intensive PRO review has been responsible for the decline in hospital volume for Medicare patients requiring care for their diabetes is probably wrong. If so, then expansion of PRO review (as might follow from that conclusion) would not only be ineffective (unless explicit consideration were taken of the technologic milieu); it would be counterproductive, insofar as resources would be squandered, and insofar as additional and unnecessary friction would be created between providers¹⁴ and regulators.

¹⁴who often comment on the irrationality of medical policy

This inefficiency may be more general; to the extent that policy making has been inattentive to the technical environment, there have been squandered resources, and needless commotion in health care. More important, opportunities for effective policy making may have been delayed or lost. Thus, the capacity to move cataract care out of the hospital existed well before 1984; yet policy that finally achieved that was not implemented until then. Almost certainly, additional opportunities to shift care out of the hospital--that capitalize on that which is technically feasible--exist, and await better understanding of that technical capacity, and appropriately designed incentive programs to permit that capacity to be actualized.¹⁵

Systematic consideration of what clinical practice implies can be done will create new opportunities to affect hospital use.

Review of the current medical practice environment suggests a number of policy changes which might serve to rationalize hospital use; that is, a number of incentives which might be offered, to capitalize on improvements in medical technical capacity. Thus, for example, out-of-hospital birth is safe, but there is no incentive to seek it; ambulatory cardiac catheterization is safe for many patients with cardiac disease,¹⁶ but there is no incentive to seek it; outpatient care for patients with many psychiatric disorders (and chronic pain) is as effective as inpatient service, but current payment incentives discourage the use of ambulatory alternatives; and preventive services (exercise, weight control, smoking cessation programs, and so on) could reduce hospitalization for a wide variety of preventable illnesses, but sufficient incentives have

¹⁵some of these are considered below.

¹⁶Health and Public Policy Committee, American College of Physicians: The Safety and Efficacy of Ambulatory Cardiac Catheterization in the Hospital and Freestanding Setting. *Annals Int Med* 1985; 103:294.

not been offered to motivate their widespread use.¹⁷ Hopefully, policy makers will appreciate the advantage that comes of understanding this capacity; and will seek to be advised in the future by those who have that understanding.

New instruments to achieve desired goals can be developed through the planned stimulation of selected technologies.

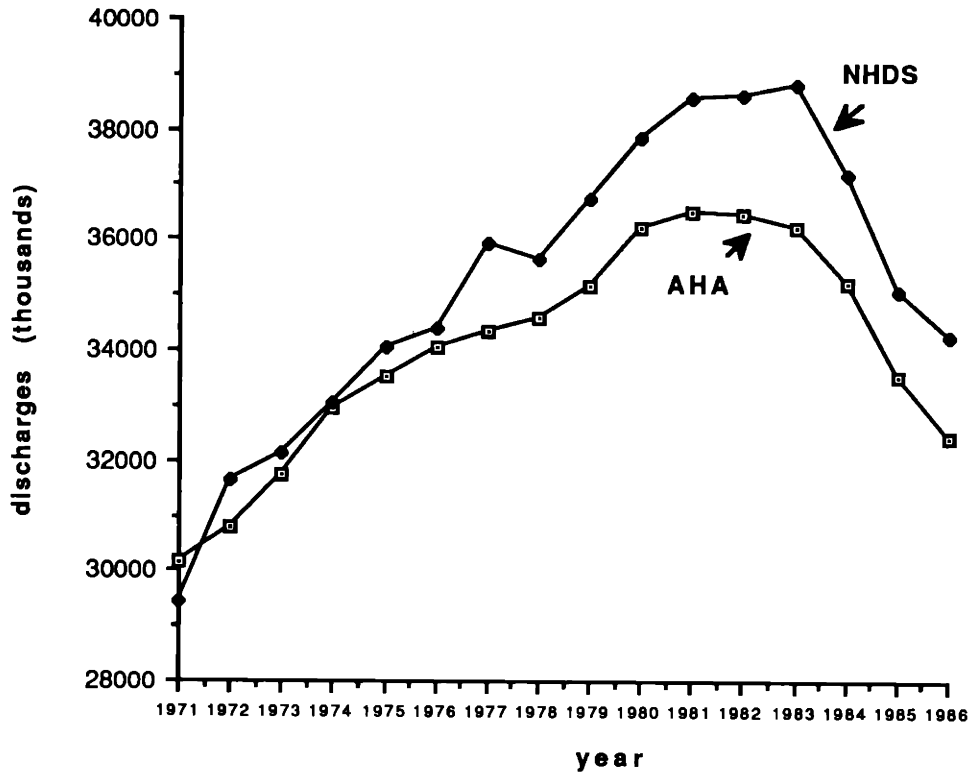
A better understanding of technology can permit economic policy to be used to create new instruments to control hospital use; policy has not been, but certainly could be, developed with the goal of advancing technology along specific paths in order to achieve desired hospital utilization objectives. This reverses the relationship between technology and policy that has been suggested to exist; it effectively creates an important new policy instrument. For example, one might suggest the introduction of incentives to develop specific technologies (or types of technologies); by offering high rates of reimbursement to producers of medical devices which permit hospital care to be avoided or replaced, the flow of innovation toward more cost-effective clinical management strategies will be enhanced; by offering support¹⁸ for selected innovations, the selective flow of clinical innovation can be enhanced. Thus, a reduction in rates of hospitalization for the complications of diabetes will be more likely, when social investment in improved insulin pumps, and an artificial pancreas, increases; and further reductions in rates of hospitalization for a number of surgical procedures (including cholecystectomy, hysterectomy, and conceivably prostatectomy) will be more likely, with additional investment in laser and ultrasonic technology. This use of policy creates a flexible instrument to effect change; further, one which may be more acceptable than the incentive-

¹⁷That many of these improvements in technology are not recent does not weaken the argument. I have suggested that it is typically the case that changes in technology precede changes in hospital use. The point has been that changes in technology permit properly constructed incentive programs to have the desired effect; the point here is that the proper incentive programs have yet to be developed, despite long-standing technical capacity to support them.

¹⁸research dollars, or shared malpractice risk against adverse outcomes

based instruments which historically have been used.

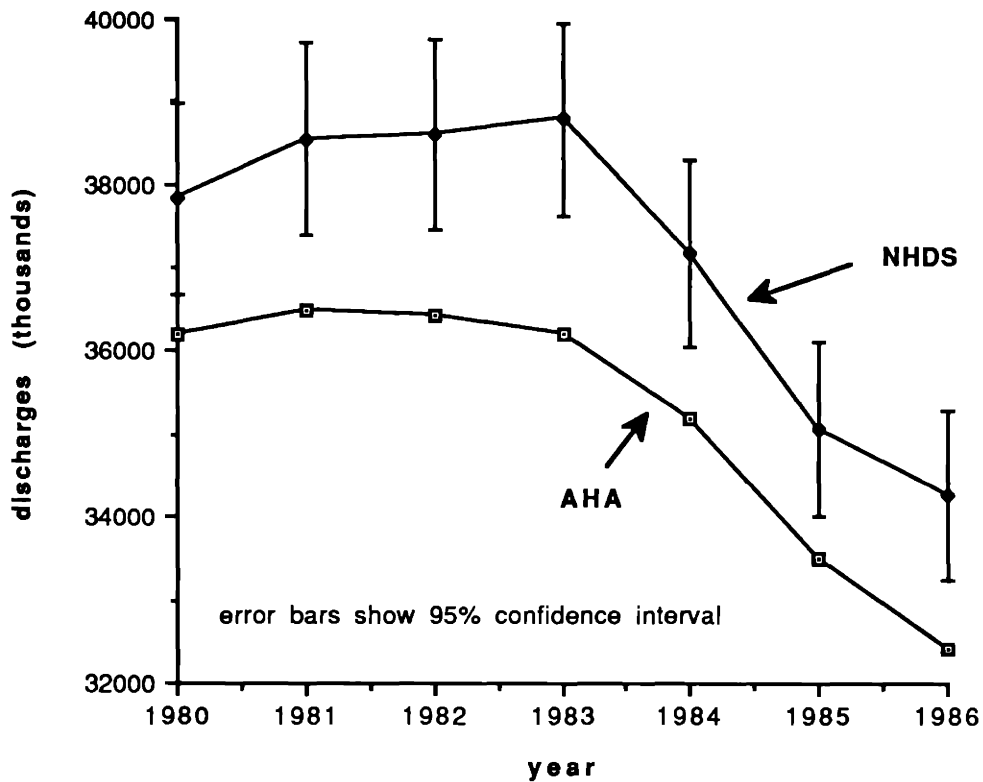
FIGURE 1.1: TRENDS IN HOSPITAL DISCHARGES



sources: NHDS (National Hospital Discharge Survey) statistics published in Annual Summaries of the National Hospital Discharge Survey. National Center for Health Statistics, Hyattsville, Maryland.

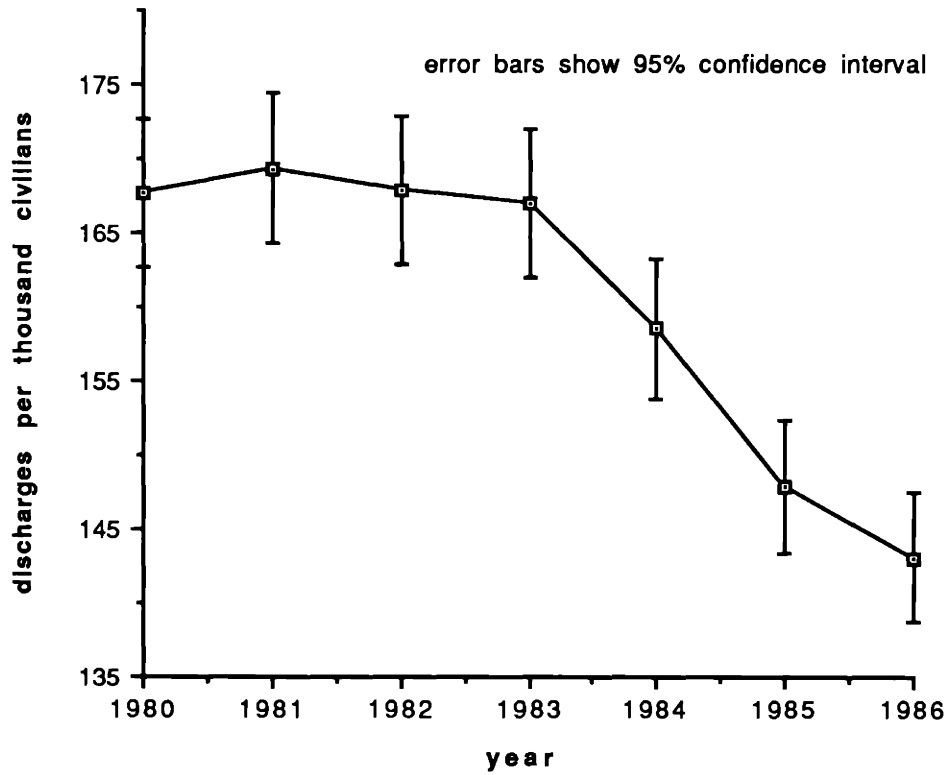
AHA (American Hospital Association) statistics published in *Hospital Statistics, 1987 edition*. American Hospital Association, Chicago.

FIGURE 2.1: DISCHARGE TRENDS, 1980-1986



sources: National Hospital Discharge Survey datatapes and AHA (American Hospital Association) statistics published in *Hospital Statistics, 1987 edition*. American Hospital Association, Chicago.

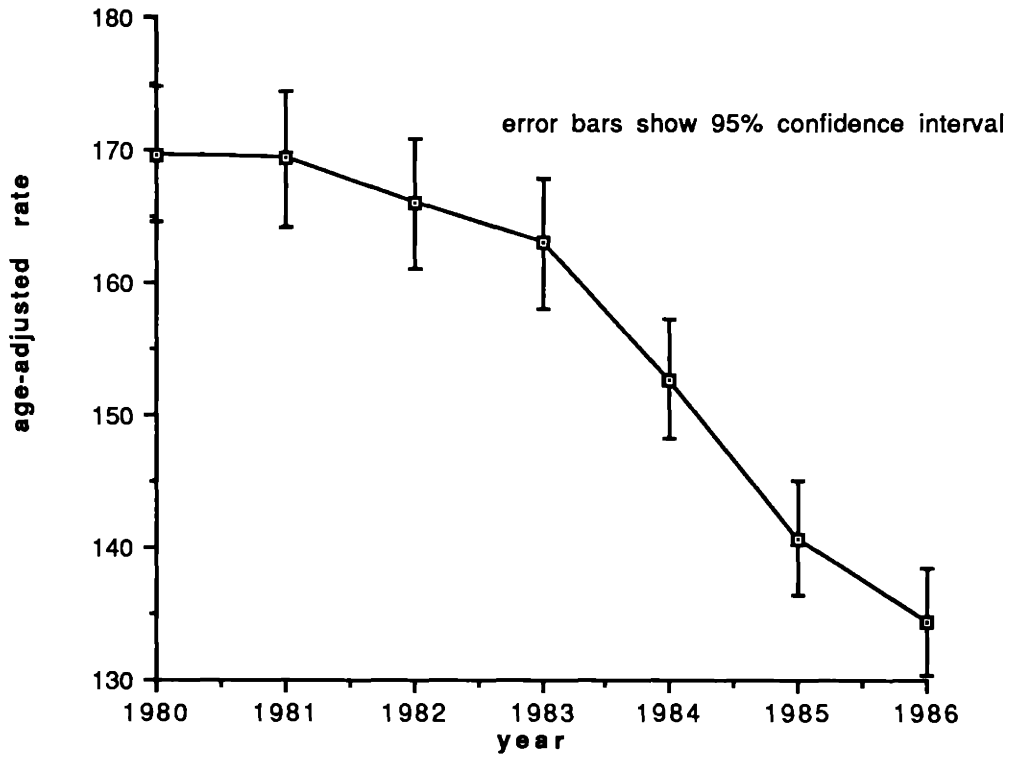
FIGURE 2.2: TRENDS IN DISCHARGE RATE



sources: discharges from National Hospital Discharge Survey datatapes.

populations statistics from US Census.

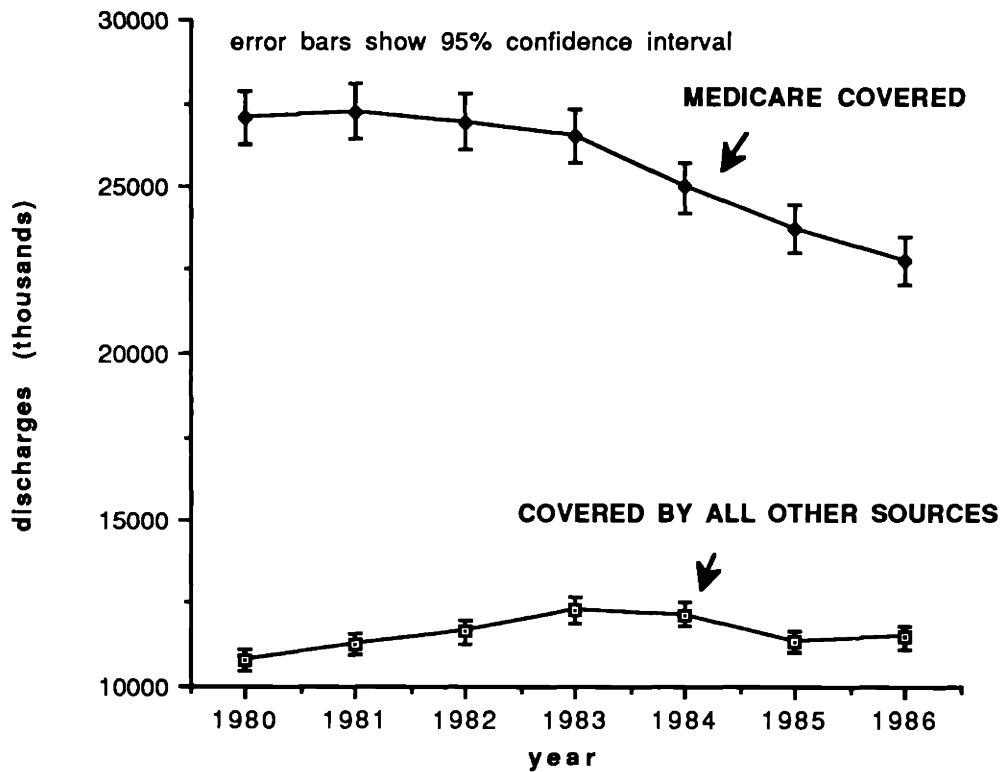
FIGURE 2.3: TRENDS IN AGE-ADJUSTED DISCHARGE RATE



sources: National Hospital Discharge Survey datatapes and US Census data.

Direct age-adjustment is described in text.

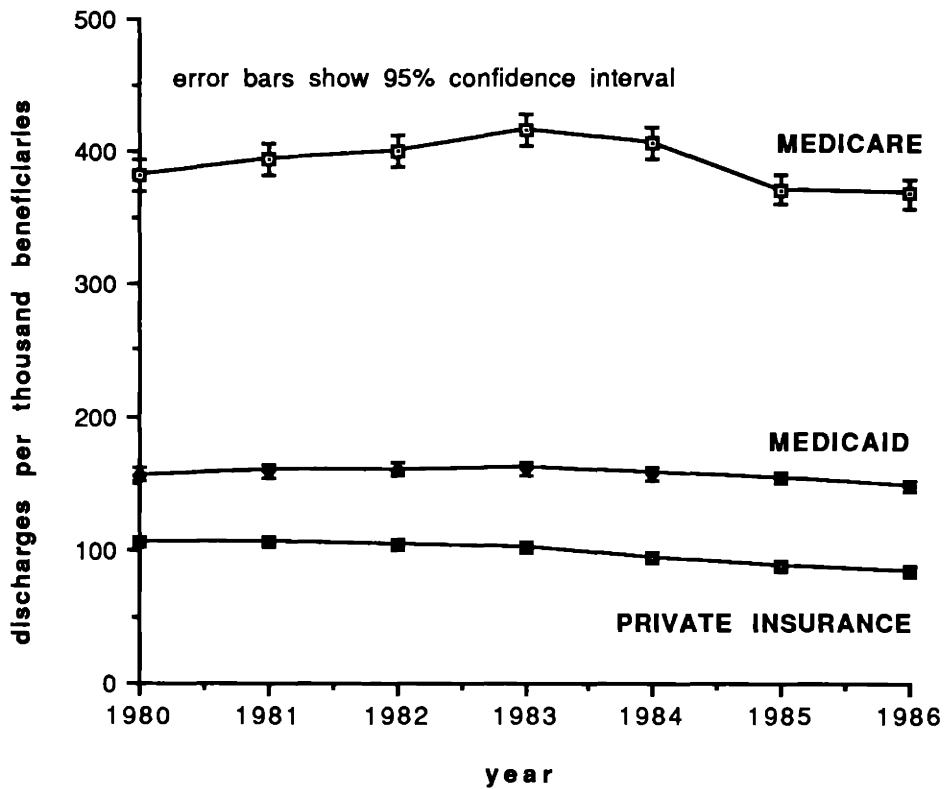
FIGURE 2.4: DISCHARGES BY SOURCE OF PAYMENT



source: National Hospital Discharge Survey datatapes.

"Source of payment" is expected first payer on NHDS record.

FIGURE 2.5: DISCHARGE RATE BY PAYER

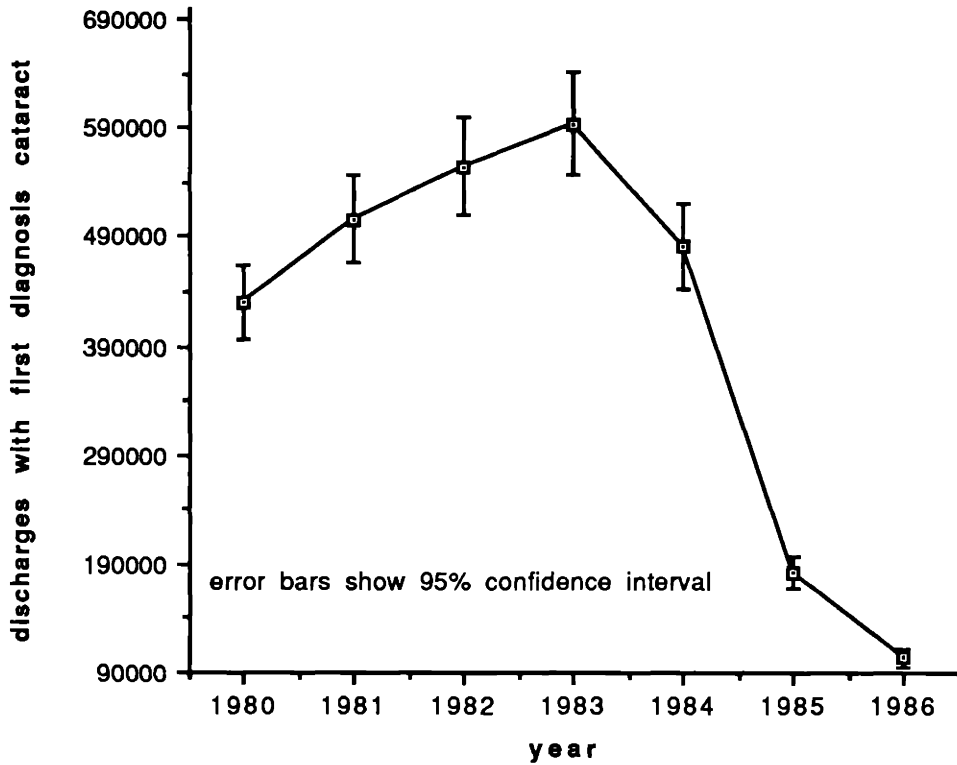


source: National Hospital Discharge Survey datatapes.

beneficiary counts are from Health Insurance Association of American and from Department of Health and Human Services, and are summarized in table 1.2 of the text.

"Payer" is expected first payer in NHDS record.

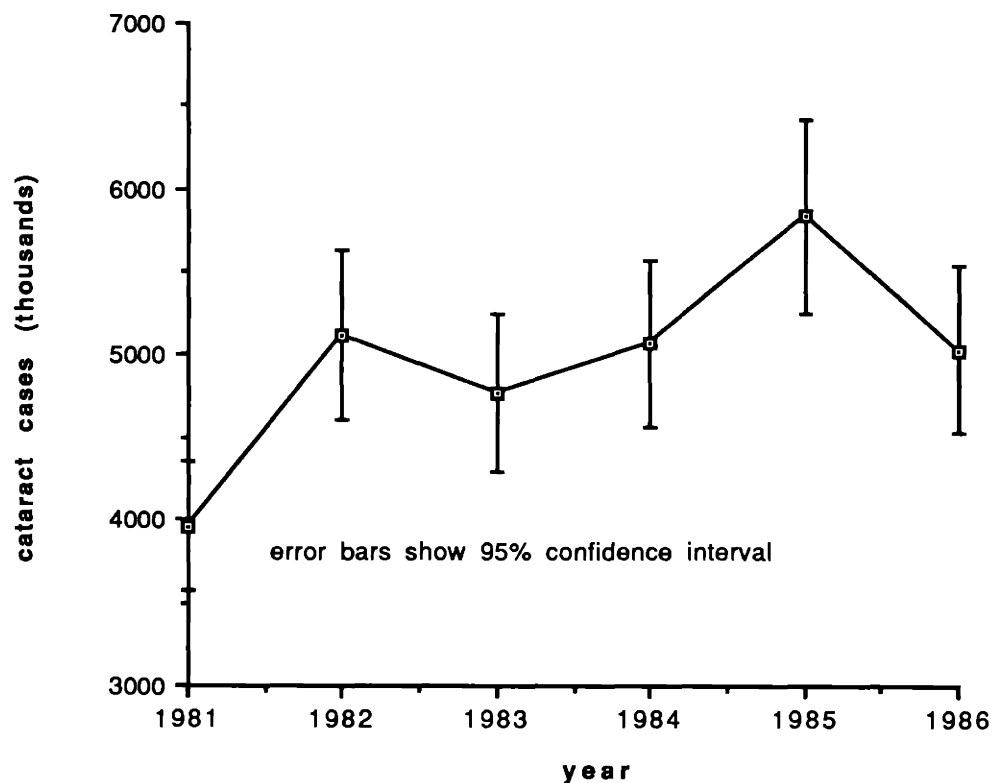
FIGURE 3.1: DISCHARGES FOR CATARACT



source: National Hospital Discharge Survey datatapes.

Discharges with first diagnosis cataract have ICD-9-CM code 366 in the first diagnosis position in the NHDS record.

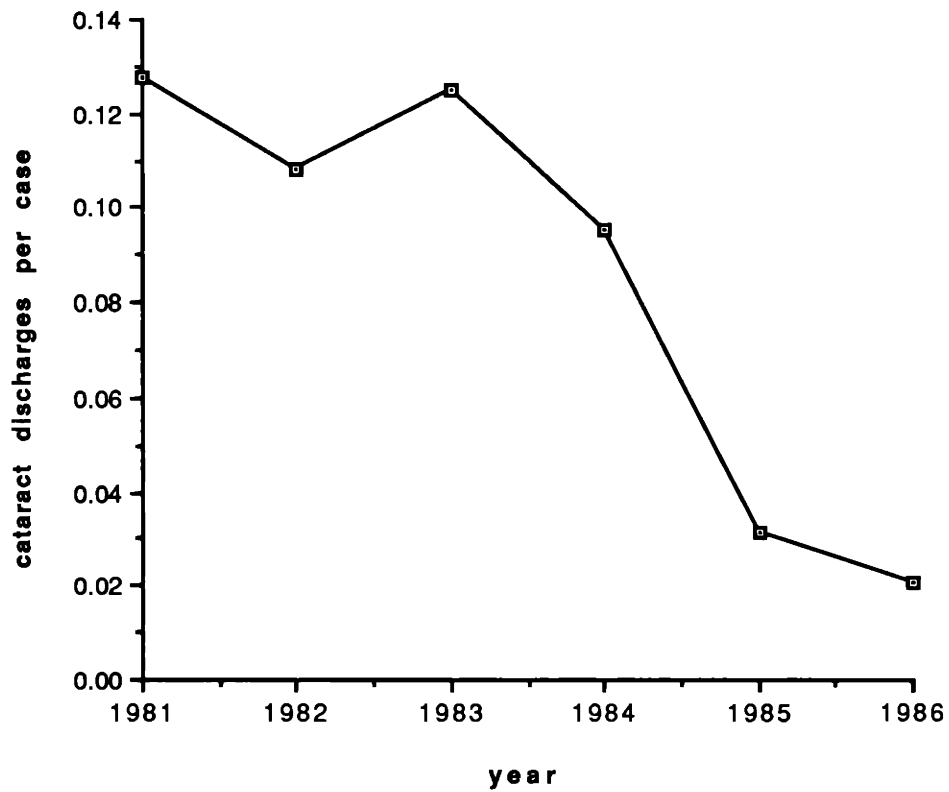
FIGURE 3.2: CATARACT CASES



source: National Health Interview Survey data, published in National Center for Health Statistics series 10.

Estimate for 1981 is for "1979-1981."

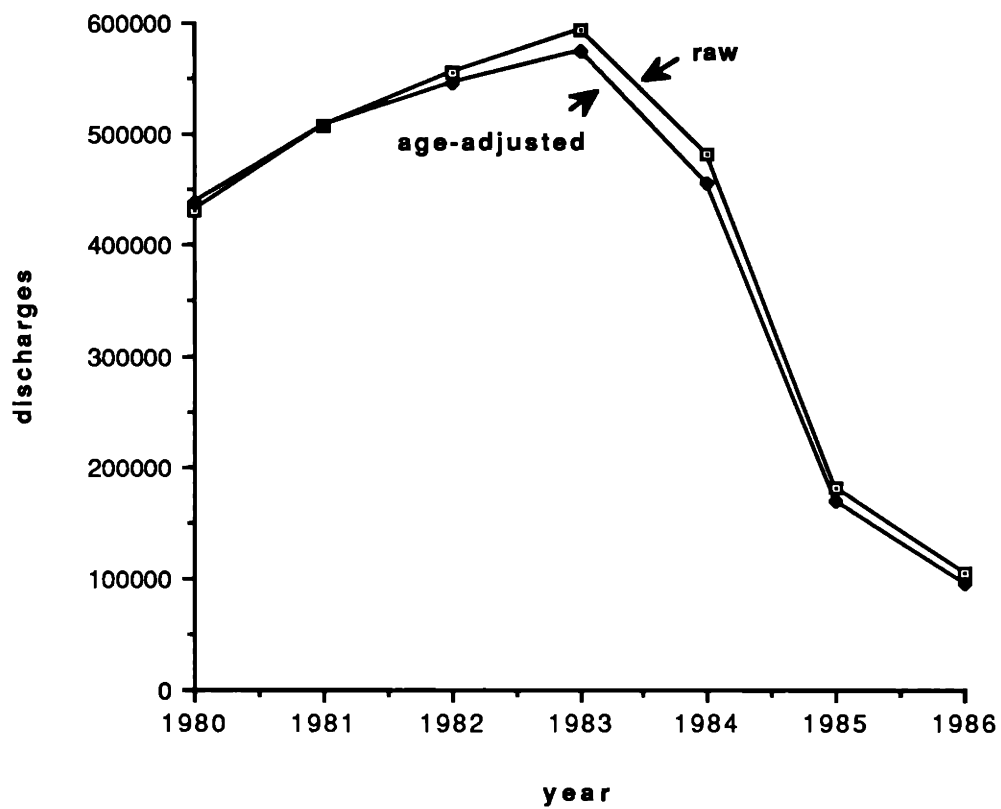
FIGURE 3.3: CATARACT DISCHARGES PER CASE



sources: cataract discharges are from NHDS datatapes.

cataract cases are from National Health Interview Survey data published in National Center for Health Statistics series 10.

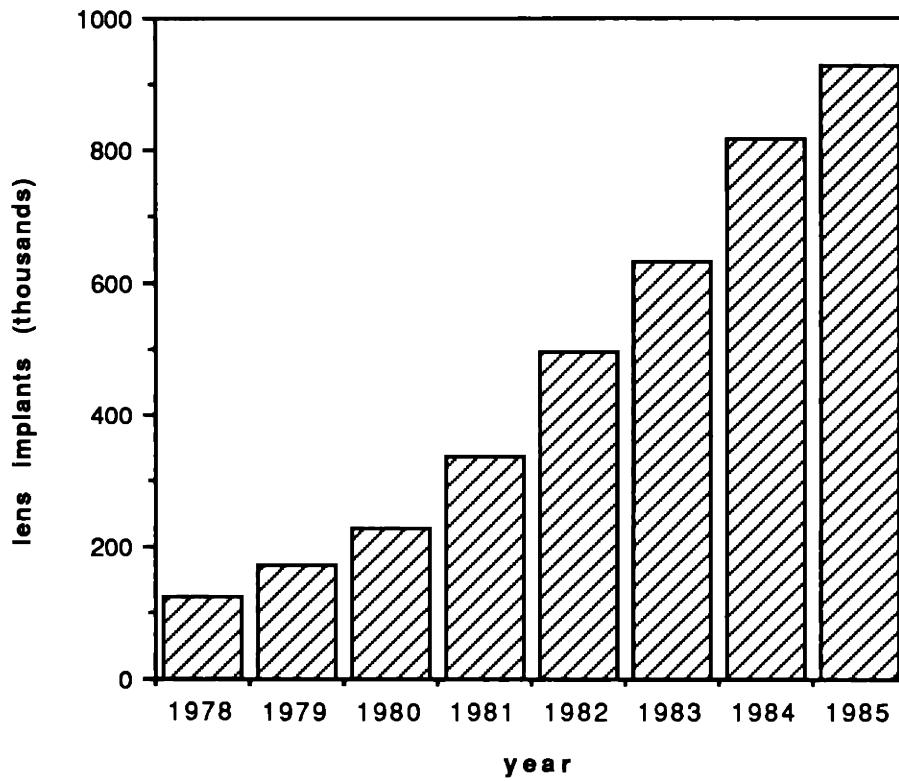
FIGURE 3.4: AGE-ADJUSTED DISCHARGES FOR CATARACT



source: National Hospital Discharge Survey datatapes.

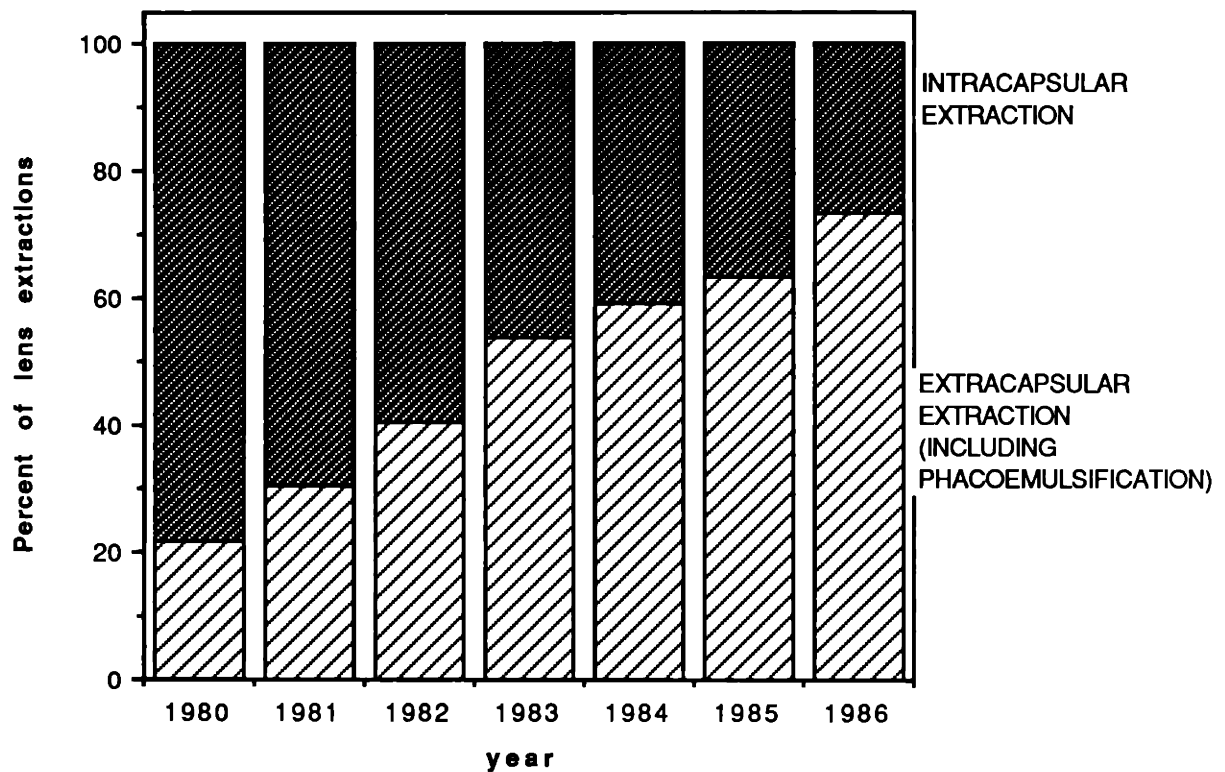
Direct age-adjustment is described in the text.

FIGURE 3.5: ESTIMATED LENS IMPLANTS



source: data from Stark WJ, Whitney CE, Chandler JW, Worthen DM: Trends in Intraocular Lens Implantation in the United States. Arch Ophthalmol 1986; 104: 1769.

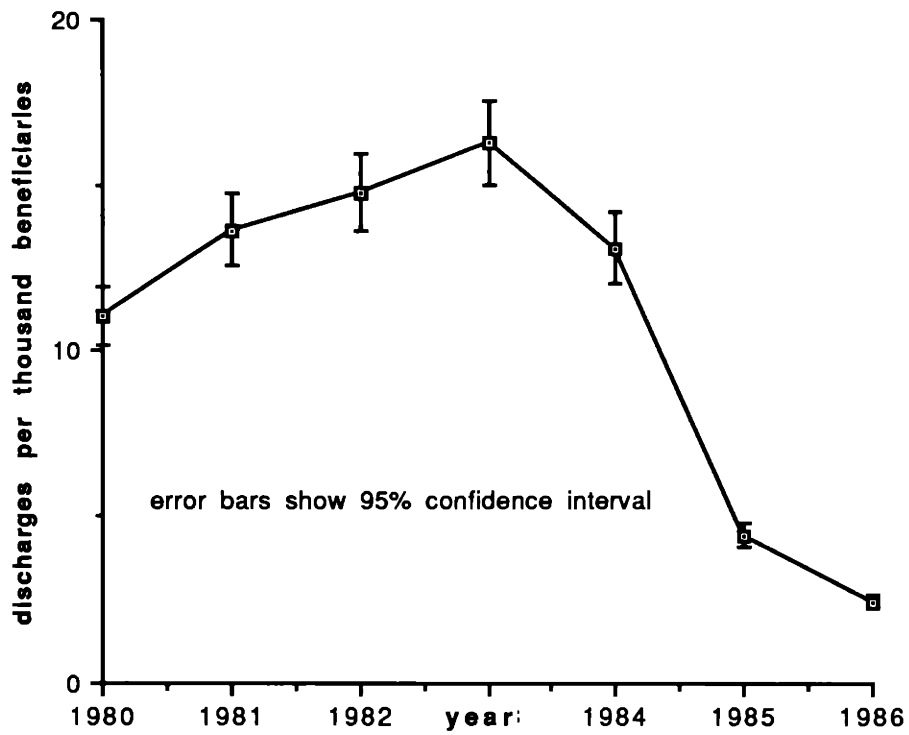
FIGURE 3.6: CHANGING APPROACH TO LENS EXTRACTION



source: National Hospital Discharge Survey datatapes.

Records are from patients with first-listed diagnosis "cataract" and first-listed procedure indicating "lens extraction."

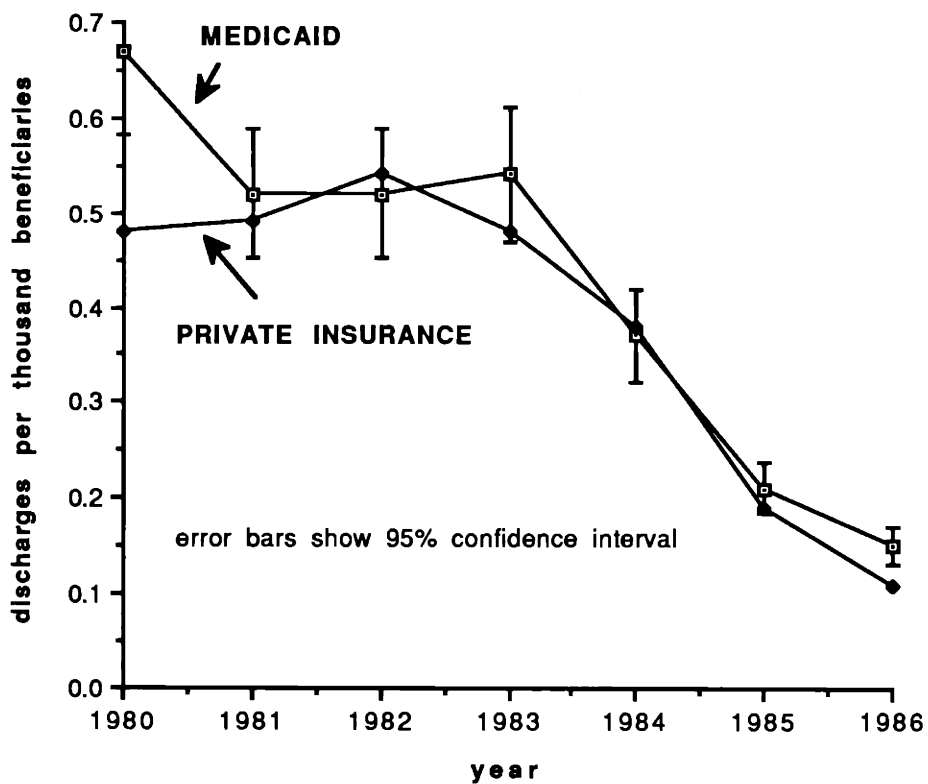
**FIGURE 3.7a: DISCHARGE RATE FOR CATARACT,
MEDICARE BENEFICIARIES**



sources: discharges from National Hospital Discharge Survey datatapes.

Medicare beneficiary counts from Department of Health and Human Services (as in table 1.2).

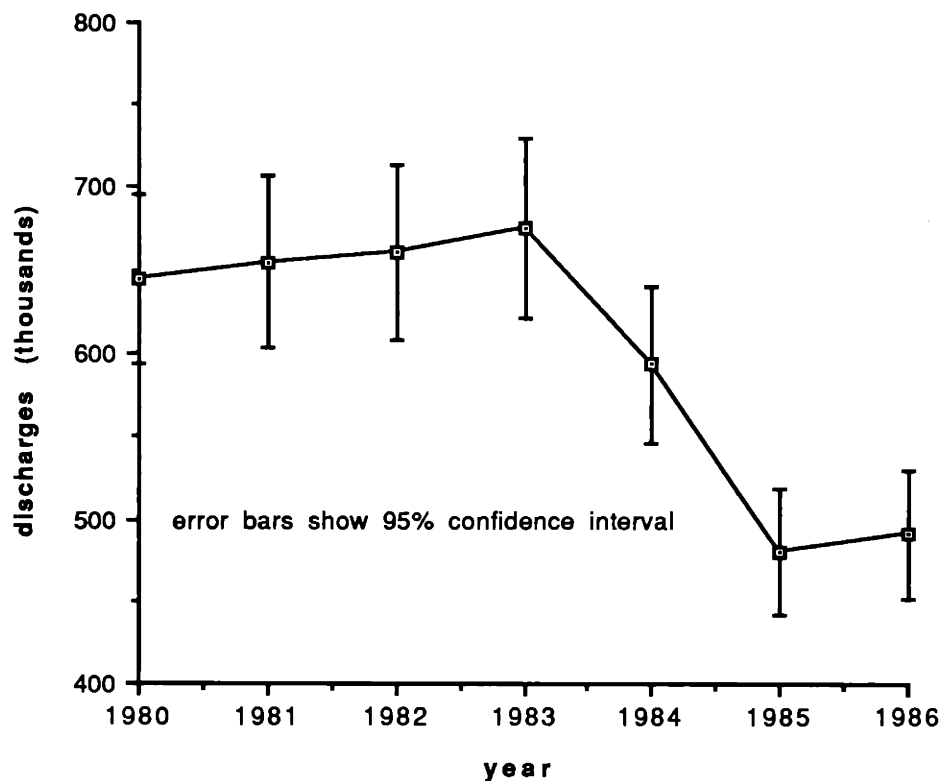
**FIGURE 3.7b: DISCHARGE RATE FOR CATARACT,
OTHER MAJOR PAYERS**



source: discharges from National Hospital Discharge Survey datatapes.

beneficiary counts from Health Insurance Association of America and Department of Health and Human Services (as in table 1.2)

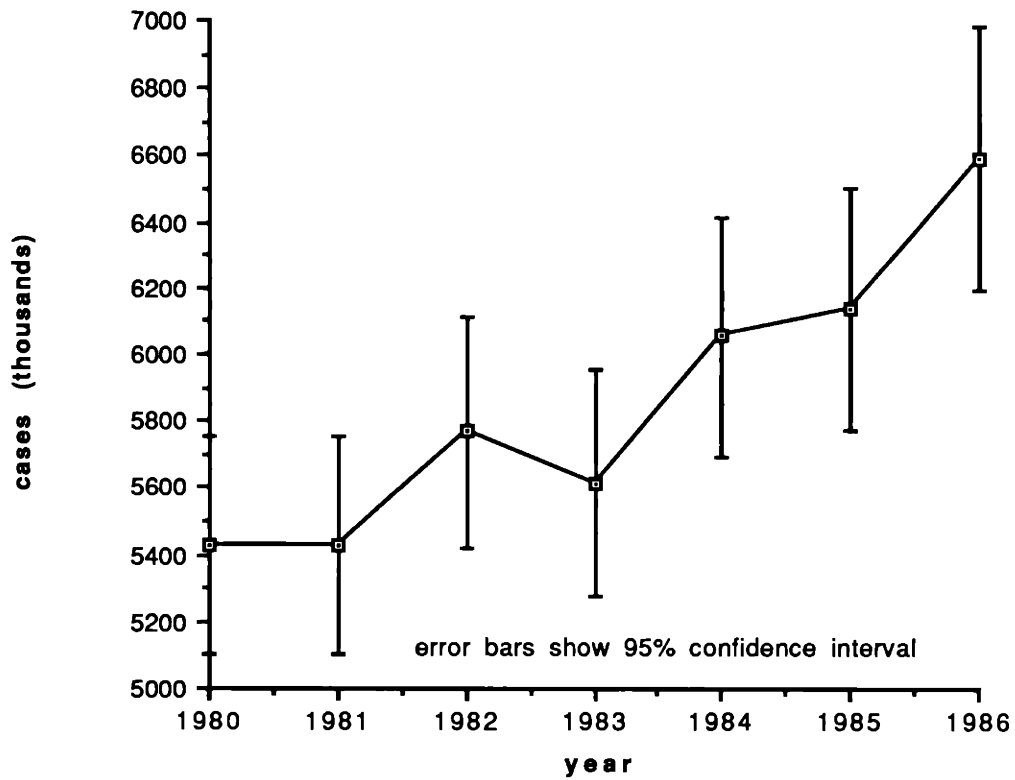
FIGURE 4.1: DISCHARGES FOR DIABETES MELLITUS



source: National Hospital Discharge Survey datatapes.

Discharges for diabetes mellitus are records with ICD-9-CM code 250 in the first diagnosis position.

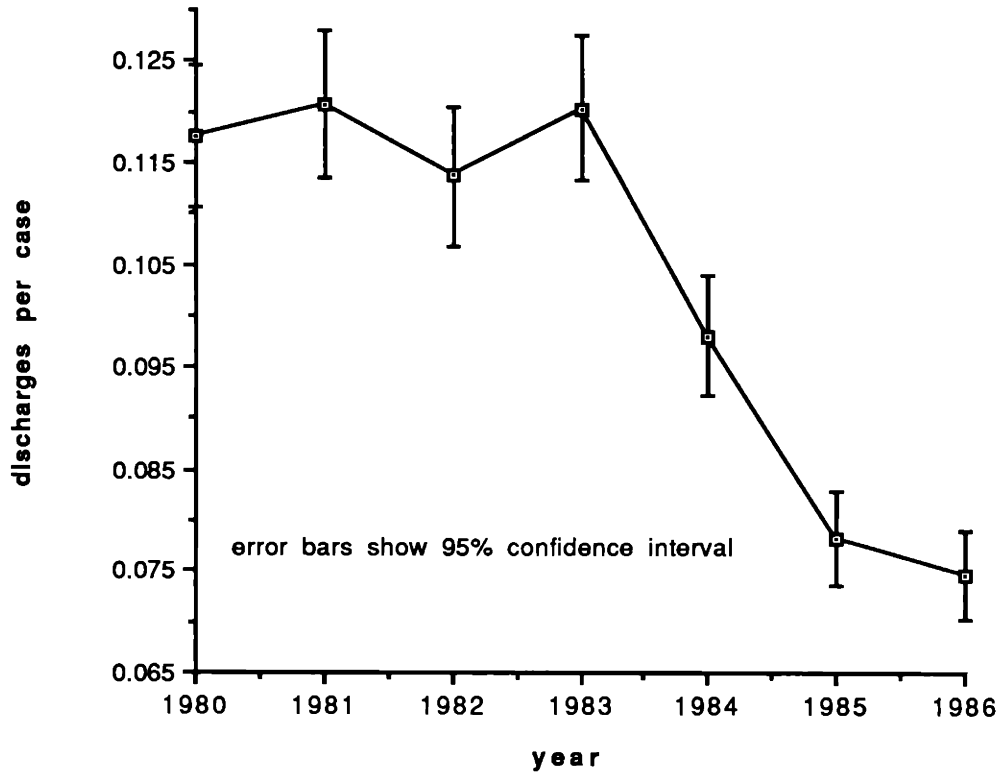
FIGURE 4.2: DIABETES CASES



source: National Health Interview Survey statistics published in National Center for Health Statistics series 10.

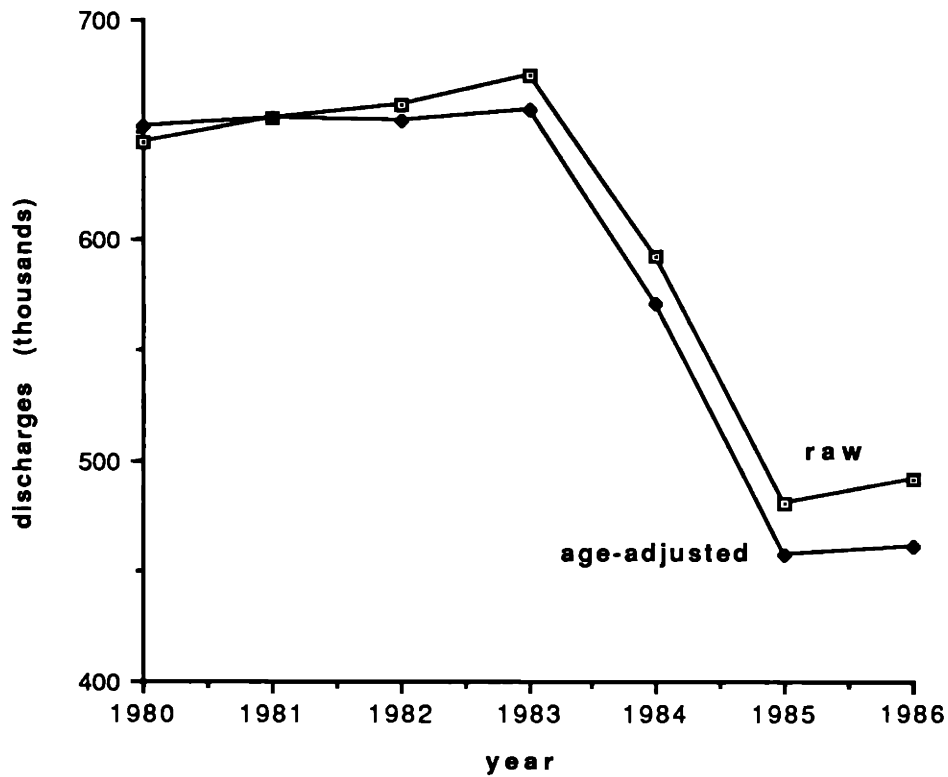
Cases in 1980 and 1981 are estimated from values for "1979-1981."

FIGURE 4.3: DIABETES DISCHARGES PER CASE



sources: discharges from National Hospital Discharge survey datatapes.
cases from published National Health Interview Survey data.

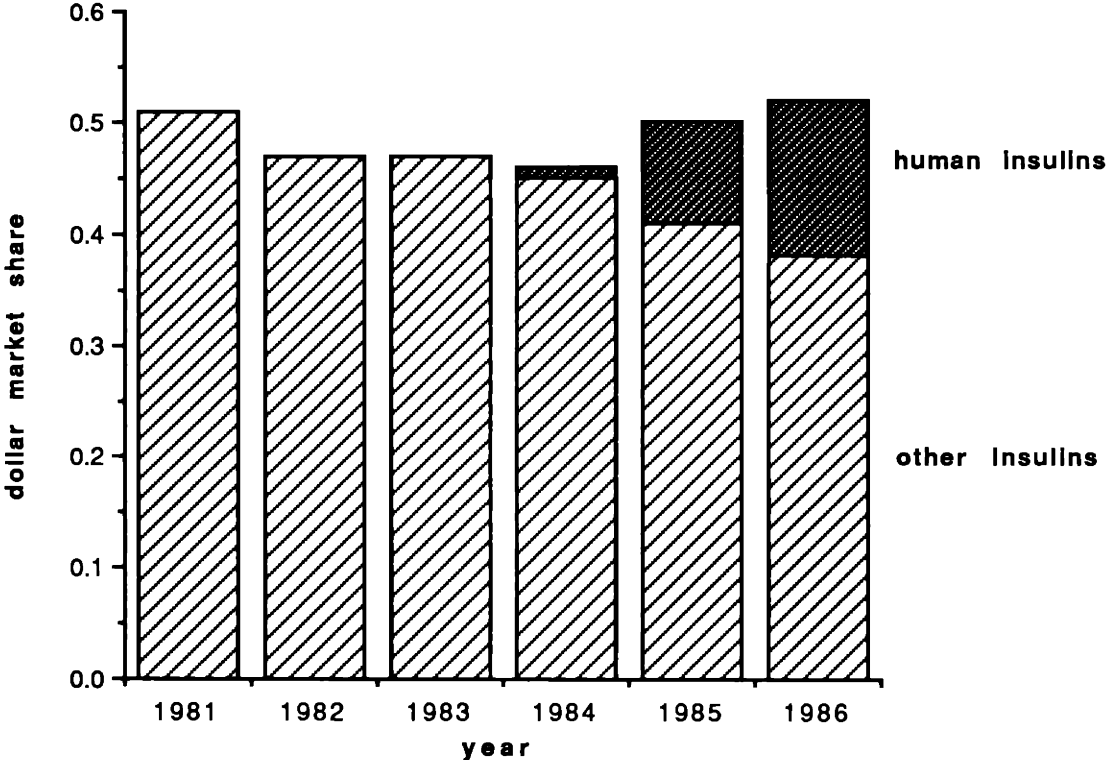
FIGURE 4.4: AGE-ADJUSTED DISCHARGES FOR DIABETES



source: discharges from National Hospital Discharge Survey datatapes.

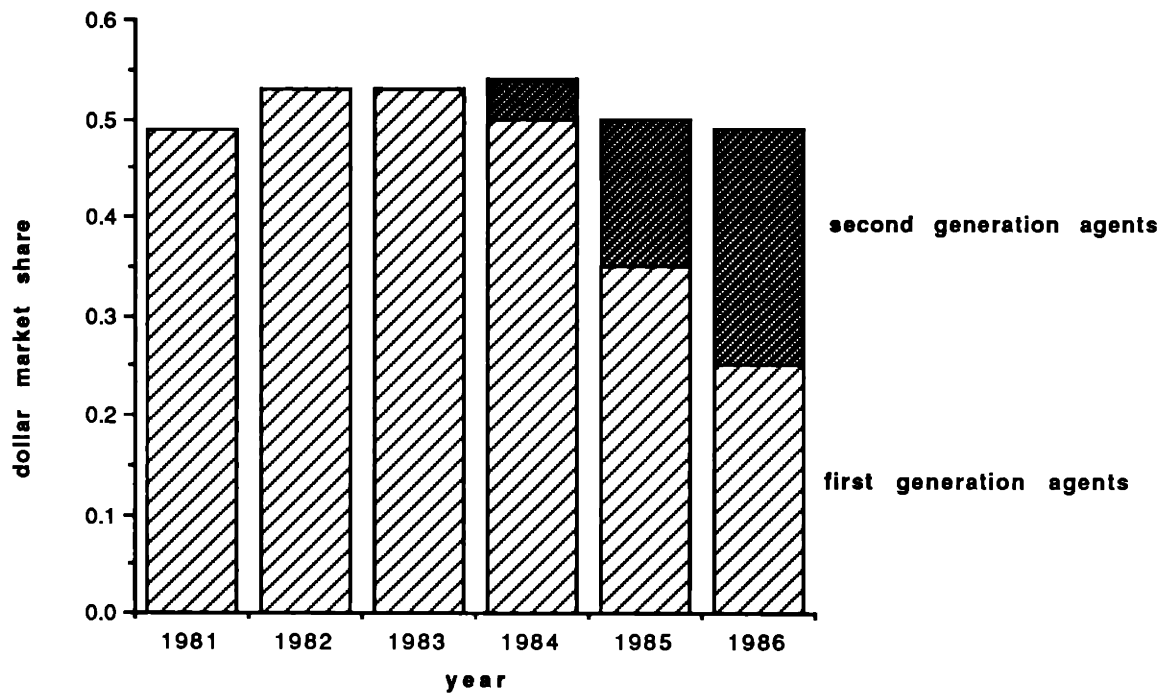
Direct age-adjustment is described in the text.

FIGURE 4.5: INSULIN SHARES OF DIABETES PHARMACOLOGICS MARKET



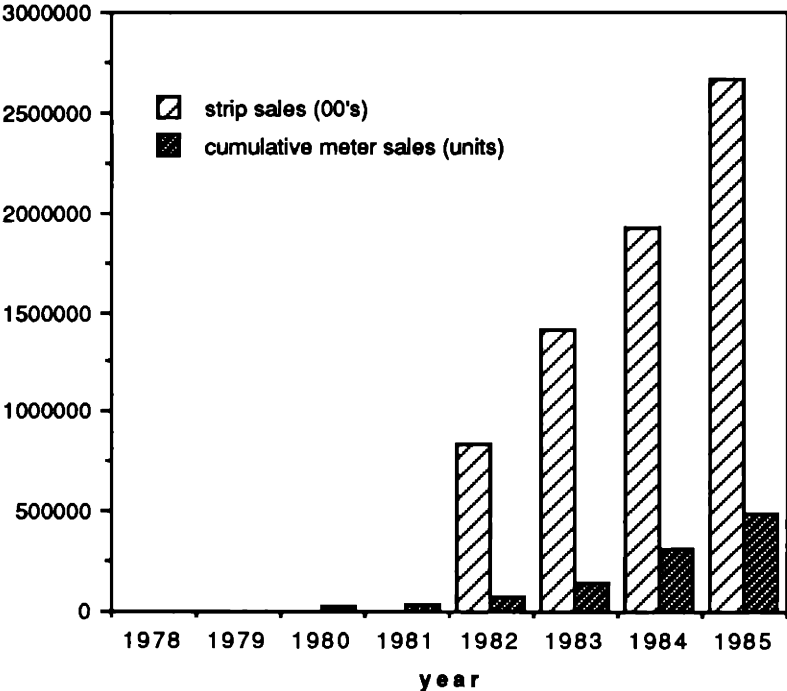
source: U.S. Pharmaceutical Market: Drug Stores. IMS America, Ltd. With permission.

FIGURE 4.6: ORAL AGENT SHARES OF DIABETES PHARMACOLOGICS MARKET



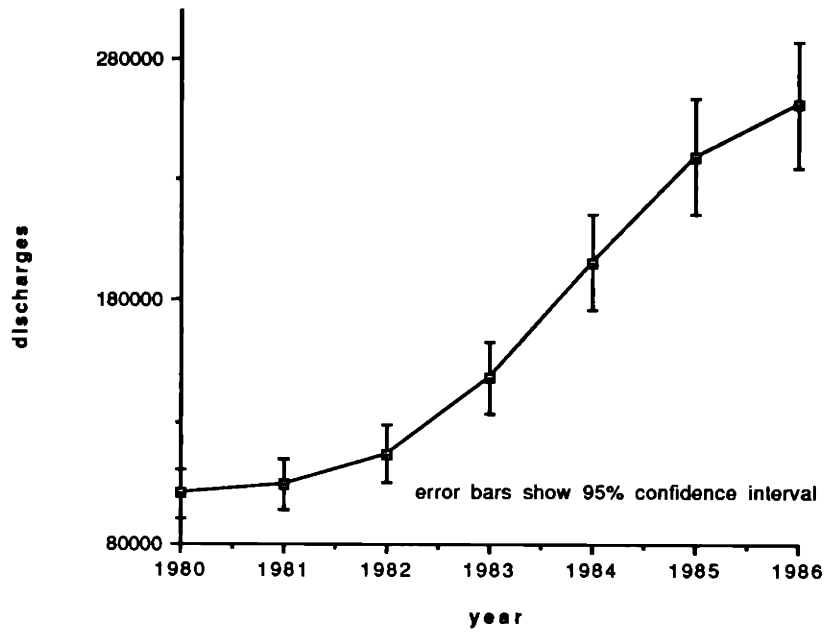
source: U.S. Pharmaceutical Market: Drug Stores. IMS America, Ltd. With permission.

FIGURE 4.7: HOME BLOOD GLUCOSE MONITORING EQUIPMENT SALES



source: Industry estimates

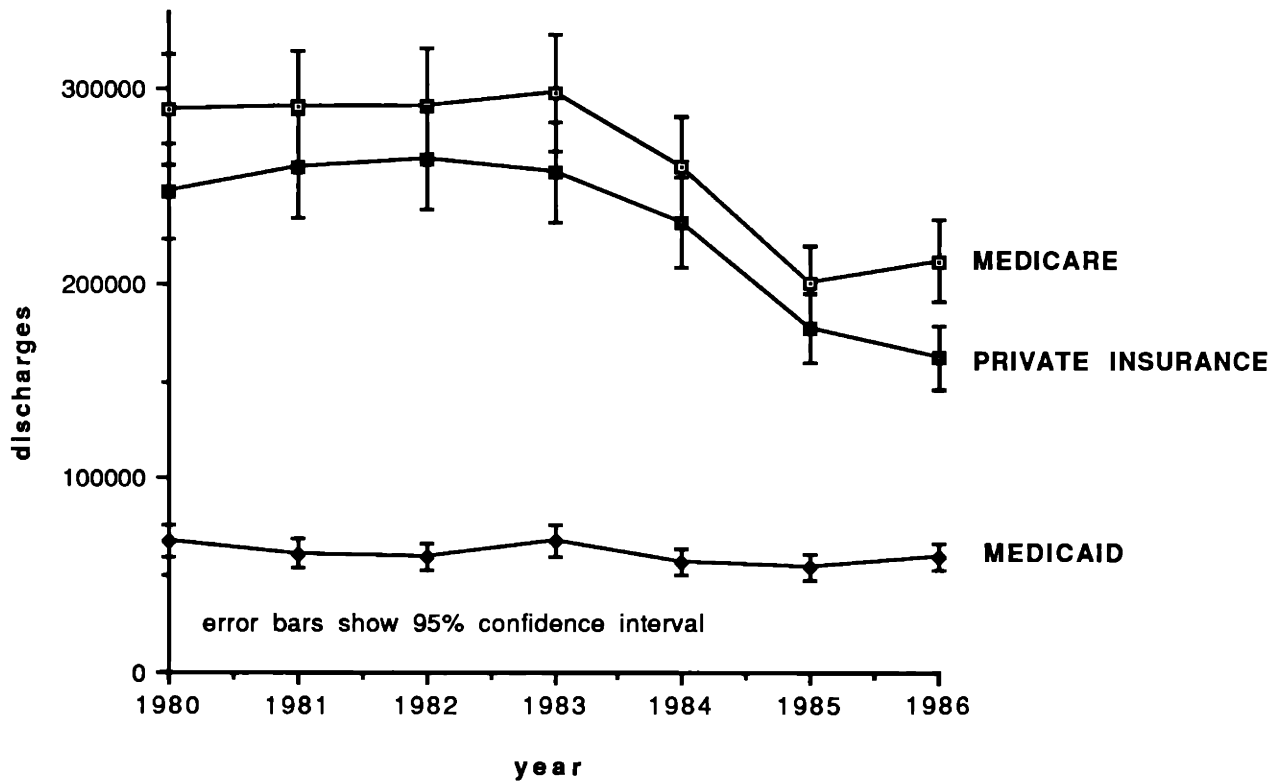
FIGURE 4.8: DISCHARGES FOR "VOLUME DEPLETION"



source: National Hospital Discharge Survey datatapes.

Discharges for "volume depletion" have ICD-9-CM code 276 in the first diagnosis position in the NHDS record.

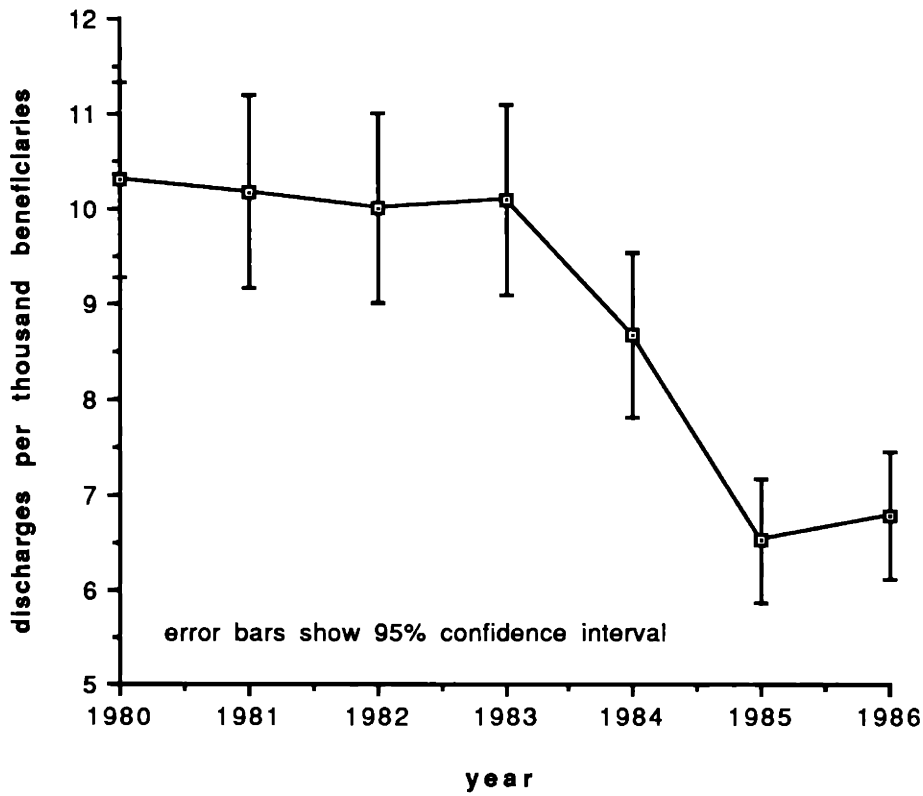
FIGURE 4.9: DIABETES DISCHARGES BY PAYER



source: National Hospital Discharge Survey datatapes.

"Payer" is expected first payer in the NHDS record.

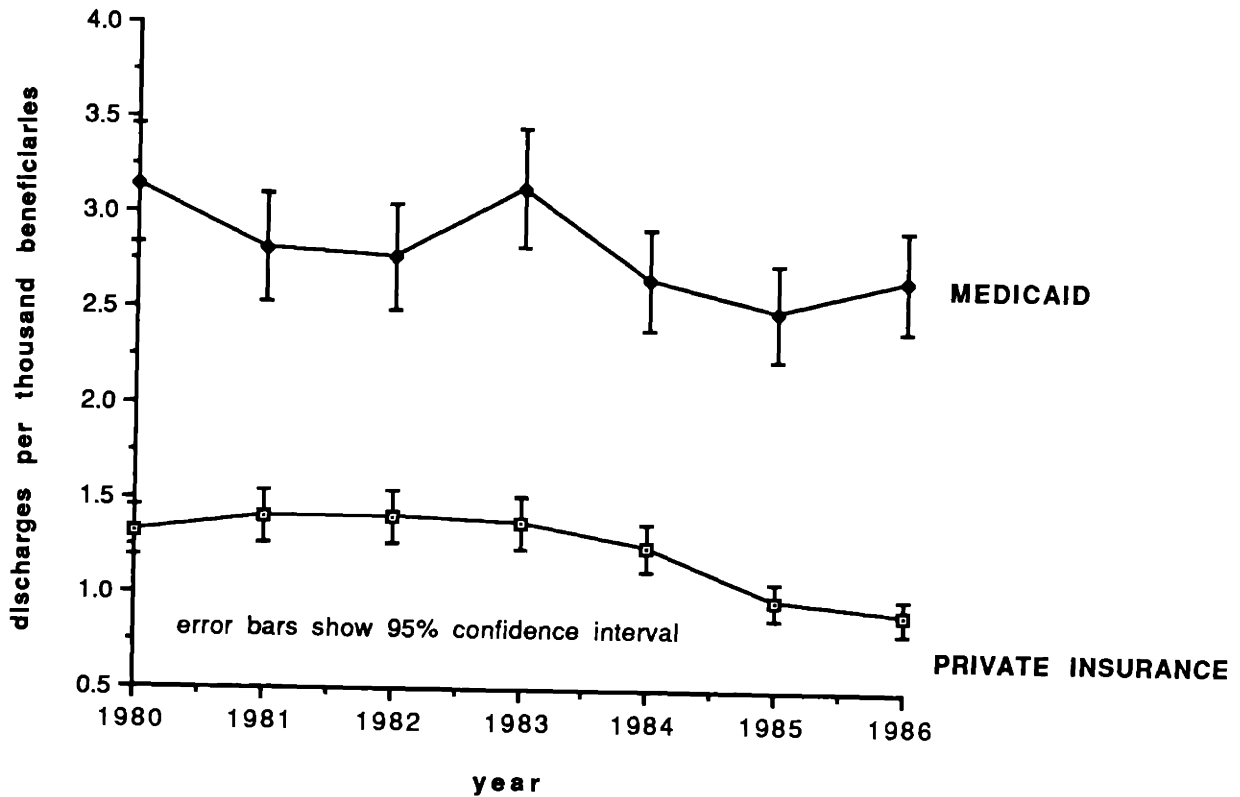
FIGURE 4.10a: DISCHARGE RATE FOR DIABETES, MEDICARE



sources: discharges from National Hospital Discharge Survey datatapes.

beneficiary counts from Department of Health and Human Services (as in table 1.2)

**FIGURE 4.10b: DISCHARGE RATE FOR DIABETES,
OTHER PAYERS**



sources: discharges from National Hospital Discharge Survey datatapes.

beneficiary counts from Health Insurance Association of America and from Department of Health and Human Services (as in table 1.2)

TABLE 1.1: CHANGES IN HOSPITAL CAPACITY

Year	Number of Hospitals (Thousands)	Number of Hospital Beds (Thousands)	Occupancy (%)
1980	5904	992	75.4
1981	5879	1007	75.9
1982	5863	1015	75.2
1983	5843	1021	73.4
1984	5814	1020	68.9
1985	5784	1003	64.8
1986	5728	982	64.2
Absolute Change			
1980-1983	-61	29	-2
1983-1986	-115	-39	-9.2
Absolute Change			
1980-1983	-1.03	2.92	-2.65
1983-1986	-1.97	-3.82	-12.53

Notes: "Hospitals" are non-federal short term general hospitals.

Statistics are from Hospital Statistics, 1987 Edition, American Hospital Association, Chicago. 1987.

TABLE 1.2: CHANGES IN HOSPITAL INSURANCE COVERAGE

Number of Persons (in Thousands) Covered by:			
Year	Medicare Pt A	Medicaid	Private Insurance
1980	28100	21605	187375
1981	28600	21980	186193
1982	29100	21603	188337
1983	29600	21554	186644
1984	30000	21607	184403
1985	30600	21808	181329
1986	31216	22405	179839
Absolute Change			
1980-1983	1500	-51	-731
1983-1986	1616	851	-6805
Percentage Change			
1980-1983	5.34	-0.24	-0.39
1983-1986	5.46	3.95	-3.65

Note: Numbers of persons covered by Medicare and Medicaid are from Department of Health and Human Services statistics. Number of persons with private insurance is from table 1.1 in the Source Book of Health Insurance Data, 1988 Update, Health Insurance Association of America, Washington, DC. 1989.

TABLE 1.3: CHANGES IN MEDICARE COPAYMENTS

DEDUCTIBLE		PART A		PART B	
Year	Nominal Dollars	1981 Dollars	Nominal Dollars	1981 Dollars	
1980	180	198.67	60	66.22	
1981	204	204	60	60	
1982	260	244.98	75	70.67	
1983	304	277.51	75	68.47	
1984	356	311.71	75	65.67	
1985	400	338.18	75	63.41	
1986	492	408.1	75	62.21	
% Change, 1980-1983		39.68		3.38	
% Change, 1983-1986		47.06		-9.14	
COINSURANCE		PART A		PART B	
Year	Nominal Dollars Days 61-90 of Hospital Care	1981 Dollars	%		
1980	45	49.67	20		
1981	51	51	20		
1982	65	61.25	20		
1983	76	69.38	20		
1984	89	77.93	20		
1985	100	84.54	20		
1986	123	102.03	20		
% Change, 1980-1983		39.68			
% Change, 1983-1986		47.06			

Notes: Nominal dollars are adjusted to 1981 dollars using consumer price indices.

Part A coinsurance rate is zero for days 1 through 60 of hospital care in any benefit period (year).

Statistics are from Department of Health and Human Services, Medicare Program Statistics (1980-1986).

TABLE 1.4: CHANGES IN AGGREGATE COPAYMENT RATE

Year	Private Copayment
1980	17
1981	NA
1982	NA
1983	20
1984	21
1985	19
1986	21

Notes: Aggregate copayment rate is the ratio of consumer expenditures for hospital care to total expenditures for hospital care -- thus, it is the fraction of hospital care that is paid out-of-pocket.

Statistics are from Waldo D, Levit K, Lazenby H: National Health Expenditures, 1985. Health Care Financing Review 1986:8(1):1 and from Division of National Cost Estimates, Office of the Actuary, Health Care Financing Administration: National Health Expenditures 1986-2000. Health Care Financing Review 1987:8(4):1.

TABLE 1.5: CHANGES IN PRIVATE DEDUCTIBLE AND COINSURANCE

Type of Coverage	Percentage by Year						
	1980	1981	1982	1983	1984	1985	1986
BASIC (Total)	88	0	0	84	0	0	67
Without Major Medical	16			17			23
With Major Medical	72			67		0	44
MAJOR MEDICAL Only	12			16			32
Deductible Amount (MAJOR MEDICAL Only)		1981	1982	1983	1984	1985	1986
Based on Earnings		5	6	6	5	5	4
Less Than \$50		3	3	3	3	3	1
\$50		23	21	21	18	13	10
\$51-99		5	5	5	4	3	3
\$100		55	56	52	47	44	44
(\$100 or less)		86	85	81	72	63	58
\$101-149				1	1	1	1
\$150		5	4	7	9	12	15
Over \$150		3	3	5	12	17	21
(More Than \$100)		8	7	13	22	30	37
Coinsurance Rate (MAJOR MEDICAL Only)		1981	1982	1983	1984	1985	1986
80%		90	90	88	86	85	86
85%		4	5	5	5	5	5
90%		3	2	3	4	4	6
Other		3	4	3	5	5	3

Notes: BASIC and MAJOR MEDICAL are defined in the text.

Statistics are from Bureau of Labor Statistics, US Department of Labor: "Employee Benefits in Medium and Large Firms." US Government Printing Office, Washington, DC. 1981 through 1986.

TABLE 1.6: CHANGES IN PRIVATE DEDUCTIBLE AND COINSURANCE

	Percentage of Plans					
	1981	1982	1983	1984	1985	1986
Deductible for Hospital Room and Board						
Applies	29	30	41	53	60	66
Does Not Apply	71	68	57	42	34	28
Depends on Plan	<1	2	2	5	6	6
Deductible Amount						
Based on Earnings	6	5	6	10	14	15
Less Than \$50	2	2	2	1	<1	<1
\$50	23	20	15	12	9	6
\$51-99	9	8	6	3	3	2
\$100	53	54	46	33	27	26
(\$100 or Less)	87	84	69	49	39	34
\$101-149	0	1	1	2	2	2
\$150	2	4	10	14	13	14
\$151-199	0	0	<1	1	1	1
\$200	<1	1	5	10	12	12
over \$200	0	0	<1	2	4	5
(\$100 or More)	2	6	16	29	32	34
Other	2	2	2	2	2	2
Depends on Plan	2	3	6	10	14	15
Coinsurance Rate						
80%	7	8	16	26	32	36
85%	2	2	2	3	3	3
90%	2	3	4	6	7	8
100%	84%	80%	71%	52%	43%	38%

Note: Statistics are from "Salaried Employee Benefits Provided by Major US Employers: A Comparison Study, 1981 Through 1986." Hewitt Associates, Lincolnshire, IL. 1987.

**TABLE 1.7: CHANGES IN HEALTH MAINTENANCE
ORGANIZATION (HMO) ENROLLMENT**

Year	HMO Enrollees (Thousands)
1980	9100
1981	10226
1982	10831
1983	12491
1984	16743
1985	18894
1986	23664
Absolute Change	
1980-1983%	3391
1983-1986%	11173
Percentage Change	
1980-1983%	37.26
1983-1986%	89.45

Note: Statistics are as reported in Statistical Abstract of the United States, 1989.
Original source is identified as Interstudy.

TABLE 1.8: SUMMARY OF ECONOMIC CONDITIONS

Parameter	EXTENT BY 1983		
	Medicare	Medicaid	Private Insurance
SUPPLY SIDE			
Hospital Capacity	Stable Capacity, Occupancy 75%		
Prospective Per Case Payment	0	10%	0-10%
DEMAND SIDE			
Health Insurance Penetration	Had Been Rising	Had Been Flat	Flat or Declining
Health Insurance Structure			
Deductible/Copayments	Rose <=40%	NA?	Rose ~25%
Prepaid Practice (HMOs)	<2% of Population	<2% of Population	5-6% of Persons
Hospital UR--Precertification	Essentially 0%	15% or More of	10% of
Hospital UR--Retrospective	Essentially 0%	50%	>=30%
Second Surgical Opinion	0%	10%	20%
Copayment Differentials for Outpatient Care	0%	0%	40%
Parameter	EXTENT BY 1986		
	Medicare	Medicaid	Private Insurance
SUPPLY SIDE			
Hospital Capacity	Declining Capacity, Occupancy 64%		
Prospective Per Case Payment	100% Prospective/DRG	40% Prospective/DRG	30-40% Prospective/DRG
DEMAND SIDE			
Health Insurance Penetration	Rose 5.5%	Rose 4.0%	Declined 3.6%
Health Insurance Structure			
Deductible/Copayments	Rose <=47%	NA?	Rose 5%
Prepaid Practice (HMOs)	3-4% of Persons	3-4% of Persons	10-12% of Persons
Hospital UR--Precertification	"100%"	60 to 65%	50%
Hospital UR--Retrospective	"100%"	"100%"	70%
Second Surgical Opinion	0%	25%	50%
Copayment Differentials for Outpatient Care	"100%"	"100%"	70%

Note: "Extent by 1983" describes the extent to which each of the relevant variables affected each insured group by 1983. "Extent by 1986" describes the same information with respect to 1986.

TABLE 1.9: SUMMARY OF DIFFUSION AND IMPACT OF ECONOMIC CHANGES, 1983-86

Parameter	Diffusion to Population (1983-1986) (%)		
	Medicare	Medicaid	Private
SUPPLY SIDE			
Hospital Capacity	Effectively Increased 12.5%		
Prospective Per Case Payment	100	30	30
DEMAND SIDE			
Health Insurance Penetration	5.46	3.95	-3.65
Health Insurance Structure			
Deductible/Copayments	47	0	5
Prepaid Practice (HMOs)	3	3	6
Hospital UR--Precertification	100	50	40
Hospital UR--Retrospective	100	50	40
Second Surgical Opinion Programs	0	15	30
Copayment Differentials for Outpatient Care	100	100	30
Parameter	Elasticity	Estimated Effect	
SUPPLY SIDE			
Hospital Capacity	1	0.00	
Prospective Per Case Payment	-0.03	-1.16	
DEMAND SIDE			
Health Insurance Penetration	0.39	-0.71	
Health Insurance Structure			
Deductible/Copayments	-0.20	-1.95	
Prepaid Practice (HMOs)	-0.25	-1.34	
Hospital UR--Precertification	-0.13	-6.29	
Hospital UR--Retrospective	0.00	0.00	
Second Surgical Opinion Programs	-0.05	-1.44	
Copayment Differentials for Outpatient Care	-0.09	-4.15	
SUM		-17.10	
OBSERVEDCHANGE		-10.5% to -11.7%	

Note: "Diffusion to population (1983-1986)" represents the difference between extent of diffusion by 1983 and extent of diffusion by 1986. These data are in table 1.8. "Estimated effects" are the product of incremental diffusion after 1983 and elasticities; incremental diffusion is the weighted sum of diffusion among three major payers. Weights used are the fraction of insured persons covered by Medicare, Medicaid, and private sources in 1983 (see table 1.2).

TABLE 2.1: DISCHARGES BY EXPECTED FIRST PAYER

Expected First Payer	DISCHARGES										Change 83-86	% Change
	1980	1981	1982	1983	1984	1985	1986					
Medicare	10766483	11283333	11657921	12306121	12177170	11341023	11483442	-822679	-6.7			
Medicaid	3374360	3498805	3446943	3467277	3382536	3344255	3303963	-163314	-4.7			
Blue Cross/Blue Shield	8560007	8377050	7642622	7130167	6426438	5645130	5143441	-1986726	-27.9			
Other Private/ Commercial Payers	11036901	11433363	11795919	11803218	10987757	10080655	9766099	-2037119	-17.3			
Other	494367	439346	430273	354589	352467	531261	585645	231056	65.2			
Workmen's Compensation	642108	642259	614776	597269	655088	756461	635210	37941	6.4			
Title V	0	39556	81156	37283	54326	73758	51680	14397	38.6			
Other Government	875215	761387	753822	790823	752891	716667	726360	-64463	-8.2			
Self Pay	2056627	2007866	2089814	2202612	2301239	2345695	2324211	121599	5.5			
No Charge	25491	59015	80109	92871	72212	220981	235307	142436	153.4			
Total	37831559	38543980	38593355	38782230	37162124	35055886	34255358	-4526872	-11.7			
Private Insurance	19596908	19810413	19438541	18933385	17414195	15725785	14909540	-4023845	-21.3			
All Non-Medicare	27065076	27258647	26935434	26476109	24984954	23714863	22771916	-3704193	-14.0			

Notes: "Expected first payer" is identified as such in National Hospital Discharge Survey. "Private insurance" includes both "Blue Cross/Blue Shield" and "Other Private/Commercial Payers."

Source: National Hospital Discharge Survey data tapes.

TABLE 2.2: ADMISSIONS PER BENEFICIARY BY PAYER

Year	Admissions Per 1000 Beneficiaries		
	Medicare	Medicaid	Private Insurance
1980	383.1	156.2	104.6
1981	394.6	159.2	106.4
1982	400.6	159.6	103.2
1983	415.7	160.9	101.4
1984	405.9	156.5	94.4
1985	370.6	153.3	86.7
1986	367.9	147.5	82.9
% Change 1980-83	8.51	3.01	-3.06
% Change 1983-86	-11.52	-8.33	-18.27

Note: Admissions are National Hospital Discharge Survey discharges for which Medicare, Medicaid, or Blue Cross or other private sources are identified as expected first payer (see table 2.1). Beneficiary counts are as in table 1.2.

TABLE 2.3: IMPACT OF ECONOMIC CHANGE ON PAYER SPECIFIC HOSPITALIZATION

Percentage Change in Hospital Admissions Attributable to Program Change				
	Medicare	Medicaid	Private Insurance	Total
1980-1983				
SUPPLY SIDE				
Hospital Capacity	0	0	0	0.00
Prospective Per Case Payment	0	-0.3	-0.3	-0.20
DEMAND SIDE				
Health Insurance Penetration	5.34	2.92	-2.65	0.46
Health Insurance Structure				
Deductible/Copayments	-8	0	-5	-5.46
Prepaid Practice (HMOs)	-0.75	-0.75	-1.5	-1.19
Hospital UR--Precertification	0	-1.95	-1.3	-0.95
Hospital UR--Retrospective	0	0	0	0.00
Second Surgical Opinion Programs	0	-0.54	-1.08	-0.68
Copayment Differentials for Outpatient Care	0	0	-3.64	-2.11
SUM	-3.41	-0.62	-15.47	-10.14
OBSERVED CHANGE IN NUMBER OF HOSPITALIZATIONS	14.3	2.75	-3.39	2.5
1983-1986				
SUPPLY SIDE				
Hospital Capacity	0.00	0.00	0.00	0.00
Prospective Per Case Payment	-3.00	-0.90	-0.90	-1.47
DEMAND SIDE				
Health Insurance Penetration	5.46	3.95	-3.65	0.30
Health Insurance Structure				
Deductible/Copayments	-9.40	0.00	-1.00	-3.47
Prepaid Practice (HMOs)	-0.75	-0.75	-1.50	-1.04
Hospital UR--Precertification	-13.00	-6.50	-5.20	-7.24
Hospital UR--Retrospective	0.00	0.00	0.00	0.00
Second Surgical Opinion Programs	0.00	-1.45	-1.74	-0.98
Copayment Differentials for Outpatient Care	-9.75	-9.00	-2.70	-5.21
SUM	-30.44	-14.65	-16.69	-19.10
OBSERVED CHANGE IN NUMBER OF HOSPITALIZATIONS	-6.7	-4.7	-21.3	-11.7

Notes: Change in hospital admissions attributable to each program change is the product of payer-specific growth of that program and elasticity. Payer specific diffusion of each program between 1980 and 1983 is estimated as the extent of diffusion by 1983 (from table 1.8). That is, all diffusion which had occurred by 1983 is assumed to have taken place between 1980 and 1983. Diffusion between 1983 and 1986 is from table 1.9. Elasticities are in table 1.9 and the text. Total change attributable to the diffusion of each program is the weighted sum of payer-specific effects. Weights are the fraction of hospitalizations attributable to that payer (calculated from table 2.1).

TABLE 2.4: CHANGES IN HOSPITAL USE BY CLINICAL CONDITION

Condition	1983	1986	Change	%		% of Total
All Diagnoses	38783	34256	-4527	-11.7	p<.001	100.0
Cataract	594	104	-490	-82.5	p<.001	10.8
Females with Deliveries	3976	3762	-214	-5.4	NS	4.7
Diabetes Mellitus	675	491	-184	-27.3	p<.001	4.1
Benign Neoplasms	618	445	-173	-28.0	p<.001	3.8
Inguinal Hernia	477	304	-173	-36.3	p<.001	3.8
Malignant Neoplasms	2024	1860	-164	-8.1	p<.05	3.6
Noninfectious Enterocolitis	584	429	-155	-26.5	p<.001	3.4
Abortions/Ectopic Pregnancy	492	343	-149	-30.3	p<.001	3.3
Disorders of Menstruation	321	173	-148	-46.1	p<.001	3.3
Diseases of Ear/Mastoid	360	217	-143	-39.7	p<.001	3.2
Chronic Disease of Tonsils/Adenoids	397	255	-142	-35.8	p<.001	3.1
Acute Respiratory Infection	564	426	-138	-24.5	p<.001	3.0
Atherosclerotic Heart Disease	466	338	-128	-27.5	p<.001	2.8
Essential Hypertension	330	204	-126	-38.2	p<.001	2.8
Sprains/Strains of Back	311	192	-119	-38.3	p<.001	2.6
Arthropathies	576	475	-101	-17.5	p<.001	2.2
Gastritis/Duodenitis	288	196	-92	-31.9	p<.001	2.0
Neuroses/Personality Disorders	264	181	-83	-31.4	p<.001	1.8
Admitted for Sterilization	146	63	-83	-56.8	p<.001	1.8
Ulcers Stomach/Small Intestine	352	295	-57	-16.2	p<.01	1.3
Anemias	247	211	-36	-14.6	p<.05	0.8
Diseases of the Central Nervous System	429	401	-28	-6.5	NS	0.6
Lacerations/Open Wounds	309	284	-25	-8.1	NS	0.6
Hyperplasia of Prostate	269	256	-13	-4.8	NS	0.3
Appendicitis	261	250	-11	-4.2	NS	0.2
Intracranial Injuries	275	267	-8	-2.9	NS	0.2
Calculus of Kidney, Ureter	330	331	1	0.3		0.0
Alcohol Dependence	388	397	9	2.3		-0.2
Fractures, All Sites	1090	1100	10	0.9		-0.2
Cholelithiasis	482	494	12	2.5		-0.3
Asthma	459	477	18	3.9		-0.4
Cerebrovascular Disease	860	889	29	3.4		-0.6
Intervetebral Disc Disorders	473	504	31	6.6		-0.7
Cardiac Dysrhythmia	454	515	61	13.4		-1.3
Acute Myocardial Infarction	676	758	82	12.1		-1.8
Other Ischemic Heart Disease	938	1043	105	11.2		-2.3
Pneumonia	837	943	106	12.7		-2.3
Congestive Heart Failure	464	582	118	25.4		-2.6
Heart Disease	3597	3731	134	3.7		-3.0
Psychoses	576	766	190	33.0		-4.2

Notes: NS = Not significant.

Statistics are from National Hospital Discharge Survey (NHDS), Annual Summaries, 1983 and 1986. National Center for Health Services Research Series 13. "Conditions" are as defined in the NHDS Annual Summaries.

TABLE 3.1: CHANGING MANAGEMENT OF CATARACT

Number of Procedures	Year						
	1980	1981	1982	1983	1984	1985	1986
0	8991	9166	11676	9715	6857	2991	3326
1	222077	192129	144557	98321	45653	16085	10092
2	180899	278221	360504	451189	395415	143272	79468
3	14056	23535	32156	28465	28816	16825	8515
4	4716	3052	6472	5850	4292	2623	2326
Total	430739	506103	555365	593540	481033	181796	103727
% with at Least 1	97.91	98.19	97.9	98.36	98.57	98.35	96.79
% with 0	2.09	1.81	2.1	1.64	1.43	1.65	3.21
% with 1	51.56	37.96	26.03	16.57	9.49	8.85	9.73
% with 2	42	54.97	64.91	76.02	82.2	78.81	76.61
% with 3	3.26	4.65	5.79	4.8	5.99	9.25	8.21
% with 4 or more	1.09	0.6	1.17	0.99	0.89	1.44	2.24

Notes: "Number of procedures" is the number of surgical procedures recorded, given that the discharge diagnosis was cataract.

Source: National Hospital Discharge Survey data tapes.

TABLE 3.2: USE OF INTRAOCULAR LENSES AFTER LENS EXTRACTION

	Year						
	1980	1981	1982	1983	1984	1985	1986
% of Discharges with Any Surgical Procedure	97.91	98.19	97.9	98.36	98.57	98.35	96.79
% with Lens Extraction	94.75	95.42	94.88	93.25	94.85	93	89.74
% with Secondary Lens Insertion When Principal Procedure Is Lens Extraction	40.55	56.13	70.2	80.77	86.96	88.28	83.98
% of All Cataract Cases That Are Lens Extraction with Insertion	38.42	53.56	66.61	75.32	82.48	82.1	75.36

Note: Data represent percentage of cataract hospitalizations for which given surgical procedure(s) were recorded in National Hospital Discharge Survey records.

Source: National Hospital Discharge Survey data tapes.

TABLE 3.3: CATARACT DISCHARGES BY EXPECTED FIRST PAYER

Expected First Payer	Discharges										Change 1983-86	% Change
	1980	1981	1982	1983	1984	1985	1986	1986	1986	1986		
Medicare	311119	390606	429715	480824	392942	134460	75941	75941	134460	75941	-404883	-84.2
Medicaid	14454	11455	11238	11669	8016	4581	3375	3375	4581	3375	-8294	-71.1
Blue Cross/Blue Shield	40161	42737	39506	38504	31032	15481	6930	6930	15481	6930	-31574	-82
Other Private/Commercial Payers	48860	49192	61949	51446	39120	19588	12729	12729	19588	12729	-38717	-75.3
Other	2713	1028	2092	2117	1448	754	642	642	754	642	-1475	-69.7
Workmen's Compensation	2063	1863	805	760	1259	2861	1121	1121	2861	1121	361	47.5
Title V		270								529	0	
Other Government	4274	3811	5388	3874	2406	1609	1523	1523	1609	1523	-2351	-60.7
Self Pay	7095	4850	4366	4346	4658	1831	1466	1466	1831	1466	-2880	-66.3
No Charge		291	306		152	102	0	0				
Total	519760	506103	555365	593540	481033	181796	103727	103727	181796	103727	-489813	-82.5
Private Insurance	89021	91929	101455	89950	70152	35069	19659	19659	35069	19659	-70291	-78.1
All Non-Medicare	208641	115497	125650	112716	88091	47336	27786	27786	47336	27786	-84930	-75.3

Notes: "Expected first payer" is identified as such in National Hospital Discharge Survey. "Private insurance" includes both "Blue Cross/Blue Shield" and "Other Private/Commercial Payers."

Source: National Hospital Discharge Survey data tapes.

TABLE 3.4: CATARACT ADMISSION RATES BY PAYER

Payer	Admissions Per 1000 Beneficiaries							% Change 1983- 86
	1980	1981	1982	1983	1984	1985	1986	
Medicare	11.07	13.66	14.77	16.24	13.1	4.39	2.43	-85.02
Medicaid	0.67	0.52	0.52	0.54	0.37	0.21	0.15	-72.23
Private Insurance	0.48	0.49	0.54	0.48	0.38	0.19	0.11	-77.32

Notes: Cataract admissions for each payer are as in table 3.3. Beneficiary counts are as in table 1.2

Source: National Hospital Discharge Survey data tapes.

TABLE 3.5: ACCOUNTING FOR THE DECLINE OF CATARACT CARE

	Percentage Change in Hospital Admissions Attributable to Program Change				
	Revised Elasticity	Medicare	Medicaid	Private Insurance	Total
1980-1983					
SUPPLY SIDE					
Hospital Capacity	-1	0	0	0	0
Prospective Per Case Payment	-0.03	0	-0.3	-0.3	-0.08
DEMAND SIDE					
Health Insurance Penetration	1.00	5.34	2.92	-2.65	3.54
Health Insurance Structure					
Deductible/Copayments	-0.20	-3.34	0	-3.34	-3.22
Prepaid Practice (HMOs)	-0.25	-0.75	-0.75	-1.5	-0.91
Hospital UR--Precertification	-0.85	0	-13.5	-9	-2.41
Hospital UR--Retrospective	0.00	0	0	0	0
Second Surgical Opinion Programs	-0.35	0	-3.74	-7.48	-1.74
Copayment Differentials for Outpatient Care	-0.85	0	0	-36	-7.74
OBSERVED CHANGE IN NUMBER OF HOSPITALIZATIONS FOR CATARACT		54.5	-18.3	1.04	40.5
1983-1986					
SUPPLY SIDE					
Hospital Capacity	-1	0	0	0	0
Prospective Per Case Payment	-0.03	-3.00	-0.90	-0.90	-2.63
DEMAND SIDE					
Health Insurance Penetration	1.00	5.46	3.95	-3.65	4.03
Health Insurance Structure					
Deductible/Copayments	-0.20	-0.64	0	-0.64	-0.63
Prepaid Practice (HMOs)	-0.25	-0.75	-0.75	-1.50	-0.87
Hospital UR--Precertification	-0.85	-85.0	-42.5	-34.0	-76.3
Hospital UR--Retrospective	0.00	0	0	0	0
Second Surgical Opinion Programs	-0.35	0	-8.83	-10.6	-1.81
Copayment Differentials for Outpatient Care	-0.85	-85.0	-85.0	-25.5	-75.8
OBSERVED CHANGE IN NUMBER OF HOSPITALIZATIONS FOR CATARACT		-84.2	-71.1	-78.1	-83.0

Notes: Change in hospital admissions attributable to each program change is the product of payer-specific growth of that program and elasticity. Payer specific diffusion of each program between 1980 and 1983 is estimated as the extent of diffusion by 1983 (from table 1.8). That is, all diffusion which had occurred by 1983 is assumed to have taken place between 1980 and 1983. Diffusion between 1983 and 1986 is from table 1.9. Elasticities are in table 1.9 and the text. Total change attributable to the diffusion of each program is the weighted sum of payer-specific effects. Weights are the fraction of hospitalizations attributable to that payer (calculated from table 3.3).

**TABLE 4.1: CODING SUBSTITUTION INVOLVING DIABETES MELLITUS (DM)
AS PRINCIPAL DIAGNOSIS**

	Number of Cases Assigned Other Principal Diagnosis Reassigned Principal Diagnosis DM	Number of Cases Assigned Principal Diagnosis DM Reassigned Other Principal Diagnosis
Total Sample		
1986		
Iowa	33	33
Nebraska	5	17
1987		
Iowa	51	49
Nebraska	13	16
Total	102	115
3% Random Sample		
1986		
Iowa	4	2
Nebraska	1	2
1987		
Iowa	5	11
Nebraska	1	5
Total	11	20

Source: Iowa Foundation for Medical Care.

TABLE 4.2: DIABETES MELLITUS (DM)
AS FIRST- OR OTHER-LISTED DIAGNOSIS

Year	Records with DM As		
	First-listed	Other-listed	Total
1980	645187	1607320	2252507
1981	655118	1696385	2351503
1982	661156	1859148	2520304
1983	674709	2039512	2714221
1984	592507	2268578	2861085
1985	479789	2179818	2659607
1986	491150	2278089	2769239
Change			
1980 to 83	29522	432192	461714
1983 to 85	-194920	140306	-54614
1983 to 86	-183559	238577	55018

Source: National Hospital Discharge Survey data tapes.

TABLE 4.3: APPEARANCE OF SUBSTITUTE CODES FOR DIABETES

ICD-9 Code of Substitute	Number of Records		
	in 1983	in 1985	Change
38.8	3297	5476	2179
38.9	54157	77230	23073
251.0	9194	11787	2593
261	1020	2880	1860
272.7	163	328	165
275.3	649	875	226
276.0	2513	3641	1128
276.1	19871	23626	3755
276.2	7643	9051	1408
276.5	148261	239129	90868
340	27449	28892	1443
364.42	263	364	101
440.2	25870	26834	964
454.2	3542	4609	1067
581.9	5161	5909	748
586	24568	29246	4678
599.9	555	1436	881
682.7	32440	40491	8051
707.8	2862	4008	1146
730.27	13122	15718	2596
783.6	1401	1640	239
Total	384001	533170	149169

Notes: ICD-9 codes of substitutes are defined in appendix 4.A. Only those substitutes which appeared more frequently in 1985 than in 1983 are included in the table.

Source: National Hospital Discharge Survey data tapes.

**TABLE 4.4: NUMBER OF CASES OF VOLUME DEPLETION
BY WHETHER OR NOT DIABETES MELLITUS (DM) IS RECORDED
AS A SECONDARY DIAGNOSIS**

Year	Number of Cases with DM	Number of Cases Without DM	Total
	As a Secondary Diagnosis		
1980	4739	95448	100187
1981	5410	99357	104767
1982	6680	110222	116902
1983	12523	135738	148261
1984	17119	178526	195645
1985	24101	215022	239123
1986	28245	232523	260768
Change			
1980 to 1983	7784	40290	48074
1983-1985	11578	79284	90862
1983-1986	15722	96785	112507

Notes: "Cases of volume depletion" are National Hospital Discharge Survey records for which the first-listed diagnosis code is 276(xx). Those "with DM as secondary diagnosis" are cases for which the diagnosis code for DM (250[xx]) is attached in any position after the first.

Source: National Hospital Discharge Survey data tapes.

TABLE 4.5: DIABETES MELLITUS DISCHARGES BY EXPECTED FIRST PAYER

Expected First Payer	Discharges										Change 83 to 85	% Change 83 to 85	Change 83 to 86	% Change
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989				
Medicare	289461	291006	291182	298340	259996	199589	211455	198751	-98751	-33.1	-86885	-29.1		
Medicaid	67945	61808	59749	67580	57335	54320	59641	-13260	-19.6	-7939	-11.7			
Blue Cross/Blue Shield	129316	127527	123866	110407	95018	80087	58849	-30320	-27.5	-51558	-46.7			
Other Private/ Commercial Payers	117982	132834	140204	147057	136641	96372	103173	-50685	-34.5	-43884	-29.8			
Other	3920	6020	6043	5504	3751	7544	10158	2040	37.1	4654	84.6			
Workmen's Compensation	1511	1019	754	739	1406	2523	2232	1784	241.4	1493	202.0			
Title V	0	1149	5036	1239	1688	993	528	-246	-711	-57.4				
Other Government	12489	11483	11464	13265	11329	8887	9011	-4378	-33.0	-4254	-32.1			
Self Pay	21279	21530	22858	29721	23822	25376	32082	-4345	-14.6	2361	7.9			
No Charge	1284	742	0	857	1521	4098	4021	3241	378.2	3164	369.2			
Total	645187	655118	661156	674709	592507	479789	491150	-194920	-28.9	-183559	-27.2			
Private Insurance	247298	260361	264070	257464	231659	176459	162022	-81005	-31.5	-95442	-37.1			
All Non-Medicare	355726	364112	369974	376369	332511	280200	279695	-96169	-25.6	-96674	-25.7			

Notes: "Expected first payer" is identified as such in National Hospital Discharge Survey. "Private insurance" includes both "Blue Cross/Blue Shield" and "Other Private/Commercial Payers."

Source: National Hospital Discharge Survey data tapes.

TABLE 4.6: DIABETES MELLITUS ADMISSION RATES BY PAYER

	Admissions Per 1000 Beneficiaries							% Change	
	1980	1981	1982	1983	1984	1985	1986	1983-85	1983-86
Medicare	10.30	10.18	10.01	10.08	8.67	6.52	6.78	-35.29	-32.76
Medicaid	3.15	2.81	2.77	3.13	2.65	2.49	2.65	-20.36	-15.28
Private/Commercial Sources (Including Blue Cross)	1.32	1.40	1.40	1.38	1.26	0.97	0.90	-29.45	-34.69

Notes: Diabetes mellitus admissions for each payer are as in table 3.3. Beneficiary counts are as in table 1.2.

Source: National Hospital Discharge Survey data tapes.

TABLE 4.7: DECLINE IN ADMISSION FOR DIABETES MELLITUS
BY REASON FOR HOSPITALIZATION

Principal Diagnosis Code (Reason for Hospitalization)	Discharges (1000s)				% of Total Change Attributable to This Reason for Hospitalization
	1983	1984	1985	Change	
250 (Diabetes)	675	593	480	-195	
250.0 (Uncomplicated)	327	204	114	-213	>100
250.1 (w/Diabetic Ketoacidosis)	72	85	81	9	increase
250.2 (w/Hyperosmolar Coma)	7	8	8	1	increase
250.3 (w/Other Coma)	6	5	5	-1	<1
250.4 (w/Renal Complications)	14	17	13	-1	<1
250.5 (w/Ophthalmologic Complications)	19	29	11	-8	4
250.6 (w/Neurologic Complications)	43	35	28	-15	7.5
250.7 (w/Peripheral Circulatory Complications)	29	35	33	4	increase
250.8 (w/Other Specified Complications)	45	44	34	-11	5.5
250.9 (w/Unspecified Complications)	113	131	153	40	increase

Source: National Hospital Discharge Survey data tapes.

TABLE 4.8: ACCOUNTING FOR THE DECLINE OF DIABETES CARE

	Percentage Change in Hospital Admissions Attributable to Program Change				
	Revised Elasticity	Medicare	Medicaid	Private	Total
1980-1983					
SUPPLY SIDE					
Hospital Capacity	-1	0	0	0	0.00
Prospective Per Case Payment	-0.03	0	-0.3	-0.3	-0.16
DEMAND SIDE					
Health Insurance Penetration	1.00	5.34	2.92	-2.65	1.80
Health Insurance Structure					
Deductible/Copayments	-0.20	-3.34	0	-3.34	-2.96
Prepaid Practice (HMOs)	-0.25	-0.75	-0.75	-1.5	-1.06
Hospital UR--Precertification	-0.30	0	-4.5	-3	-1.73
Hospital UR--Retrospective	0.00	0	0	0	0.00
Second Surgical Opinion Progs	0.00	0	0	0	0.00
Copayment Differentials for Outpatient Care	-0.25	0	0	0	0.00
OBSERVED CHANGE IN NUMBER OF HOSPITALIZATIONS FOR DIABETES		3.07	-0.54	4.11	3.09
1983-1986					
SUPPLY SIDE					
Hospital Capacity	-1	0.00	0.00	0.00	0.00
Prospective Per Case Payment	-0.03	-3.00	-0.90	-0.90	-1.91
DEMAND SIDE					
Health Insurance Penetration	1.00	5.46	3.95	-3.65	1.53
Health Insurance Structure					
Deductible/Copayments	-0.20	-0.64	0.00	-0.64	-0.57
Prepaid Practice (HMOs)	-0.25	-0.75	-0.75	-1.50	-1.06
hospital UR--Precertification	-0.30	-30.00	-15.00	-12.00	-20.94
Hospital UR--Retrospective	0.00	0.00	0.00	0.00	0.00
Second Surgical Opinion Progs	0.00	0.00	0.00	0.00	0.00
Copayment Differentials for Outpatient Care	-0.25	-7.50	-3.00	-5.00	-5.98
OBSERVED CHANGE IN NUMBER OF HOSPITALIZATIONS FOR DIABETES	1983-1985	-33.1	-19.6	-31.5	-30.98
	1983-1986	-29.1	-11.7	-37.1	-30.52

Notes: Change in hospital admissions attributable to each program change is the product of payer-specific growth of that program and elasticity. Payer specific diffusion of each program between 1980 and 1983 is estimated as the extent of diffusion by 1983 (from table 1.8). That is, all diffusion which had occurred by 1983 is assumed to have taken place between 1980 and 1983. Diffusion between 1983 and 1986 is from table 1.9. Elasticities are in table 1.9 and the text. Total change attributable to the diffusion of each program is the weighted sum of payer-specific effects. Weights are the fraction of hospitalizations attributable to that payer (calculated from table 4.5).

APPENDIX 4.A: Potential substitute diagnoses for Diabetes Mellitus

for 250.0 (diabetes without complications)

- 250.1 (diabetes with ketoacidosis)
- 250.2 (diabetes with hyperosmolar coma)
- 250.3 (diabetes with other coma)

- 276.0 hyperosmolarity and/or hypernatremia
- 276.1 hypoosmolarity and/or hyponatremia
- 276.2 acidosis
- 276.5 volume depletion
- 648.0 diabetes in pregnancy
- 648.8 abnormal glucose tolerance during pregnancy
- 775.0 syndrome of "infant of a diabetic mother"
- 775.1 neonatal diabetes mellitus
- 780.0 coma and stupor
- 780.7 malaise and fatigue
- 783.5 polydipsia
- 783.6 polyphagia
- 790.2 abnormal glucose tolerance test
- 791.5 glycosuria

for 250.4 (diabetes with renal complications)

- 271.4 renal glycosuria
- 581.81 nephrotic syndrome in disease specified elsewhere
- 581.9 nephrotic syndrome with unspecified pathologic lesion
- 583.81 nephritis/nephropathy in disease specified elsewhere
- 583.9 nephritis/nephropathy with unspecified pathologic lesion
- 585 chronic renal failure
- 586 renal failure unspecified
- 595.0 acute cystitis
- 595.9 cystitis, unspecified
- 599.0 urinary tract infection, site unspecified
- 599.9 unspecified disorder of urethra and urinary tract
- 788.2 retention of urine

for 250.5 (diabetes with ophthalmologic complications)

- 366.41 diabetic cataract
- 364.42 rubeosis iridis
- 362.0 diabetic retinopathy

for 250.6 (diabetes with neurologic complications)

- 337.1 peripheral autonomic neuropathy in disorders classified elsewhere
- 340 multiple sclerosis
- 354 mononeuritis of upper limb/mononeuritis multiplex
- 355 mononeuritis of lower limb
- 357.2 polyneuropathy in diabetes
- 358.1 myasthenic syndromes in diseases classified elsewhere
- 713.5 neurogenic arthropathy

for 250.7 (diabetes with peripheral circulatory disorders)

- 440.2 atherosclerosis of arteries of extremities
- 443.81 peripheral angiopathy in diseases classified elsewhere
- 443.9 peripheral vascular disease, unspecified
- 454.0 varicose veins with ulcer
- 454.2 varicose veins of lower extremity with ulcer and inflammation
- 682.7 other cellulitis and abscess of foot except toes
- 707.1 ulcer of lower limbs except decubitus
- 707.8 chronic ulcer of unspecified site
- 707.9 chronic ulcer of other specified site
- 730.27 unspecified osteomyelitis of ankle
- 785.4 gangrene

for 250.8 (diabetes other specific complications)

- 258.1 other combinations of endocrine dysfunction
- 259.8 other specified endocrine disorders
- 261 nutritional marasmus
- 272.2 mixed hyperlipidemias
- 272.7 lipidoses
- 275.0 bronzed diabetes
- 275.3 disorder of phosphate metabolism
- 731.8 other bone involvement in diseases classified elsewhere

for 250.9 (diabetes with unspecified complication)

- 38.8 other specified septicemias
- 38.9 unspecified septicemias
- 251.0 hypoglycemic coma
- 251.2 hypoglycemia, unspecified
- 790.6 other abnormal blood chemistry