DOCUMENT RESUME

ED 242 265 HE 017 130

AUTHOR Tracy, Octavious; Birchette-Pierce, Cheryl
TITLE Physician Requirements-1990. For Cardiology.
INSTITUTION Health Resources Administration (DHHS/PHS), Hyattsville Md. Office of Graduate Medical Education.
REPORT NO HRA-82-617
PUB DATE Oct 81
NOTE 108p.; For related documents, see HE 017 122-124 and HE 017 127-133.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS *Cardiovascular System; Delphi Technique; *Employment Projections; Employment Statistics; *Graduate Medical Education; Higher Education; *Labor Needs; *Needs Assessment; *Physicians; Prediction
IDENTIFIERS *Cardiology

ABSTRACT

Professional requirements for physicians specializing in cardiology were estimated to assist policymakers in developing guidelines for graduate medical education. The determination of physician requirements was based on an adjusted needs rather than a demand or utilization model. For each illness, manpower requirements were modified by the projected 1990 percent of change. In general, the Delphi panel members reduced the incidence/prevalence reference data for those diseases expected to decline as a consequence of more effective preventive strategies and innovative procedures. Hospital discharge rate data were complicated by age differences. The estimated percent of change in admission rates by 1990 was a variable in determining the projected cardiology manpower requirements. Norms of care were developed, and the number of visits associated with different conditions were estimated. In addition, the length of hospitalization for different conditions was predicted. The amount of service produced per year of specialty labor was also assessed. The raw data for the estimation procedures are appended, along with an algorithm for calculating requirements. Lists of panel members and advisory committee members and information on reference data sources are also appended. (SW)

PHYSICIAN REQUIREMENTS-CE 1990

For Cardiology

OFFICE OF
GRADUATE MEDICAL EDUCATION

U.S. DEPARTMENT OF
HEALTH AND HUMAN SERVICES
Public Health Service
Health Resources Administration

PHYSICIAN REQUIREMENTS-1990

For Cardiology

Octavious Tracy, Ph.D.
Cheryl Birchette-Pierce, M.D., M.P.H.

U.S. DEPARTMENT OF
HEALTH AND HUMAN SERVICES
Public Health Service
Health Resources Administration
Office of Graduate Medical Education

DHHS Publication No. (HRA) 82-617

FOREWORD

This document was developed by the Office of Graduate Medical Education (OGME) in follow-up of the deliberations of the Graduate Medical Education National Advisory Committee (GMENAC). The Cardiology Delphi Panel convened on its behalf.

The purpose of this enterprise was to provide exposition and an updated refinement of the GMENAC estimate of physician workforce requirements for 1990. GMENAC was chartered by the Secretary of Health, Education, and Welfare (currently Department of Health and Human Services) in 1976 to provide recommendations regarding changes in graduate medical education likely to achieve a balance in the specialty and geographic distribution of physicians, according to estimated needs of physician services. One of a series of specialty-specific monographs, this paper should serve as a resource to professional organizations, governmental planners and other groups of health policymakers in developing guidelines for graduate medical education, and planning for equitable access to health services for all segments of the United States population.

Jerald Katzoff, Chief of the Research and Analysis Branch of OGME, and F. Lewis Aumack, Social Science Analyst, were responsible for developing and organizing the materials and methodology which served as a basis for the entire study. In addition, F. Lewis Aumack had lead responsibility in coordinating the Delphi Panel groups and tabulating the results. Cheryl Birchette-Pierce served as coordinator for the dialogue with subspecialty organizations, and was involved in the collation and drafting of materials for this monograph series. Itzhak Jacoby, the former Director of OGME, was responsible for the initiation of the effort.

Comments regarding this monograph may be sent to the Office of Graduate Medical Education at the Center Building, Room 10-30, 3700 East-West Highway, Hyattsville, MD 20782.

Marjorie A. Bowman M.D.

Marjorie A. Bowman, M.D.
Director
Office of Graduate Medical Education

ACKNOWLEDGMENTS

A number of individuals provided invaluable assistance in the preparation of this monograph.

Gail Issen and Karen A. Rudzinski contributed much of the introductory section. Janet Cuca furnished reference and specialty data materials and Barry J. Greengart was responsible for computer models and programs.

Although the authors accept all responsibility for this report, Mary Westcott, Robert Thorner, Joan Rosenbach, and Walter H. Abelmann, Chairman, Ad Hoc Manpower Advisory Committee, American College of Cardiology, reviewed drafts and offered critical comments, while Eleanor Wesolowski and Edna Simon supplied editorial and editing reviews. Administrative support services were arranged by Sherry S. Whipple and Norman Cronquist.

Without the dedicated and conscientious work of the OGME secretarial staff, this paper would not have been completed. Carolyn Conrad deserves special credit along with Brenda Stansbury, Mickey Reed, Catherine Alexander, and Beverly Leasiolagi. Additional assistance was provided by Robin Ridley.

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I. INTRODUCTION

BACKGROUND

Over the past several decades, there has been a growing concern among the medical community, policymakers, and the public at large about the ability of the Nation to meet its health care needs. Initially, this took expression as a fear that a shortage would result from the combined effects of advancing medical knowledge, specialization, urbanization, and rising demand caused by greater public awareness. To offset the perceived shortage, many government programs were instituted in the 1960s to increase the supply of physicians.

Gradually, however, there grew an awareness that the problem was not so much one of undersupply as it was one of maldistribution of physicians, both by geographic area and by specialty, and that the expanding supply of physicians would not solve the problems related to poor distribution. As concern about the physician maldistribution grew in the 1970s, many people in both government and the private sector debated the programs and policies that should be pursued in the future to assure that the health care needs of the public would be best served. This debate was of great concern when the Comprehensive Health Manpower Training Act of 1971 (P.L. 92-157) expired in 1974. Two years of continued national debate ensued. Several proposals were made to regulate the number and distribution of residency training programs and positions in an effort to correct the perceived physician specialty maldistribution. During those debates, the Secretary of the Department of Health, Education, and Welfare (DHEW) 1/ submitted a plan to establish an "Advisory Council on Graduate Medical Education," using existing authority under section 222 of the Public Health Service Act. The culmination of those debates was the Health Professions Educational Assistance Act of 1976 (P.L. 94-484).

GRADUATE MEDICAL EDUCATION NATIONAL ADVISORY COMMITTEE

The task of alleviating maldistribution thus fell to the Secretary of the U.S. Department of Health, Education, and Welfare who chartered the Graduate Medical Education National Advisory Committee (GMENAC) on April 20, 1976. The charter, originally due to expire on April 20, 1978, was extended to April 30, 1980 and then again to September 30, 1980. The Committee consisted of 19 representatives from the private sector (13 physicians, 2 nurses, 2 attorneys, 1 hospital administrator, and 1 economist) and three ex-officio Federal agency members. A roster of the GMENAC members is in Appendix A.

As stated in the "Interim Report" (Department of Health, Education, and Welfare, 1979), the primary purpose of the Committee was to make recommendations to the Secretary regarding physician specialty and

1/ As a result of the creation of the Department of Education in May 1980, the Health and Welfare components of DHEW became the Department of Health and Human Services (DHHS).

geographic distribution, and methods to finance graduate medical education. The Committee chose 1990 as its target date for the following reasons: (1) it was estimated that 30 percent of the current supply of physicians will have been replaced due to retirement, death, or other causes; and (2) 40 percent of the physicians will have been trained since 1976, the inception of the Committee's work. Thus the opportunity existed to affect and assess change by the Committee's efforts.

STRATEGIES FOR ANALYSIS

To fulfill its charter purposes, the Committee directed its analysis along three directions: (1) data analyses; (2) constitution of Technical Panels of Inquiry; and (3) models for forecasting future physician supply and physician requirements. For the most part, this monograph will deal with the third strategy for analysis. A few comments about the first two will, however, serve to provide a perspective of the total process.

The Committee has examined all data available on students, interns, residents, and practitioners in both osteopathic and allopathic medicine. A detailed analysis of this data may be found in the Report of the Graduate Medical Education National Advisory Committee to the Secretary, September 1980, Volume One. The Nation's supply of active physicians is expected to continue to grow rapidly. This future growth will outpace U.S. population increases, so that the ratio of physicians to population will also rise. The number of physicians in primary care specialties is projected to increase relative to the total population. It is expected that the higher ratio of physicians to population will encourage the primary care physicians to offer expanded hours of service in order to meet the competition of colleagues. It is projected that this will result in a moderation of the increase of the total visits to emergency departments.

GMENAC's second strategy for analysis called for the use of technical advisory panels covering various issues. Five panels were formed: (1) Modeling Research and Data, which provided direction to the modeling efforts which will be described below: (2) Financing, which examined the effects of different means of financing medical education, housestaff training, and delivery of services and the effect of each on distribution and geography; (3) Nonphysician Health Care Providers, which examined the role of nurse practitioners, physician assistants, and other providers and the implication of their existance on needs for certain categories of physicians; (4) Geographic, which examined the geographic and distributive considerations which need to be addressed to most effectively meet access problems related to both generalists and specialists; and (5) Educational Environment, which examined the impact of the institutional environments (medical school, teaching hospital) on specialty and geographic distribution of physicians. A full discussion of the work of the Technical Panels will be found in the Report of the Graduate Medical Education National Advisory Committee to the Secretary, September 1980, Volumes Two, Three, Four, Five and Six. A summary of the major tasks of GMENAC is presented in Volume One of the Report.

GENERIC MODEL

GMENAC's third strategy for analysis involved determining the future need for physicians. A generic model was developed by the Committee for this purpose which is referred to as an "adjusted needs- based model" (see Figure 1). Existing epidemiological data and hospital utilization data were used as a starting point in determining service requirements or needs. Data on conditions that were known to be treated by physicians in a given specialty or specialty group were selected based on analyses of current practice content by self-designated specialists and estimates of the training content in each specialty. These data were adjusted by panels of experts to take account of poorly measureable variables. Panels of experts provided their advice at the points in Figure 1 shown as "P", using a modified Delphi process to reach consensus. A full discussion of the generic model may be found in the Interim Report of the Graduate Medical Education National Advisory Committee to the Secretary (HRA) 79-633, and the Report of the Graduate Medical Education National Advisory Committee to the Secretary, Volumes One and Two.

CARDIOLOGY PHYSICIAN REQUIREMENTS

Requirements Modeling Process

A panel of expert consultants (Delphi Panel) was selected from a list of nominees and provided with briefing materials. Although staff had the major responsibility for the design of the model and the selection of the ICDA codes to be considered by the Panel, the panelists had very significant input. They refined the model and reviewed the selected ICDA codes making additions, deletions and combinations which they considered appropriate. The Delphi Panel then made the appropriate estimates needed to implement the model and the results of their deliberations were presented to the Modeling Panel for its consideration. The Modeling Panel endorsed the Delphi Panel recommendations with minor modifications which were then presented to the GMENAC at a plenary session. The requirements for cardiology were thus deliberated and adopted in the public arena.

Cardiology Models

At the time the generic model was conceptualized, it was recognized that it could not be fully implemented by each specialty, but that a series of closely related models would be developed. In the case of cardiology, two related models were developed -- one for ambulatory care and one for hospital care. Like the generic model which they parallel, the cardiology models are ICDA specific and use the Delphi Panel to provide advice at each point.

Service requirements for ambulatory and hospital care are, of course, additive. Nonetheless, it is possible to estimate total manpower requirements by considering only one or the other of the service requirement components in isolation. In order to estimate total manpower requirements using only part of the service requirements (i.e. ambulatory vs. hospital care), it is only necessary to know what proportion of the total care the "missing" element represents. Then the productivity parameter can be adjusted so that it represents only that portion of the care that

Figure 1: Generic Adjusted Needs-Based Model Used by Specialty Delphi Panels to Estimate Professional Requirements for 1990

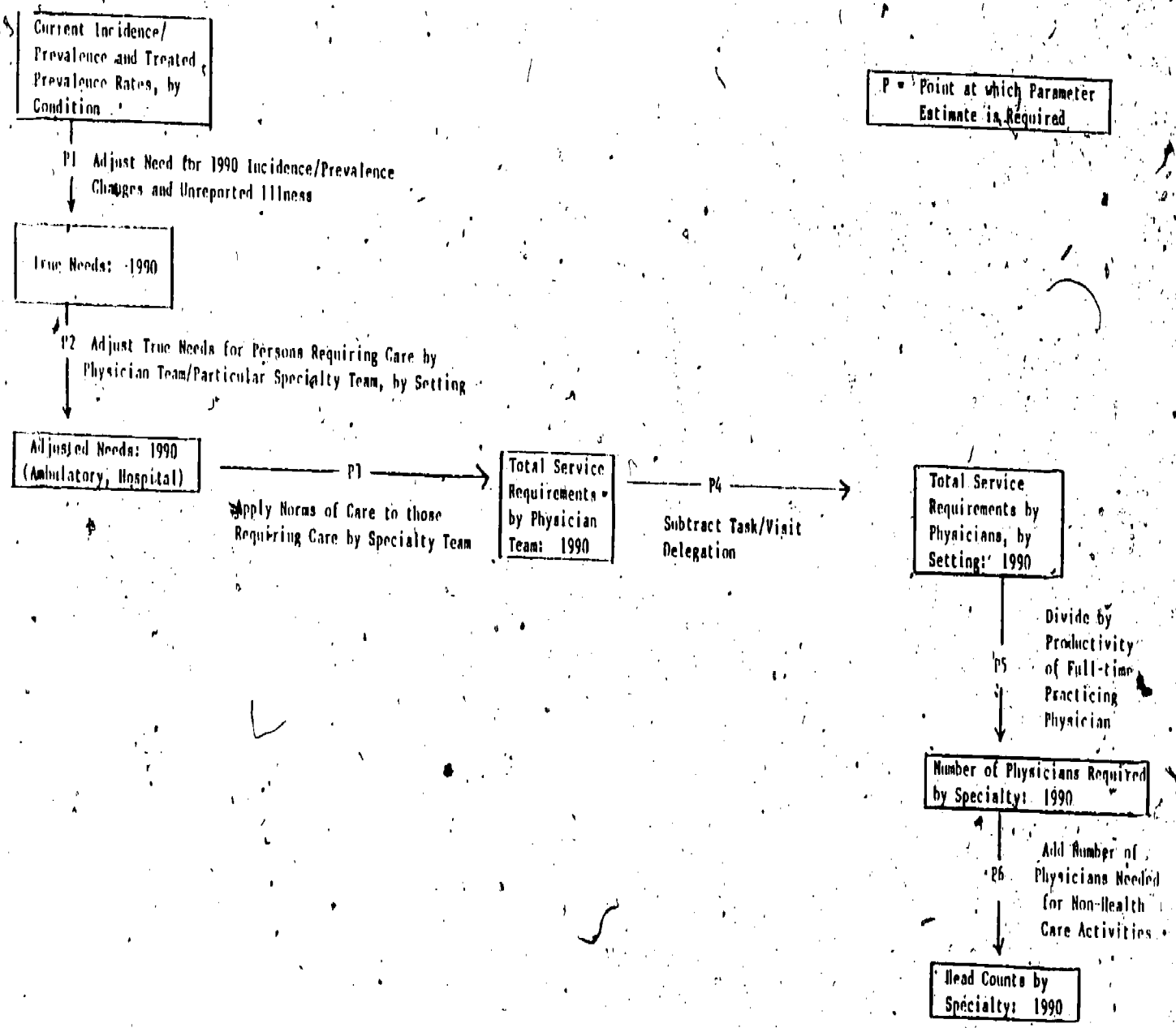


Figure 1 (Continued)

P1 - True need was based on changes made to existing epidemiologic data and adjusted need was based on the percentage of true need requiring health care which should be handled by a particular specialty.

P2 - Norms of Care in terms of visits for each specialty and proportion of visits which should be delegated to nonphysician health care providers.

P3 - Productivity of specialists in terms of number of visits provided within a week, and hours spent in patient care. Productivity data on specialists should be adjusted for changes ensuing as a result of utilization of services, other than direct visits, provided by nonphysician health care providers.

P4 - Calculation of manpower requirements was made by changing FTE requirements into total requirements based on the proportion of a specialist's workload devoted to nonhealth care activities (e.g. teaching, research, administration).

could be provided in a work week divided between both components of care. For example, in the case of cardiology the average physician's total visit productivity was divided between ambulatory and hospital care in the ratio 45:55. By deflating productivity by 45 percent the total manpower requirements were estimated by explicitly examining only ambulatory care. The same procedure was applied to the hospital care model, estimating total manpower requirements by explicitly examining only hospital care.

CARDIOLOGY AMBULATORY CARE MODEL

As noted in Figure II, the ambulatory care model consists of two tracks. Track 1 estimates the services provided to patients referred to the cardiologist by the general practitioner, family practice physician or general internal medicine specialist (a group henceforth referred to as "GFIM" or generalists). Track 2 estimates the services provided to patients who were not referred to the cardiologist from GFIM sources.

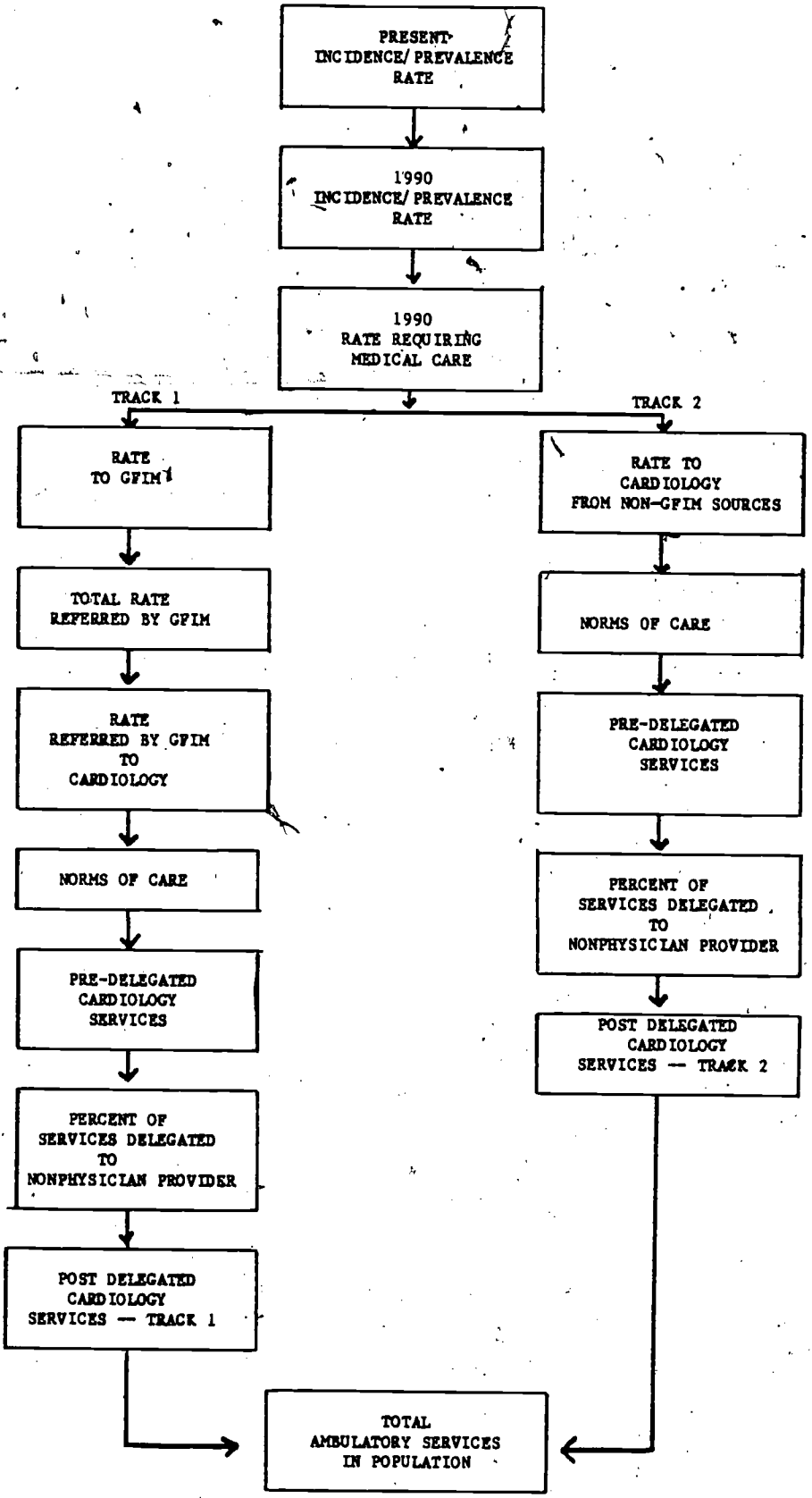
The model starts with the present incidence/prevalence rate per 100,000 population for each ICDA category under consideration. The Delphi Panelists were then asked how they thought this rate should change by 1990 and to estimate the prevalence rate that should require medical care in 1990.

At this point, the model divides into two tracks. In Track 1, the panelists were asked to estimate the rate of those requiring health care that should be seen by the GFIM. Of these, the panelists were asked to predict the rate that should be referred by the GFIM to an internal medicine subspecialist and the percentage of that rate which should be referred to the cardiologist in particular. The figure thus derived was multiplied by the norms of care which the panelists estimated as the number of visits required for the treatment of the particular ICDA code. The product of these factors was then multiplied by the 1990 estimated adult population to yield the pre-delegated cardiologist services from Track 1. The panelists were then asked to estimate the percent of cardiology services that should be delegated to the nonphysician provider. This was then multiplied by the pre-delegated estimate and subtracted from it to yield the post-delegated cardiology services from Track 1.

In Track 2, the panelists were asked to estimate the rate of those requiring cardiology care who were not referred from GFIM sources. This figure was then multiplied by the norms of care as in Track 1 to yield the pre-delegated cardiology services from Track 2. The percent delegation was then applied and subtracted from the pre-delegated estimate to yield the post-delegated services from Track 2.

FIGURE II

CONCEPTUALIZATION OF THE CARDIOLOGY DISEASE AMBULATORY CARE MODEL



The total cardiology services from Tracks 1 and 2 were then summed to yield the total ambulatory services. The model described thus far represents "V" in the expression, $\frac{V}{S \times P} \times (1+C)(1+G) = N_a$, indicating calculation of total cardiology manpower requirements from data in Table 1 where:

- V = total, non-delegated visits
- S = simultaneity factor
- P = productivity
- C = add-on for percent of patients less than 17 years of age
- G = add-on for the percent requirements of general practice
- N_a = total number of cardiologists required (ambulatory model)

Cardiology Hospital Care Model

The hospital care model is depicted in Figure III. As was true of the ambulatory model, it is ICDA code specific. The model starts with the present hospital discharge rate for each ICDA code under consideration. The panelists were then asked how they thought this rate should change by 1990, thus estimating "true need." True need was defined as hospital utilization assuming not only no access barriers to hospitalization, but also no unnecessary hospitalization. The next step in the model required the panelists to estimate the rate requiring care by cardiologists and the norms of care which were defined as the length of stay times the number of visits per day by the specialists. Multiplying the above factors yielded an estimate of the total visits accruing to cardiologists. Following this, the panelists were asked to determine the percent of the cardiology visits that should be delegated to the nonphysician provider. Mathematical calculations then resulted in the total visits required of cardiologists.

The model described thus far represents the term "V" in the expression, $\frac{V}{P} \times (1+C)(1+G) = N_h$, which indicates calculation of total projected cardiology manpower requirements, utilizing data from Table 1, where:

- V = total, non-delegated visits
- P = productivity
- C = add-on for percent of patients less than 17 years of age
- G = add-on for the percent requirements of general practice
- N_h = total number of cardiologists required (hospital model)

The hospital model did not include the use of a simultaneity factor because the hospital model relied on discharge diagnoses rather than on total diagnoses as used in the ambulatory model. As in the ambulatory care model, services to patients under the age of 17 and general medical care were treated as add-ons (Table 1). Physicians required for teaching, research and administration were factored into productivity.

Table 1

CARDIOLOGY
SUMMARY REQUIREMENTS

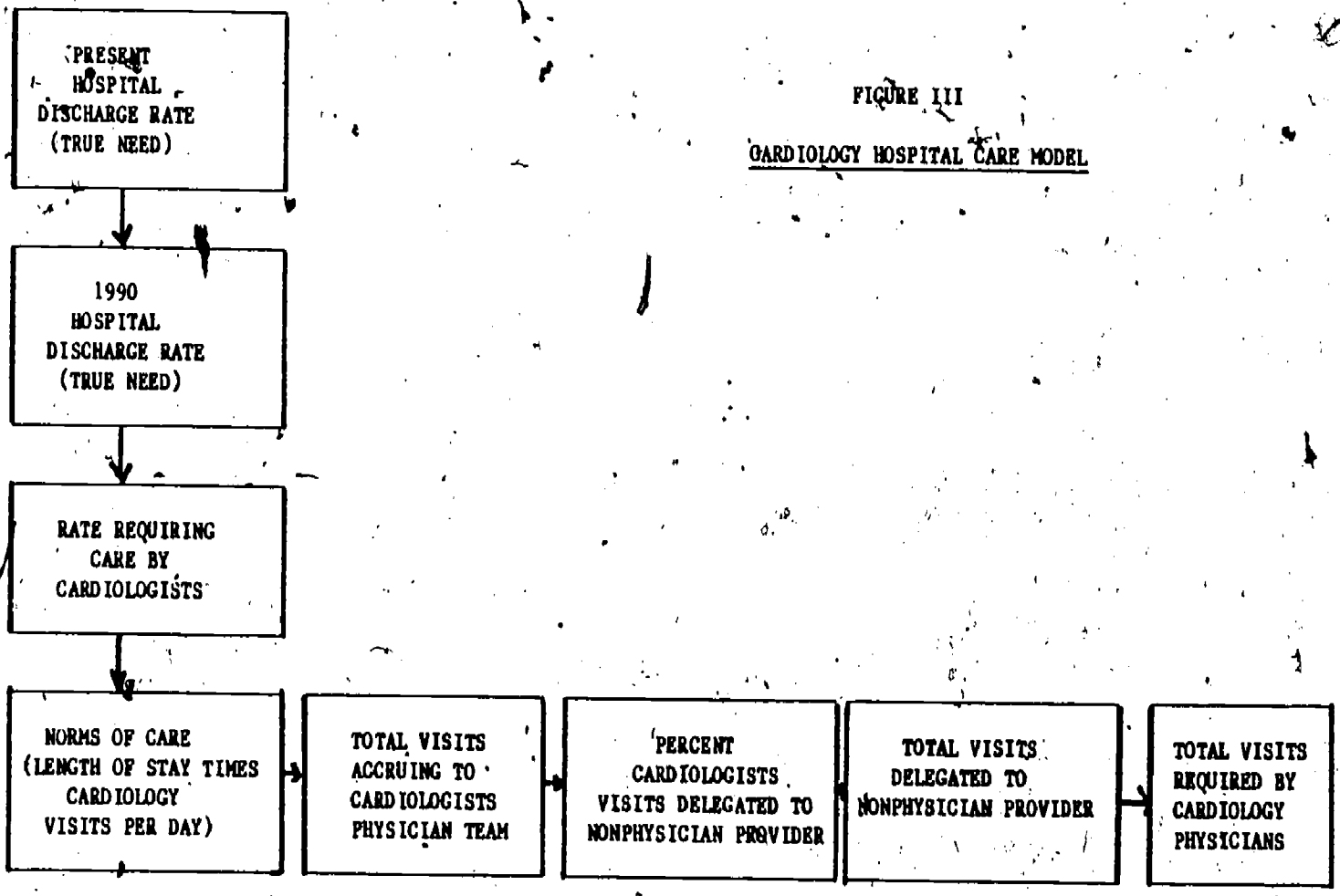
	(6-6-80) Final Delphi		(7-13-80) Modeling Panel
AMBULATORY CARE DATA (1990)			
Total Diagnostic Visits	16,540,827		16,540,827
Total, Non-Delegated Visits (88%)	14,529,314		14,529,314
Simultaneity Factor	(1.20)		(1.20)
Total Non-Delegated Patient Visits	12,107,761		12,107,761
Productivity: 47 weeks x 40 visits/wk	(1,880)		(1,880)
Basic Number, Patient Care Physicians	6,440		6,440
Patients < 17 years of age (1% = .010 add on)	64	(1/2% = .005)	32
Subtotal	6,504		6,472
General Practice (10% = .111 add-on)	722		718
TOTAL REQUIRED CARDIOLOGISTS	7,226		7,190
ALTERNATE METHOD OF CALCULATING:			
HOSPITAL CARE DATA (1990)			
Total Diagnostic Visits	20,812,295		20,812,295
Total, Non-Delegated Visits (75%)	15,514,210		15,514,210
Productivity: 47 weeks x 50 visits/wk	(2,350)		(2,350)
Basic Number, Patient Care Physicians	6,602		6,602
Patients < 17 years of age (1% = .010 add-on)	66	(1/2%=.005)	33
Subtotal	6,668		6,635
General Practice (10% = .111 add-on)	740		736
TOTAL REQUIRED CARDIOLOGISTS	7,408		7,371

Note: Above estimates do not include impact of pediatric cardiologist on adult cardiological care.

Source: Report of the Graduate Medical Education National Advisory Committee (GMENAC), Volume II, Modeling, Research, and Data Technical Panel. DHHS Publication No. (HRA) 81-652 (1981)

FIGURE III

CARDIOLOGY HOSPITAL CARE MODEL



DELPHI PROCESS

As in each specialty studied, a Delphi Panel was selected for cardiology to provide advice on the application and implementation of an appropriate model to use in developing professional requirements for cardiology. Because of the constraints of time, the panelists were selected from a list of GMENAC nominations. The Delphi Panel for cardiology was composed of four practitioners. One was a consultant, two others practiced in hospital settings and a fourth was based at a large university. A roster of the cardiology panel is provided in Appendix D.

As noted by Delbecq et al. (1975), Delphi may be described as a method for structuring a communication process so that a group of individuals may effectively make judgments about complex issues. Delphi has been applied to a variety of situations requiring group communication, including situations whose principal purpose was classification and prediction.

During Delphi Panel deliberations, participants usually exchange views and comments anonymously through written materials. Anonymity protects the group from being dominated or influenced by strongly articulated positions, aggressive personalities, or peer pressure.

In determining manpower requirements, the Delphi process was modified. The Delphi was divided into three phases which took place during two two-day meetings separated by a phase which took place by mail. The first phase explored the subject being studied. The participants studied and refined the models, became acquainted with the reference data utilized, and made adjustments to the ICDA selections for study. The participants were then asked to individually complete their questionnaires and to return them to the staff for compilation. During the second phase, data from the first meeting were mailed to the participants together with the calculated median responses. The panelists then returned their new responses to staff for compilation and calculation of new medians. The third phase identified areas of agreement and disagreement among group members. An attempt was made to reduce variance in panel estimates with the aim of inserting the consensus or median estimates into the models so that cardiology professional requirements could be derived.

The modified Delphi, which was used in the study of cardiology, offers several advantages as a method of obtaining expert opinion over the traditional Delphi. It imposes a minimum burden of time and expense on participants and reduces the number of group meetings, thus expediting the final result.

II. OVERVIEW OF SUBSPECIALTY

In the context of this discussion, cardiology is defined as that area of medicine related to the diagnosis and treatment of diseases of the cardiovascular system.

HISTORICAL PERSPECTIVE

The growth of cardiology as a medical area distinct from internal medicine has been characterized by a number of developments. In the late 1940s and early 1950s two technological advances were responsible for the establishment of cardiology as a medical subspecialty (Abelmann, 1976). One of these advances was cardiac catheterization, originally an experimental technique which became one of the most accurate means of diagnosing major cardiovascular diseases. As use of this technique burgeoned, there was an obvious need for specialized training, promoting an impetus for a subspecialty designation. The other major development was open heart surgery, performed primarily on traumatic cardiac lesions, valvular heart disease, coronary artery disease, and congenital defects. With the advent of improved prognosis and prolonged life of patients with severe cardiovascular disabilities, there evolved the need for more highly trained medical clinicians to provide diagnostic evaluations and extensive follow-up management and therapy.

Another important factor in the development of cardiology as a medical subspecialty involved the elaboration of coronary care concepts in the 1960s. During this period, acutely ill, chronically debilitated cardiac patients were being placed in designated intensive care sections of hospitals where highly specialized monitoring equipment and treatment were concentrated.

Cardiology is a medical subspecialty characterized by increasing technological complexity and sophistication of its diagnostic procedures and therapeutic processes. Technological advances in invasive diagnostic procedures such as cardiac catheterization and intra-arterial pressure monitoring as well as innovations in noninvasive procedures such as echocardiography necessitate specialized expertise. Advances in the development of new pharmacologic agents, especially for the treatment of cardiac arrhythmias, angina pectoris, and essential hypertension have resulted in innovative treatments.

Where cardiac arrhythimias have been suspected of being etiologically related to sudden cardiac death or myocardial infarction, treatment with newer drugs such as amiodarone, aprindine, tocainide, procainamide (Pronestyl), and disopyramide (Norpace) has lowered mortality (Lown, 1969; Maronde, 1980).

The treatment of angina pectoris with beta-adrenergic blocking agents represented an addition to the pharmacological treatment of angina pectoris. These newer drugs such as propranolol (Inderal) and metoprolol

(Lopressor) have decreased the frequency of angina attacks and increased patients' work tolerance. Management of angina may require a considerable time commitment from highly skilled cardiologists, as effective management often entails extensive testing of pharmacologic agents to determine effectiveness in controlling and preventing angina episodes, which are frequently precipitated by various emotional and physical stresses.

The management of hypertension may be enhanced by beta-blocking drugs such as propranolol and the newer NaPa agents, and there have been indications that these drugs produce less postural hypotension and less impotence than some of the adrenergic suppressing drugs (Maronde, 1980). Approximately 80 percent of hypertensive patients readily respond to diuretics when they are combined with other antihypertensive agents, while the remaining 20 percent of hypertensive patients pose difficult control problems requiring skilled treatment and management (Marande, 1980). However, since there is no completely reliable method of precisely predicting individual responses to antihypertensive therapy, cardiologists may be required to devote more time in evaluation of patient responses to newly marketed and experimental drugs.

The development of advanced pharmacological agents for the treatment of cardiovascular diseases has intensified efforts to devise improved techniques for determining the effectiveness and the proper dosage of drugs for specific patients. The cardiology manpower required to test, evaluate, and disseminate information about newer pharmacologic products cannot be predicted with certainty. However, given the proliferation of these drugs, it would seem that additional cardiology manpower would be required to assess the safety and effectiveness of newly developed cardiovascular drugs. In addition, while lowering mortality rates, some of the newer theraputic agents have also been indicted in contributing to an increased prevalence of dysrhythmias, thereby exacerbating the demand for highly skilled cardiologists to treat, manage, and/or monitor the probable side-effects of intensive or prolonged pharmacologic therapy.

DEFINITION AND CHARACTERIZATION OF SUBSPECIALTY PRACTITIONERS

With the evolution of efforts to distinguish cardiology from general internal medicine has come the difficulty of defining cardiologists as distinct from general internists. Before cardiology became a recognized subspecialty, cardiologists were largely identified by a temporal factor of experience. Given training in general internal medicine, a practitioner whose practice subsequently concentrated on the treatment of cardiovascular disease became eligible for subspecialty designation.

Another development which has contributed to this definitional issue originated from geographic and distribution market pressures which obliged cardiologists to provide a substantial amount of primary care. These circumstances have tended to perpetuate an overlap between cardiologists and general primary care providers in clinical practice profiles, thereby complicating the task of distinguishing the subspecialists from this larger group of primary care providers. This overlap in practice profiles has produced significant differences in various estimates of the current supply of cardiologists. Estimates have ranged between 4,500 and

10,000 cardiovascular specialists, depending on the precision and scope of the definition of cardiologists. An unequivocal designation is crucial to determining the future supply and requirements for cardiologists, as well as to facilitating a more effective planning and allocation of future cardiology resources. GMENAC determined the 1990 cardiology supply, including residents/fellows, at 14,900, of which 7,750 would be required, resulting in a surplus of 7,150 FTE Cardiologists.

As a planning aid, a definition should comprise two additional qualities. First, it should reflect the specific diagnostic and therapeutic activities, including interpretation of data, actually performed by medical specialists, in contradistinction from those tests or procedures performed by surgical specialists or merely ordered from technicians or requested of nursing assistants. Second, this definition should specify the level of training or equivalent clinical expertise required to achieve subspecialty designation. Although the difficulties of adequately defining cardiologists have not all been resolved, a task force sponsored by the American College of Cardiology (1976) proposed the following definition:

> A cardiologist is a physician recognized by himself and his peers as possessing exceptional knowledge and skill in the diagnosis and treatment of cardiovascular disease, and who is frequently utilized by other physicians through referral of difficult or unusual cardiovascular problems. His knowledge and skill are usually obtained through a special training program leading to subspecialty board certification.

The task force recommended that, as defined above, cardiologists should not have a major responsibility for care designed to prevent cardiac diseases, for treatment of mild, uncomplicated cardiovascular disease (e.g. essential hypertension), and for routine treatment of chronic heart disease. The task force recognized that its definition of cardiologists implied a number of assumptions not only about cardiologists but also about the larger health care system.

In general, the definition of cardiologists proposed by the ACC task force has been accepted by GMENAC.

The Ad Hoc Manpower Advisory Committee (AHMAC) of the American College of Cardiology (1981) suggested that accelerated progress in diagnostic methods and therapeutic techniques should be factored into the definition of cardiologists. The AHMAC specifically recommended that when defining the current and future projected aggregate supply and requirements of cardiologists, only trained and board certified cardiologists should be included. As defined, the AHMAC suggested that the supply of cardiologists in 1980 was 4,500 and that, assuming a yearly production of 700 and a 2 percent annual attribution rate, the projected supply of cardiologists through 1990 would be 10,578 (Appendix I). This figure represents a 1990 oversupply of approximately one third (36 percent) of GMENAC's projected requirement for FTE cardiologists. The AHMAC indicated to GMENAC that GMENAC's projected cardiology requirement of 7,750 represented a statistically significant underestimate.

In the last half of the 1970s, rapid change characterized cardiology and its practitioners. Factors responsible for these changes were complex, involving new technology and more formal training programs. These particular areas of change effected modifications in choices of practice settings, in percent of time devoted exclusively to cardiology, in rate of board certification in cardiovascular disease, and in referral patterns.

In practice settings, important changes occurred between 1973 and 1978 (table 2). There was an appreciable decrease in the percent of clinicians who practiced exclusively at either institutional or noninstitutional settings, while there was a marked increase in the percent of specialists engaged in practice at combined (private, group, institutional and noninstitutional) settings. There have been indications that this increase stemmed largely from financial advantages of combined practice arrangements (Relman, 1980).

Another area where important change has occurred was in the percent of time cardiologists devoted exclusively to the treatment of cardiovascular disease. In recent years this percent of time increased. In 1974, 50 percent of these practitioners' time was devoted exclusively to the provision of cardiac care (Swann, 1974). By 1978, this percent had increased to 65 (Mendenhall, et al. 1978). This expansion in subspecialty practice could have resulted from increased referrals by generalists. GMENAC suggested that referrals by generalists would be essential if cardiologists were to significantly expand their specialty practice, while contracting primary care practice.

Among the most prominent causes of current change in the field of cardiology are technological developments. The influence of such developments on the projected requirements for cardiologists will become more evident as the use of highly sophisticated procedures requiring well trained and experienced cardiologists expands, and as advanced cardiac procedures become simplified, allowing them to be performed by less specially trained internists and generalists. Whether technologically advanced procedures can be simplified for generalists' use depends on the specific nature of the procedures. It appears probable that simplication will be possible only if future procedures remain largely noninvasive (e.g. echocardiography). If invasive procedures such as angiography predominate, the impact of generalists on cardiology manpower requirements will be minimal. A related concern is that while generalists may be trained to perform certain advanced diagnostic tests, their training may be insufficient to allow them to interpret the results of such tests. The feasibility of simplifying newer technology also depends on the pace at which it is utilized by cardiologists. If utilization occurs slowly, no consequence for generalists may develop. A similar result may transpire in the event that newer technology proves expensive and changeable, as these features would diminish the cost-effectiveness of training generalists. Questions such as these underscore the difficulty of determining the effect that the interaction of future technology and generalists' practice profiles will have on cardiology manpower.

TABLE 2

PERCENT OF CARDIOLOGISTS IN DIFFERENT PRACTICE SETTINGS

SETTING	N	1973 1/	1978	PERCENT CHANGE
		TOTAL PERCENT		
Noninstitutions	4808/ 4134	69	64	7 (decrease)
Institutions	1352/ 774	19	12	37 (decrease)
Other	821/ 1545	12	23.9	-50 (increase)
TOTAL	6981/ 6453			

1/ In the Adams et al. data "combination" values were substracted from the noninstitution and institution categories and added to the third category, "other." This was done for consistency of analyses.

1973 data from Adams et al., (1973)

1978 data from Mendenhall et.al., (1978a)

III. ANALYSIS

MODEL

GMENAC's approach to the determination of physician requirements was based on an adjusted needs rather than a demand or utilization model. The adjusted-needs approach based medical service requirements on the prevalence of illness in the population, and although this approach was concerned with the provision of services to underserved areas, it considered realistic restraints on medical care requirements. In the adjusted-needs model, assessed need, as determined by health care providers and epidemiologists, and modified by the perceived wants of patient-consumers, were further modulated by various constraints to equitable access to care and were manifested as actual demand. The adjusted-needs model utilized by GMENAC represented the translation from assessed and perceived needs to achievable normative workforce requirements in the determination of the physician workforce requirements. However, even though reference data utilized in the GMENAC modeling process were modified by the Delphi Panel, the quality of this data was crucial to the accuracy of the projected physician workforce requirements, and the GMENAC has requisitioned further analysis of these requirements as more precise data become available.

METHODOLOGY

Ambulatory Data

When the reference incidence/prevalence data (Appendix E) were modified by the Delphi Panel, the rationale involved several criteria related to the design and methodological limitations of the data studies and technological advances in the refinement of diagnostic procedures. In reference to the diseases that necessitated the most frequent visits (Appendix E), the Delphi Panel increased chronic ischemic heart disease (ICDA Code 412, eighth revision), the largest category of care. The range of the classification included diseases involving dysfunction of the left ventricle, congestive heart failure, and myocardial infarction. Some panel members indicated that the breadth and complexity of ischemic diseases contributed to misclassification and undercounting by the Health Interview Survey (HIS). Also, the tendency to deny serious heart disease could have contributed to underreporting during the survey. In recent years, the projected cardiology manpower required to accommodate care of patients with chronic ischemic heart disease has been increasing in part because of newly developed treatments and expanded research into the etiology and pathogenesis of arrhythmias and other precipitous illnesses prominent in sudden cardiac death. The panel also increased the rate for other acute and subacute forms of ischemic heart disease (ICDA code 411). The panel members suggested that the National Ambulatory Medical Care Survey (NAMCS) study did not include all types of encounters such as those made by telephone or which involved follow-up visits and therefore undercounted the rate of this disease. This rationale was further supported by the concurrent actions of the Adult Medical Care Panel which

also increased the rate for other acute and subacute forms of ischemic heart disease (ICDA Code 411). The rate for congenital anomalies of the heart (ICDA code 746) was also increased. The Delphi Panel members noted that the reference data emphasized the extent of congenital heart disease in the population at large at a given time (prevalence) and could have undercounted the disease as determined by its rate to live births in a given time (incidence). Since a certain percentage of the latter die in infancy, a number of cases could have been unreported by the HIS, resulting in an undercount of the true incidence/prevalence rate. However, since the Delphi Panel focused on workforce requirements for adult medical care, cardiology manpower requirements were adjusted to indicate service demands emanating from the prevalence and not the incidence of congenital anomalies of the heart.

For each illness, manpower requirements were modified by the projected 1990 percent of change. If other aspects of the model such as the delegation to nonphysician providers remained constant, an increased or decreased rate of illness for 1990 resulted in a correspondent change of the estimated 1990 manpower requirements. In some cases, incidence/prevalence data were decreased because the panel members concluded that technological developments would contribute to an eradication or stabilization of a disease by improvement of its detection, diagnosis, and treatment. In other cases, the panel increased disease rates based on the assumption that the development of advanced technological procedures such as echocardiography would permit the diagnoses of cases previously undiagnosed or erroneously diagnosed.

Epidemiological factors would also influence future incidence/prevalence rates. For example, some Delphi Panel members suggested that the rate for hypertensive disease (ICDA codes 400-404) would tend to increase as the population aged, while improved nutritional habits effecting a reduced intake of sodium and cholesterol would contribute to a decreased overall prevalence of hypertensive disease. The Delphi Panel members predicted that essential benign hypertension (ICDA code 401) in particular would decrease as a result of a decline in smoking, enhanced regular exercise programs, and other health promotion initiatives. Technological progress in clinical management and disease prevention, and epidemiological trends, related in part to disease cycles, demographics and demography, were prominent factors in the panel members' decision to reduce the percent of change for active rheumatic fever (ICDA codes 390-392), chronic rheumatic heart disease (ICDA code 393-398), and ischemic heart disease (ICDA codes 410-414). In general, the Delphi Panel members reduced the incidence/prevalence reference data for those diseases that the panel expected to decline as a consequence of more effective preventive strategies and innovative procedures.

Hospital Data

Hospital discharge rate data were complicated by age differences. The reference data were for ages 15 and above, or for all ages. Since considerations focused on care for adults, defined as those persons 17 years and above, the Delphi Panel was required to abstract from the data the rates appropriate for persons aged 17 and above. Because some illnesses have been highly correlated with age, the rate for patients 17 years of age and older could be higher or lower than the rates for all

patients. However, even though rates for certain diseases at different age strata could change, the absolute number of patients treated by cardiologists would remain constant. For example, the Delphi Panel members determined a discharge rate for acute myocardial infarction (ICDA code 410) that was greater than the rate for all patients, since this disease afflicts older persons disproportionately. In reference to illnesses that required frequent visits, the Delphi Panel members established a lower discharge rate for chronic ischemic heart disease (ICDA Code 412). The Delphi Panel noted that a large percent of ischemic patients treated in hospitals could benefit equally well from outpatient care. The major illness in this category had been frequently limited to left ventricular ischemia and congestive heart failure. Since patients with left ventricular ischemia have been commonly admitted to hospitals for left ventricular catheterization, the panel members indicated that catheterization procedures were better accounted for within the diagnostic category of other acute and subacute forms of ischemic heart disease (ICDA code 411). In reference to illness that produced modest service requirements, the panel members sizably reduced the discharge rate for cerebrovascular disease (ICDA codes 433-436). The reference data for this disease category covered ICDA codes 433-438. The panel members deleted ICDA codes 437 and 438 (generalized ischemic cerebrovascular disease and other and ill-defined cerebrovascular disease, respectively) and incorporated their rates into the category of other acute and subacute forms of ischemic heart disease (ICDA Code 411).

The estimated percent of change in admission rates by 1990 was a variable in determining the projected cardiology manpower requirements. Among the illnesses that necessitated the most frequent visits, the panel members moderately increased the discharge rate for cardiomyopathy (ICDA code 425). Increased knowledge of this disease's etiology would improve its diagnosis and treatment. It was postulated that the development of earlier and more precise diagnosis, and improved treatment of cardiomyopathy would effect a decrease in both the mortality and severity of morbidity of this disease, which, in the latter case, would contribute to a decreased length of stay for patients with this illness. The prediction of enhanced initiatives in health promotion was a major factor in the Panel members' decision to decrease the 1990 rate of discharge for acute myocardial infarction (ICDA code 410). The panel members predicted that in the older population this illness would continue to decrease for another decade. However, it was anticipated that younger adults would persistently suffer from this disease, as a consequence of general competitive lifestyles and other environmental and psychophysiological stresses endured by the 35-55 age group.

In some cases, the Technical Modeling Panel, a subgroup of the GMENAC, selected a value that differed from that proposed by the subspecialty Delphi Panel members. Different values for service requirements were attributed to different assumptions; the Delphi Panel members were instructed by GMENAC to determine service requirements without considering realistic constraints such as costs on the need for medical care. In contrast, the Technical Modeling Panel members explicitly regarded such constraints in determining need for medical services. Decisions of the Technical Modeling Panel were ratified by the full GMENAC.

NEEDS ASSESSMENT

After the assessment of the projected course of diseases by 1990, the Delphi Panel determined a percent of cases that required care by general medical personnel and by cardiologists in particular. In an adjusted-needs model, not all ill persons would require treatment by physicians or other health providers, since some conditions would spontaneously remit and others would be mitigated by the patient's self-prescribed treatment. The eventual cardiology manpower requirement would be predicated upon the assessed percent of ill persons who would actually require professional medical intervention. In some cases, only a very small percent of the patients requiring medical care should be seen by a cardiologist. For example, the cardiology Delphi Panel suggested that in ambulatory settings cardiologists would treat less than 10 percent of patients with other diseases of the circulatory system (ICDA code 458, Appendix E), as well as selected disorders of the veins and lymphatic channels (ICDA code R-43). It was assumed that generalists would treat 90 percent of all such cases. This assumption was based on the supposition that generalists in 1990 would be better trained than they have been. As a rule, when the panel members indicated that a very large percent of patients would be seen by generalists, the rationale was partially based on the assumption that newer technology would simplify advanced procedures sufficiently to allow generalists to perform them. The panel predicted that while generalists would frequently provide the initial contact with cardiac disease patients, cardiologists would predominantly receive patients on referrals from generalists.

NORMS OF CARE

After the service requirements accruing to cardiologists had been converted into actual numbers of cases of illnesses by multiplying the percent rate of illnesses by the adult population value, norms of care for each illness were determined. Norms of care were defined as visits per episode per year, or as the number of days spent in the hospital times the number of visits by cardiologists and nonphysicians providers per day. The major data sources for norms of care were Schonfeld's Standards for Good Medical Care, the Columbia Medical Plan Study, the AMA Profiles of Medical Practice, the Hospital Discharge Survey, and assorted data from the USC-Mendenhall studies. Among the criteria that contributed to the determination of an appropriate frequency of physician encounters were progress of remission, degree of functional disability, and requirements for care by nonphysician providers.

Ambulatory Model

The Delphi Panel determined that acute myocardial infarction (ICDA code 410) would generate the largest single number of visits per episode. The etiological complexity and high potential for mortality from this disease accounted for the high visit rate. The panel members also proposed that in 1990 each episode of chronic ischemic heart disease (ICDA code 412) would require one visit when referral by a generalist and two visits when referred from other sources. Each incident of other acute and subacute forms of ischemic heart disease (ICDA code 411) would require three visits when patients were referred by a generalists and six

visits when referred from nongeneralist sources. On the average, patients referred by generalist would require one half the visits necessary for patients referred from nongeneralist sources. Patients from the latter group were primarily self-referred, having evaded a preliminary evaluation or diagnostic workup.

Hospital Model

The Delphi Panel members' estimated length of stay for acute myocardial infarction (ICDA code 410) was less than that indicated by the reference data. The panel predicted that better trained generalists would provide follow-up care for patients released early. Although the hospital stay for chronic ischemic heart disease (ICDA code 412) would be relatively extensive, the number of visits by cardiologists would be modest, and the delegation rate to nonphysician providers for routine follow-up care would be correspondingly greater. The panel recommended that where adequate care existed, cardiologists would increasingly limit their participation in the routine treatment of uncomplicated ischemic heart diseases. The average length of stay for chronic nonrheumatic disease of pericardium (ICDA code 423) was increased, and the visit rate for this disease was among the highest. The panel noted that the severity of this disease indicated a need to provide intensive care to reduce mortality.

SERVICE REQUIREMENTS

After determination of the number of patient-encounters, a percent of the required visits for routine care was delegated to nonphysician providers. The remaining visits represented the service requirements of cardiologists. The distribution of ambulatory or hospital visits across ICDA codes is shown in Appendices E and F, respectively, while the total number of nondelegated visits for both ambulatory and hospital models is presented in table 1. Because physicians have been engaged in various nonpatient care professional activities, such as research, teaching and administration, and have provided therapeutic, diagnostic and other services which have not been reflected by ICDA codes, the total requirements for physician manpower would be underestimated if based only on number of practicing clinicians and patient encounters. Consequently, time required for nonpatient care activities as well as patient care services not covered by ICDA codes were factored into the productivity value and final GMENAC requirements of 7,500 - 8,000 cardiologists. The Ad Hoc Manpower Advisory Committee of the American College of Cardiology expressed concern that the GMENAC methodology did not allow sufficient manpower for preventive, rehabilitative and other subspecialty services provided by cardiologists.

In summary of the methodological procedures discussed, after establishing incidence/prevalence, estimating probable changes by 1990, determining rates of illnesses accruing to cardiologists, converting rates of illnesses into frequency of visits, specifying total visits, and delegating a percent of visits to nonphysician providers, the total number of nondelegated ambulatory visits to cardiologists was calculated. The raw data for these procedures are placed in Appendix E, and the calculations presented in Appendix H were summarized by an algorithm developed by the GMENAC staff.

Before the aggregate supply of full-time equivalency (FTE) cardiologists required to provide subspecialty cardiac services was calculated, several concepts such as productivity and simultaneity values were factored into the requirements modeling process. As discussed in the following section, simultaneity and productivity values significantly affected the requisite aggregate supply of FTE cardiologists.

SIMULTANEITY FACTOR

This factor is defined as the average number of different illnesses treated during an office visit. Since a practitioner can treat more than one illness per visit, the total number of visits per patient can be reduced. After an extensive review of NAMCS and other office-based data, GMENAC established a simultaneity factor of 1.7 for general internal medicine. By comparison, the cardiology Delphi Panel established a simultaneity factor of 1.2, indicating that within the average visit, slightly more than one condition was treated. This simultaneity value was below average, compared to the mean value for all internal medicine subspecialties. The panel selected the particular simultaneity and productivity values because they reflected the nuances of cardiology practice where patients typically have presented cardiologists with selected complaints of cardiovascular illnesses.

In relation to GMENAC's final projected cardiology manpower requirements of 7,500-8,000, the specific manpower effect of simultaneity may be examined by holding the total nondelegated visits and productivity value constant. In general, as simultaneity decreases towards zero, the requirements for cardiologists increase. Consequently, a low simultaneity factor would tend to reduce the possibility of an underestimation and increase the probability of an overestimation of the required cardiology workforce. A converse situation would exist for a high simultaneity value.

PRODUCTIVITY

The Delphi and Technical Modeling Panel members reviewed productivity data from the AMA, Mendenhall, and other studies. Productivity is defined as the amount of service produced per year of specialty labor. The amount of service required is determined by multiplying the average number of visits accommodated per week by the average number of weeks worked per year averaged over all cardiologists. In the GMENAC model, this averaging across all cardiologists included those who were primarily engaged in research, teaching, or in other activities which limited time devoted to direct patient care. As a result of such averaging, the visits accommodated per week may have been lower than those presented in various reference data used by the Delphi Panel. Concurrent with several other specialties, this averaging strategy was used by the cardiology Delphi Panel in preference to determining independent calculations for nonpatient care activities, since the Delphi Panel decided that in the majority of cases cardiologists combined patient care and nonpatient care activities rather than having engaged in one activity to the exclusion of the other. As a consequence of this practice assumption, adjustment for the effects of nonpatient care activities on patient care productivity was made by lowering patient encounter productivity. In addition, the productivity

calculation factored in the patient care provided by residents and fellows. The Delphi Panel suggested that a variety of constraints such as relative proficiency and training requirements rendered residents' and fellows' patient care equivalent to approximately 35 percent of a full-time cardiologist, which necessitated the expression of the projected workforce requirements in full-time equivalency (FTE) units.

While physicians' participation in research, teaching, and administration would lower patient encounter productivity, physician productivity would be increased by the assistance of nonphysician providers who would assume the major responsibility for certain types of care, or would perform functions which directly increased physicians' patient encounter productivity.

The Delphi Panel formulated a productivity value for cardiologists of 1,880 (47 weeks x 40 vists/wk.), which was below average compared to the mean value for all internal medicine subspecialties.

Simultaneity and productivity are complementary and compensatory factors; as the number of conditions seen per visit increases, productivity decreases. If this hypothesis were correct, an overestimation of manpower requirements would result when simultaneity and productivity were both low, and an underestimation would occur when both simultaneity and productivity factors were high. However, the hypothesis applies to only one aspect of the interaction of simultaneity and productivity; simultaneity would increase the amount of time required per visit, thereby decreasing productivity. By reducing the number of visits, productivity would increase. This paradox may be explained by observing that simultaneity is a complex variable involving the interaction of multiple illnesses, as well as time required per visit and total number of visits, and not simply a calculation of average coexisting illnesses.

The validity of the GMENAC modeling effort in determining future normative requirements is predicated upon the quality of the reference data used and the accuracy of the assumptions about cardiology practice profiles. Given better data and tested practice assumptions, the proposed requirement may change. As for the validity of the present requirement, it is generally agreed that the GMENAC model is "the most sophisticated attempt yet to determine how many doctors will be needed in each specialty at the end of the decade" (Medical Economics, 1980) and may represent the highest state of the art in this area. Even so, technological advances and other factors such as a changing economic climate and the effects of individual and corporate initiatives in disease prevention and health promotion may create conditions which would affect physician manpower requirements. In anticipation of such factors, the GMENAC model has been designed to accommodate new developments. GMENAC's assumption was that while the specific numerical requirements might change over time, the projected cardiology manpower calculation provided a valid starting point in the ultimate determination of the required number of aggregate cardiologists needed for 1990.

It should be emphasized that disease conditions were categorized according to the specifications of the eighth revision of the International Classification of Diseases, Adapted for use in the United States

(ICDA-8). This was the most commonly accepted system for designating disease conditions in 1977, the base year for which data were collected and collated. The ICDA-8 code was used routinely by most practitioners, health facility management systems, and health surveys.

IV. DISCUSSION

Cardiology was one of the subspecialties for which an oversupply was estimated. An oversupply was defined as an excess of the aggregate number of cardiologists relative to the need ascertained for cardiac care requiring subspecialty expertise. It was suggested that an oversupply of cardiologists and other practitioners has had negative consequences for health care delivery and consumption. This suggestion about surplus specialists was partially based on the assumption that surplus specialty practitioners contributed to higher costs of medical care largely through capitation grants, curriculum developments, and other expenditures related to the cost of their training. In addition, higher medical costs have been associated with the utilization of advanced medical technology and other aspects of specialty practice.

Proponents of a specialty physician surplus have suggested that such a surplus would possibly encourage specialists to schedule more time for each patient, competitively reduce medical costs, lessen waiting time for appointments, and ease accessability and availability problems of rural and inner city residents. In addition, advocates of an expansion of the aggregate supply of specialists have indicated that specialists provide a cost-effective treatment based on a capacity to treat a large percentage of patients without the necessity of referral or consultation. The Ad Hoc Manpower Advisory Committee of the American College of Cardiology suggested that measures to limit the number of subspecialists could result in a transfer of specialty services to less qualified and less extensively educated technologists.

While some of these arguments have varying degrees of merit, others have not been substantiated. For example, in many physician surplus areas, costs have not necessarily decreased, and it can be argued that given an oversupply of providers, aggregate medical costs may increase as practitioners may be forced to charge higher fees to compensate for a diminished practice volume (Business Week, 1981). Moreover, whether training physicians disproportionately to higher levels of skill would be cost-effective and would promote the optimal use of the health care system constitute issues which have not been adequately formulated or systematically explored. As for access problems, highly specialized physicians cannot practice in rural areas lacking sophisticated support facilities and personnel, and to the extent that physicians generate demand for services, motivations to relocate into inner cities or rural areas are reduced; market forces alone have limited capacity to correct specialty and geographic maldistributions. A balanced specialty mix of physicians would likely contribute to stabilized costs and improved equitable access to medical care.

The issue of oversupply has been related to practice profiles, since the manner in which cardiologists practice represents a factor in determining the number of these specialists needed to provide cardiac care. GMENAC assumed that the practice profile of cardiologists in 1990

would be influenced by several factors which involved increased interdependence between cardiologists and generalists, decreased/increased rates for certain diseases, and reduced subspecialty treatment of certain diseases in conjunction with expanded treatment of other diseases.

GMENAC predicted that in 1990 more highly trained generalists would allow cardiologists to shift their practices away from substantial provision of primary care towards increased consultation for generalists and treatment of complex and diagnostically challenging cardiac diseases. Better trained generalists would be able to treat the great majority of cardiac diseases they encountered and would be skilled in recognizing patients requiring referral to cardiologists. Although generalists would have the responsibility for providing the majority of primary care, GMENAC emphasized the importance and desirability of cardiologists providing primary care for selected patients.

The practice profile of cardiologists would be expected to change as a consequence of decreased as well as increased incidence/prevalence rates of certain cardiovascular diseases. As suggested, the largest ambulatory reductions by the Delphi Panel members were for ICDA codes 390-392 (active rheumatic fever), 394-398 (chronic rheumatic heart disease), 401-402 (hypertensive heart disease), and 410-414 (ischemic heart disease). The panel predicted that technological factors related to earlier and more precise diagnoses and treatments, as well as epidemiological events such as improved dietary habits would combine to reduce the rates of those diseases.

In another case, cardiologists' practice profiles would change as they provided less care for certain illnesses and more care for others. Such changes were indicated by the comparison of GMENAC's projected top ten visit generating ICDA codes (Table 3) with the actual ICDA codes used in the 1978 USC-Mendenhall cardiology practice study (Table 4). These investigations referred to different time periods and involved normative versus actual care, and while such factors prevented a direct comparison of the studies on ICDA code-based practice profiles, the analysis highlighted practice profile trends for cardiologists. Essentially, the comparison revealed that the GMENAC cardiology practice profile for 1990 would contain only those diseases which directly involved the cardiovascular system. In general, cardiologists in 1990 would provide relatively less care for chronic cardiovascular illnesses of a serious but clinically uncomplicated nature and would concentrate on diagnostically challenging or clinically debilitating diseases. The Delphi Panel assumed for example that essential hypertension would be treated significantly less frequently by cardiologists in 1990 compared to 1978. In addition, the panel predicted that in 1990 generalists would treat 90 percent of essential hypertensive cases (Appendix E). When requirements for acute myocardial infarction, a more serious disease, were determined, GMENAC assumed that cardiologists would treat this disease more than three times the frequency indicated by the USC-Mendenhall study. It was predicted that cardiologists in 1990 would be treating fewer patients with diseases outside of the cardiovascular system and would follow a smaller, more select number with chronic cardiac diseases or functional disability requiring expert management and long term primary care.

Table 3

GMENAC's Top 10 ICDA Codes Compared to Mendenhall's (1978) Top 10 ICDA Codes

		GMENAC percent of total visits	MENDENHALL percent of total visits	GMENAC cumulative percent of total visits	MENDENHALL cumulative percent of total visits
412	Chronic ischemic heart disease	38.1	25.1	38.1	25.1
410	Acute myocardial infarction	7.4	2.3	45.5	27.4
411	Other acute and subacute forms of ischemic heart disease	7.1	*	52.6	*
427	Symptomatic heart disease	7.0	6.1	59.6	33.5
413	Angina pectoris	6.1	3.2	65.7	36.7
421	Acute and subacute endocarditis	5.0	*	70.7	*
746	Congenital anomalies of heart	4.2	0.7	74.9	37.4
R-38	Residuals **	3.9	NC	78.8	NC
401	Essential benign hypertension	3.6	12.2	82.4	49.6
425	Cardiomyopathy	3.5	0.8	85.9	50.4

* While these ICDA codes appeared in the GMENAC data, they were absent from Mendenhall's top ten ICDA code list.

** R-38 refers to ICDA codes 397, disease of endocardial structure; and 398, other heart disease, specified as rheumatic. No comparison for residuals was possible.

NC No comparison was possible for residuals.

Source: Cardiology Delphi Panel manpower modeling data.

Table 4

Mendenhall's (1978) top 10 ICDA Codes Matched With GMENAC's Top 10 ICDA Codes

	MENDENHALL percent of total visits	GMENAC percent of total visits	MENDENHALL cumulative percent of total visits	GMENAC cumulative percent of total visits
412 chronic ischemic heart disease	25.1	38.1	25.1	38.1
401 Essential benign hypertension	12.2	3.6	37.3	41.7
427 Symptomatic heart disease	6.1	7.0	43.4	48.7
402 Hypertensive heart disease	4.5	2.9	47.9	51.6
Y0 Medical or special examination	3.7	*	51.6	
413 Angina pectoris	3.2	6.0	54.8	57.6
250 Diabetes mellitus	2.7	0.4	57.5	58.0
410 Acute myocardial infarction	2.3	7.4	59.8	65.4
398 Other heart disease, specified as rheumatic	2.0	NC	61.8	NC
783 Symptoms referable to respiratory system	1.6	0.4	62.4	65.8

* While appearing in the Mendenhall data, these ICDA codes were absent from the GMENAC data.

NC No comparison was possible because ICDA code 398 was included in a residual grouping (R-38) by GMENAC.

Source: R.C. Mendenhall et al., Cardiology Practice Study Report. (USC/ORME D-1077) Division of Research in Medical Education, University of Southern California, School of Medicine, Los Angeles, 1978. Data were collected over a three-day recording period; excluding Sunday. Data represent one typical day.

Although the process by which the cardiology physician requirements was modeled has provided an estimate of the Nation's physician requirements for 1990, it has not afforded conclusive answers to all questions pertaining to requirements for this specialty. The limitations inherent in the modeling process preclude such definitive, comprehensive determinations. Although an attempt was made to assess the impact of technological advances in cardiology, there is no way to measure the accuracy of these predictions. Advances in by-pass surgery, for example, may extend the life span of cardiac patients resulting in the need for more visits per patient.

Even though the Delphi Panel was provided with the most complete data available, it was recognized that such data were not without limitations. It must be recognized that the GMENAC effort represents an advance in manpower planning, but further studies must be conducted to validate its results and to extend knowledge in the field.

V. CONCLUSIONS

The issues addressed by GMENAC will influence cardiology manpower requirements beyond 1990. Because of the state of the art and a lack of uniform data on physician workforce, some of the issues raised by GMENAC may not be resolved or given specific policy formulation until additional data become available. Moreover, GMENAC suggested that the particular numerical recommendations may change, depending on further study and updated refinements of data. Perhaps the most important contribution of the GMENAC Report was the detailing of a comprehensive process of determining physician manpower requirements utilizing input from private sector clinical practitioners, academicians, as well as government policy makers. GMENAC indicated that the Report would be considered to have achieved GMENAC's goals if the publication produced dialogue and improvement of the state of the art in physician manpower modeling.

It has been suggested that an oversupply of cardiologists and other practitioners has negative consequences for health care delivery and consumption. The tremendous costs of medical care in an era of austerity and limited monetary resources compel a reduction of the unit costs of equitably providing medical services to those in need of health care. Substantial savings may result from training a balanced specialty mix of physicians and from lessening the application of sophisticated technology for routine diagnoses.

GMENAC's approach to determining physician workforce requirements was based on an adjusted needs rather than a demand or utilization model. Since this model was ICDA code-based (eighth revision), the panel factored into various ICDA codes and productivity these services and activities not covered by specific ICDA codes. In addition, the panel created a special ICDA code grouping, NOS-A (hospital model), to reflect particular cardiology practice concerns.

The definition of cardiologists is crucial to determining the current supply of and future requirements for cardiology manpower. This definition must be a functional definition based on observable procedures actually performed by cardiologists. If broadly defined, cardiologists provide a substantial amount of primary care. This is due to historical forces of training and practice as well as to market forces which obligate cardiologists to compete with generalists. Most cardiologists seem to prefer a practice predominated by cardiovascular infirmities where their skills are maximally employed.

GMENAC's final estimation was that for 1990, between 7,500 and 8,000 cardiologists would be needed. This estimation was based on several assumptions about the practice profile of cardiologists: in 1990, 90 percent of cardiologists' professional time would be devoted to subspecialty practice; the spectrum of complex and diagnostically challenging cardiovascular disease could be treated by fewer cardiologists than those expected at the present rate of growth; a key

present rate of growth; a key element of future cardiology practice would be the promotion and enhancement of a functional interface between cardiologists and generalists.

The projected supply of cardiologists in 1990 was 14,900, of which 7,150 was determined to be surplus. The consequences for the health care industry of not adopting GMENAC's cardiology manpower and practice recommendations could possibly be an increased unit cost of cardiac care, an inefficient and ineffective use of these specialists; and persistent barriers to access such as financial status and geographic location for a significant proportion of the population.

VI. RECOMMENDATIONS

1. GMENAC's projected cardiology manpower requirement, as well as other specialty requirements, should be periodically evaluated in order to determine whether new developments would affect the specific manpower values.

   The accuracy of the specific projected specialty requirements would be improved by several factors --- wider acceptance of a better definition of specialty practitioners, more precisely differentiated ICDA code entries specific for cardiology, and more data on productivity and simultaneity factors for cardiology in particular. The availability of more information on technological and practice pattern changes would also contribute to more exact requirements projections during subsequent review and calculations. Periodic review of GMENAC's physician manpower projection would allow medical schools and teaching hospitals opportunities to monitor their programs within flexible guidelines and would accommodate GMENAC's position that the primary intent of its work was to institute a dialogue as well as a paradigm for continued planning and monitoring of physician manpower requirements, rather than an absolute projection of such requirements.

2. Cardiology manpower studies should be recurrently conducted to keep abreast of technological and other developments which may influence workforce requirements.

   The effects of future technology on cardiology manpower needs are uncertain. A clearer manpower picture should emerge as more information on the specific nature of newer technology becomes available. A likely outcome would be that certain technological procedures would increase the need for highly trained cardiologists. However this increase could be offset by generalists trained to provide more cardiac care. It appears that requirements for cardiologists significantly depend on the type of training that generalists and specialists receive as well as on the characteristics of their practices. To the extent that technological developments create a need for modifications of training and practice patterns, the types of cardiologists needed for 1990 could be very different from those practicing today, although the actual projected number required may remain the same.

3. In future manpower studies and analyses, cardiologists must be operationally defined.

   While important descriptive studies of the practices of cardiologists have been conducted (Mendenhall, et al., 1980), there has existed a need for studies which analyze the practice content of cardiologists to discover which activities they actually perform. Moreover, much of the disagreement over whether there has been an oversupply or undersupply of cardiologists depends on whether cardiologists are

defined exclusively (i.e. those board certified in cardiovascular diseases) or inclusively (i.e. those board certified in cardiovascular diseases or self-designated). At present, some cardiologists have self-designated status resulting from special personal interest or patient selection and spend the majority of their time providing primary care, as compared to those having board eligibility or certification as expert practitioners in cardiology. In addition, to be most effective, GMENAC assumed that cardiologists should direct the majority of their professional attention to complex and diagnostically challenging cardiovascular diseases, while devoting a relatively small percentage of practice to care designed to prevent cardiac diseases, for treatment of mild, uncomplicated cardiovascular diseases (e.g. essential hypertension), and for routine treatment of chronic heart disease.

4. Studies must be conducted to determine whether there is a cost-efficient basis for different cardiology training tracks.

   The Delphi Panel suggested that there could be a need for a cardiologist whose training falls between that of a general internist and a highly trained cardiologist. Different types of cardiac illnesses require different levels of skills, and the requirements for cardiac services vary by geographic region and practice arrangement. The issue of different training tracks will become more important as cardiologists increase the trend towards greater subspecialization. A one or two year cardiology training track may be cost-effective and could have implications for easing the problem of geographic maldistribution.

5. Efforts to insure an equitable representation of minorities and women at all levels of the medical care complex should be strengthened to enhance access to care by all ethnic and socio-economic population groups.

6. Future Delphi Panels should comprise a broader spectrum of cardiologists, representing various areas of expertise and geographic and ethnic perspectives.

Future Delphi Panels should be larger in order to be as representative as possible. As the Delphi approach becomes increasingly utilized in manpower studies, it will be refined. Perhaps an epidemiology Delphi Panel would be needed, since epidemiologists are especially well qualified to evaluate incidence/prevalence data. Another possibility would be that epidemiologists and subspecialists could jointly determine incidence/ prevalence with subspecialists determining visits, productivity, and related factors.

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VIII. APPENDICES

APPENDIX A

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Professor & Chairman
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Pritzker School of Medicine
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Chicago, Illinois

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Assistant General Counsel
Metropolitan Life Insurance Company
New York, New York

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Catherine McAuley Health Center
Ann Arbor, Michigan

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Clinical Professor
Orthopedic Surgery
University of Pittsburgh
School of Medicine
Pittsburgh, Pennsylvania

GARCIA, Delores I., M.D.
Chief Resident in Pediatrics
Department of Pediatrics
and Communicable Diseases
University of Michigan
Medical Center
Ann Arbor, Michigan

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Medical School
Los Angeles, California

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Pierson, Ball and Dowd
Washington, D.C.

MAGEN, Myron S., D.O.
Dean and Professor of Pediatrics
Michigan State University
College of Osteopathic Medicine
East Lansing, Michigan

MORGAN, Beverly C., M.D.
Chairman
Department of Pediatrics
University of Washington
Seattle, Washington

NESBITT, Tom E., M.D.
Urologist, Private Practice
Assistant Clinicl Professor Urology
Vanderbilt University
Nashville, Tennessee

O'ROURKE, Karen G., R.N., M.S.
National Representative
Federation of Nurses and
Health Professionals
AFT/AFL-CIO
Washington, D.C.

SPIVEY, Bruce E., M.D.
President
Pacific Medical Center
San Francisco, California

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Deputy Medical Director
American Psychiatric Association
Clinical Professor Psychiatry
Schools of Medicine
George Washington and
Howard Universities
Washington, D.C.

STAPLES, Eugene L.
Director
West Virginia University
Hospital
Morgantown, West Virginia

STELMACH, W. Jack, M.D.
(First Chairman)
Director
Family Practice Residency
Program
Baptist Memorial Hospital
Kansas City, Missouri

TREVINO, Margarita C., R.N., M.S.
Associate Director of Health
Services for Nursing and
Clinic Operations
Community Health Centers of
Dallas, Inc.
Assistant Professor
Baylor University School of Nursing
Dallas, Texas

WILKINSON, Charles B., M.D.
Executive Director
Greater Kansas City
Mental Health Foundation
Associate Dean
School of Medicine
University of Missouri
Kansas City, Missouri

ZUBKOFF, Michael, Ph.D.
Professor and Chairman
Department of Family
& Community Medicine
Dartmouth Medical School
Professor of Economics
Amos Tuck School of Business
Administration
Dartmouth College
Hanover, New Hampshire

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Administrator
Health Resources Administration
Chairman, Health Manpower
Coordinating Committee, PHS
Department of Health and Human
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Hyattsville, Maryland

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WILSON, Almon C., M.D. RADM, MC, USN Commanding Officer Naval Health Science Educational and Training Command National Naval Medical Center Bethesda, Maryland	TAYLOR, E. Lee, M.D. CDR, MC, USN Director, Medical Corps Programs National Naval Medical Center Bethesda, Maryland

STAFF

SCHWAB, Paul, M. Executive Secretary Graduate Medical Education National Advisory Committee Health Resources Administration Department of Health and Human Services Hyattsville, Maryland	JACOBY, Itzhak, Ph.D. Staff Director, GMENAC Director, Office of Graduate Medical Education Health Resources Administration Department of Health and Human Services Hyattsville, Maryland

FORMER MEMBERS

AGUIRRE, Marilyn N. Project Director Identity Development and Education for Adolescents New York, New York	COX, J. William, M.D. RADM, MC, USN (Ex Officio) Asst. Chief for Human Resources and Professional Operations Bureau of Medicine & Surgery Department of Navy Washington, D.C.
BARCHET, Stephen, M.D. RADM, MC, USN (Ex Officio) Inspector General, Medical Bureau of Medicine & Surgery Department of Navy Washington, D.C.	DiPRETE, Henry A. Second Vice-President John Hancock Mutual Life Ins. Co. Boston, Massachusetts
BURNETT, Mary M., D.O. General Practitioner Dallas, Texas	FRIEDMAN, Serena M., M.D. Resident, Emergency Medicine University of Southern California Medical Center Los Angeles, California

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FORMER MEMBERS (Cont'd)

HOGARTY, William R.
Executive Director
Puget Sound Health Systems Agency
Seattle, Washington

HOLDEN, William D., M.D.
Professor and Director
Department of Surgery
Case Western Reserve University
School of Medicine
Cleveland, Ohio

JOHNSON, David W., M.D.
Seattle District Medical Officer
Food and Drug Administration
Department of Health and Human Services
Seattle, Washington

KISTNER, Robert A., D.O., M.D.
Dean of Faculty
Chicago College of Osteopathic Medicine
Chicago, Illinois

LeMAISTRE, Charles A., M.D.
President
The University of Texas System Cancer Center
Texas Medical Center
Houston, Texas

MARGULIES, Harold, M.D.
(Ex Officio)
Formerly, Deputy Administrator
Health Resources Administration
Currently, Special Assistant for Environmental Health
Office of the Assistant Secretary of Health
Department of Health and Human Services
Rockville, Maryland

MAYER, William M.D.
(Ex Officio)
Asst. Chief Medical Director for Academic Affairs
Veterans Administration
Washington, D.C.

PITTMAN, James A., Jr., M.D.
Executive Dean
School of Medicine
The University of Alabama in Birmingham
Birmingham, Alabama

WAYBUR, Ann Dr.
Senior Health Care Consultant
Social Security Department
International Union, UAW
Detroit, Michigan

FORMER STAFF

FEATHERSTONE, Frederick V., M.D.
Executive Secretary (GMENAC)
Assistant Director for Planning
Division of Medicine
Health Resources Administration
Department of Health and Human Services
Hyattsville, Maryland
Currently, Deputy Executive Director
American Academy of Orthopaedic Surgeons
Chicago, Illinois

GRAHAM, Robert, M.D.
Executive Secretary (GMENAC)
Acting Deputy Administrator
Health Resources Administration
Department of Health and Human Services
Hyattsville, Maryland
Currently, Professional Staff Member
Subcommittee on Health and Scientific Affairs
United States Senate
Washington, D.C.

GRADUATE MEDICAL EDUCATION NATIONAL ADVISORY COMMITTEE

FORMER STAFF (Cont'd)

McNUTT, David R., M.D., M.P.H.
(Acting Executive Secretary GMENAC)
Director, Office of Graduate Medical
Education
Health Resources Administration
Department of Health and
Human Services
Currently, Deputy Commissioner of Health
City of Chicago
Richard J. Daley Center
Chicago, Illinois

APPENDIX B

MODELING TECHNICAL PANEL

DONALDSON, William F., M.D.
Clinical Professor
Orthopedic Surgery
University of Pittsburgh
School of Medicine
128 North Craig Street
Pittsburgh, Pennsylvania 15213

SPIVEY, Bruce E., M.D.
President
Pacific Medical Center
P.O. Box 7999
San Francisco, California 94120

STELMACH, W. Jack, M.D.
Director
Family Practice Residency
Program
Baptist Memorial Hospital
6601 Rockhill Road
Kansas City, Missouri 64131

WILKINSON, Charles B., M.D.
Executive Director
Greater Kansas City
Mental Health Foundation
600 East 22nd Street
Kansas City, MO 64108

MORGAN, Beverly C., M.D.
Chair and Professor
Department of Pediatrics
UCI Medical Center
101 City Drive South
Orange, California 92668

NESBITT, Tom E., M.D.
Trustee, AHA and AMA
1921 Hayes Street
Nashville, Tennessee 37203

APPENDIX C

GRADUATE MEDICAL EDUCATION NATIONAL ADVISORY COMMITTEE

ADULT MEDICAL CARE AND INTERNAL MEDICINE SUBSPECIALTY

DELPHI PANELS

Adult Medical Care Panel

CONVENERS

TARLOV, Alvin R., M.D.
Professor and Chair
Department of Internal Medicine
Pritzker School of Medicine
University of Chicago
Chicago, Illinois

MAGEN, Myron S., D.O.
Dean and Professor of Pediatrics
Michigan State University
College of Osteopathic Medicine
East Lansing, Michigan

PANELISTS

Family Practice

BLOOM, Sanford, M.D.
Director, Family Practice Residency Program
Santa Monica Hospital Medical Center
Santa Monica, California

EGGER, Ross L., M.D.
Director, Family Practice Residency Program
Ball Memorial Hospital
Muncie, Indiana

JONES, James G., M.D.
Chairman, Department of Family Practice
East Carolina University
School of Medicine
Greenville, North Carolina

NIKOLAUS, Donald G., M.D.
Private Practice
Dunedin, Florida

POTTS, Donald, M.D.
Private Practice
Independence, Missouri

REPPART, John, M.D.
Col., MC, USAF
David Grant USAF Medical Center
Travis AFB, California

RUSCO, Ralph, D.O.
Private Practice
Chicago, Illinois

SCHACKELFORD, Robert, M.D.
Group Practice
Mount Olive, North Carolina

GRADUATE MEDICAL EDUCATION NATIONAL ADVISORY COMMITTEE

ADULT MEDICAL CARE AND INTERNAL MEDICINE SUBSPECIALTY

DELPHI PANELS (Cont'd)

Internal Medicine

BRISTOW, Lonnie R., M.D.
Private Practice
San Pablo, California

BYNNY, Richard, M.D.
Professor of Medicine
Health Science Center
University of Colorado
Denver, Colorado

DAVIES, Nicholas E., M.D.
Private Practice
Atlanta, Georgia

DAVIS, William D., Jr., M.D., F.A.C.P.
Professor of Clinical Medicine
Tulane University
Chairman Emeritus, Department of
Internal Medicine
Ochsner Foundation Hospital
New Orleans, Louisiana

DuPREE, Richard H., M.D.
Private Practice
Haddonfield, New Jersey

WALDMAN, Robert H., M.D.
Professor and Chairman
Department of Medicine
West Virginia University
School of Medicine
Morgantown, West Virginia

Other Specialists

Preventive Medicine

SCHOENRICH, Edyth, M.D.
Associate Dean
Johns Hopkins School of Hygiene
and Public Health
Baltimore, Maryland

Nonphysician Health Care Providers

JOYNER, Steven, P.A.
Physician's Assistant in Family
Practice
Dixon Medical Center, Inc.
Ayden, North Carolina

MULLINIX, Connie, M.P.H.
Assistant Professor and Family Nurse
Practitioner
University of Wisconsin/Milwaukee
School of Nursing
Milwaukee, Wisconsin

GRADUATE MEDICAL EDUCATION NATIONAL ADVISORY COMMITTEE

ADULT MEDICAL CARE AND INTERNAL MEDICINE SUBSPECIALTY

DELPHI PANELS (Cont'd)

Internal Medicine

Staff

JACOBY, Itzhak, Ph.D.
Staff Director, GMENAC
Director, Office of Graduate Medical Education
Health Resources Administration
Department of Health and Human Services
Hyattsville, Maryland

AUMACK, Lewis, Ph.D.
Social Science Analyst
Office of Graduate Medical Education
Health Resources Administration
Department of Health and Human Services
Hyattsville, Maryland

ROSENSTEIN, Judy, M.H.S.A.
Program Analyst
Office of Graduate Medical Education
Health Resources Administration
Department of Health and Human Services
Hyattsville, Maryland

APPENDIX D

CARDIOLOGY DELPHI PANEL

Panelists

GOLDBARG, Alberto, M.D.
Chief, Cardiac Surveillance Unit
Michael Reese Medical Center
Chicago, Illinois

HAMMERMEISTER, Karl E., M.D.
Veterans Administration Hospital
Seattle, Washington

ROMERO, Calixto, M.D.
Texoma Cardiology Associates
Consultant in area hospitals
Denison, Texas

VANDEN BELT, Ron J., M.D.
Clinical Assistant Professor of
Internal Medicine (Cardiology)
University Hospital
Ann Arbor, Michigan

ABBREVIATIONS FOR ADULT MEDICAL CARE DATA

AMC =	Adult Medical Care Panel
CA =	Cardiology Delphi Panel
F =	Family Practice
G =	General Practice
GFIM =	General Practice/Family Practice/Internal Medicine
HIS =	Health Interview Survey
HSP =	Health Service Provider
IM =	Internal Medicine
I/P =	Incidence/Prevalence
Model =	Modeling Panel of GMENAC
NAMCS =	National Ambulatory Medical Care Survey
NE =	Nephrology Delphi Panel
NPP =	Nonphysician provider
SS =	Subspecialty

Descriptions of Column Variables in Table 5

Ambulatory Adult Medical Care: All data refer to the subject of the total U.S. population aged 17 years or older. Medical practice requirements for the younger population are accounted for later by means of an estimated add-on.

1/ International Classification of Diseases, Adapted for Use in the United States, Eight Revision (ICDA): Currently the most commonly accepted international categorical classification system for medical diseases. Most Internal Medicine subspecialty panels utilized the "3-digit" level of aggregation (e.g. 019, 135, etc.), with occasional use of the "4-digit" level.

2/ Data Source: Data relating to various parameters of medical practice requirements were obtained from the following sources.

Reference data: Major empirical survey data included the Health Interview Survey (HIS), National Ambulatory Medical Care Survey (NAMCS), or others specified in subsequent footnotes.

Adult Medical Care Delphi Panel (AMC): Judgments made by the Adult Medical Care Delphi Panel served both to determine General/Family Practice and General Internal Medicine requirements and to provide additional reference data to the I.M. subspecialty panels.

Cardiology (CA): Judgments made by CA representatives based on a consideration of the reference and AMC data.

Modeling Panel (Model): The GMENAC "Modeling Panel" assumed the responsibility for changing any Delphi panel judgments is considered in error. This applied to both the AMC and CA Panel estimates. In order to highlight the comparisons, only the Modeling Panel changes are recorded below the respective panel judgments.

3/ Incidence/Prevalence, Rate per 100,000: Composite of incidence and prevalence data, primarily from HIS; all HIS data pro-rated to base year of 1977, necessitated by special chronic surveys of different body system/disease groupings in different years.

NAMCS data presented in absence of HIS data; other data presented in addition when presumed more valid.

Panel estimates based on Median judgments of members present at Delphi debates.

4/ Percent Change, 1977-1990: Panel estimates of predicted change in rate from 1977 to 1990; based on projected changes in the population, psychosocial parameters, medical practice, scientific advances, etc.

5/ Percent Requiring Medical Care: Panel estimates of the percent of persons with a given ICDA condition who should be seen by the health care system in 1990.

6/ Percent Seen by GFIM: The percent of those who should be seen at all by the health care system (reference 5/) who should be seen specifically by General, Family or General Internal Medicine Practitioners** (1990).

7/ Percent Referred by GFIM: The percent of persons seen by GFIM physicians (reference 6/) who should be referred elsewhere (1990).

8/ Percent GFIM Referrals to Cardiology: The percent of persons referred by GFIM (reference 7/) who should be referred specifically to a cardiologist (1990).

9/ Average Numbers of Visits to Cardiologist: Panel estimates as to the average number of visits required per year in 1990 to treat a given occurrence of a given ICDA disorder for those patients obtained from GFIM channels.

10/ Percent of CA Visits to Nonphysician Providers (NPP): Panel estimates of the percent of all visits to the cardiologist that should be delegated in 1990 to some kind of supervised nonphysician health care provider.

11/ Percent CA Patients from Non-GFIM Sources: Panel estimates of the percent of patients comprising the typical cardiologist's office practice in 1990 who should come from sources other than GFIM referrals; this percent could include referrals from non-GFIM physicians, referrals from nonphysicians, and "walk-ins".

12/ Average Number of Visits to Cardiologist: Panel estimates of the average number of visits required per year in 1990 to treat a given occurrence of a given ICDA disorder for patients obtained from other than GFIM sources.

13/ Percent of CA visits to Nonphysician (NPP): Panel estimates of the percent of all visits to the cardiologist that should be delegated in 1990 to some kind of supervised nonphysician health care provider.

Medical Health Care Visits

14/ Total Required: Computation of total number of visits required of cardiology physicians, directly or indirectly from all sources.

** For convenience, collectively referred to as generalists.

15/ Total Delegated to NPP: Computation of the total number of visits that the cardiologists of 1990 should delegate to nonphysician health care providers.

16/ Percent Delegated: A "weighted-average" calculation of delegation estimate from GFIM (reference 8/) and non-GFIM (reference 13/) sources.

17/ Total Required by CA: Computation of the total number of visits that should be handled directly and solely by cardiology physicians in 1990.

APPENDIX E

AMBULATORY MODEL

REFERENCES AND DELPHI PANEL DATA TABLE

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		2/	3/	4/	5/	6/	7/	Patients from GFIM Referred		
ICDA 1/	Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GFIM	Percent Referred by GFIM	8/ Percent Referred to CA	9/ Average Number of Visits	10/ Percent Visits to MPP
III. ENDOCRINE, NUTRITIONAL, & METABOLIC DISEASES (240-279)										
	a. Diseases of Thyroid Gland (240-246)									
	242 Thyrotoxicosis w. or w/o goiter	HIS	210		100					
		AMC Model.	210	0	100	90	50			
		CA Model.	210	0	100	80	50	10	1.5	0
	244 Myxedema	HIS	924		100					
		AMC Model.	1,000	0	100	95	10			
		CA Model.	1,000	0	100	80	50	10	2	10
	b. Diseases, O. Endocr. Gl. (250-258)									
	250 Diabetes mellitus	HIS	3,157		100					
		AMC Model.	4,000	10	100	95	5			
		CA Model.	4,000	10	100	90	10	10	1	25
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)										
	a. Active Rheumatic Fever (390-392)									
	R-37 Residuals 390 Rheumatic fever w/o mention heart involv. 391 Rheum. w. heart involv.	HIS	27		100					
		AMC Model.	27	-10	100	95	20			
		CA Model.	27	-10	100	95	50	80	2	0

\# Data not available.
* Not judged as a separate 3-digit item.

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		2/	3/	4/	5/	6/	7/	Patients from GPIM Referred		
ICDA 1/ Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GPIM	Percent Referred by GPIM	8/ Percent Referred to CA	9/ Average Number of Visits	10/ Percent Visits to NPP
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)									
b. CHRONIC RHEUMATIC HEART DISEASE (393-398)									
394.0 Disease of mitral valve specified as rheumatic	HIS	*		*					
	AMC	*	*	*	*	*			
	Model.								
	CA	18	-20	100	70	50	100	1	0
	Model.								
394.9 Disease of mitral valve not specified as rheumatic	HIS	*		*					
	AMC	*	*	*	*	*			
	Model.								
	CA	5,000	0	10	70	10	100	1	0
	Model.								
395 Diseases of aortic valve	HIS	11		100					
	AMC	100	0	100	90	25			
	Model.								
	CA	11	-20	100	90	50	100	1	0
	Model.								
R-38 Residuals	HIS	598		100					
397 Dis. endocardial struct.	AMC	598	-5	100	90	30			
398 O. heart dis., spec. rheum.	Model.								
	CA	598	0	100	70	50	100	1	0
	Model.								
c. Hypertensive Disease (400-404)									
401 Essential benign hypertension	HIS	9,756		99					
	AMC	15,000	10	100	98	1			
	Model.	13,636			99				
	CA	13,750	-10	100	85	10	50	1	50
	Model.								

Data not available.
* Not judged as a separate 3-digit item.

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		2/	3/	4/	5/	6/	7/	Patients from GPIM Referred		
ICDA 1/	Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GPIM	Percent Referred by GPIM	8/ Percent Referred to CA	9/ Average Number of Visits	10/ Percent Visits to NPP
VII.	DISEASES OF THE CIRCULATORY SYSTEM (390-458)									
	c. Hypertensive Disease (400-404)									
	402 Hypertensive heart disease	HIS	1,541		100					
		AMC Model.	1,600	0	100	95	10			
		CA Model.	1,500	-20	100	85	25	100	1	25
	R-39 Residuals	HIS	67		100					
	400 Malignant hypertension	AMC	70	0	100	80	30			
	403 Hypersensive renal disease	Model.								
	404 Hypert. heart & renal dis.	CA	70	0	100	80	80	50	3	0
		Model.								
	d. Ischemic Heart Disease (410-414)									
	410 Acute myocardial infarction	HIS	1		100					
		AMC Model.	300	-5	100	90	20			
		CA Model.	285	-10	100	90	75	100	4	30
	411 O. acute & subacute forms of ischemic heart disease	NAMCS	104		#					
		AMC Model.	300	-5	100	90	30			
		CA Model.	300	-10	100	90	80	100	3	20
	412 Chronic ischemic heart disease	HIS	1,760		100					
		AMC Model.	2,000	-2	100	95	20			
		CA Model.	5,000	-7.5	100	90	60	100	1	0

Data not available.
* Not judged as a separate 3-digit item.

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS	2/	3/	4/	5/	6/	7/	Patients from GPIM Referred		
ICDA 1/ Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GPIM	Percent Referred by GPIM	8/ Percent Referred to CA	9/ Average Number of Visits	10/ Percent Visits to NPP
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)									
d. Ischemic Heart Disease (410-414)									
413 Angina pectoris	HIS	684		100					
	AMC Model.	684	-2	100	95	10			
	CA Model.	684	-7.5	100	80	60	100	1	20
e. Other Forms of Heart Dis. (420-429)									
420 Acute pericarditis, nonrheumatic	HIS	3		100					
	AMC Model.	*	*	*	*	*			
	CA Model.	150	0	100	90	40	100	1	0
421 Acute and subacute endocarditis	HIS	3		67					
	AMC Model.	*	*	*	*	*			
	CA Model.	150	0	100	90	100	100	2	0
423 Chronic disease of pericardium, nonrheumatic	HIS	3		100					
	AMC Model.	*	*	*	*	*			
	CA Model.	50	-10	100	90	100	100	1	0
424 Chronic disease of endocardium	HIS	156		98					
	AMC Model.	156	0	100	90	30		1	
	CA Model.	156	0	100	90	60	100	1	0

Data not available.
* Not judged as a separate 3-digit item.

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS	2/	3/	4/	5/	6/	7/	Patients from GPIM Referred		
							8/	9/	10/
ICDA 1/ Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GPIM	Percent Referred by GPIM	Percent Referred to CA	Average Number of Visits	Percent Visits to NPP
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)									
e. Other Forms of Heart Dis. (420-429)									
425 Cardiomyopathy	HIS	1		#					
	AMC	156	0	100	90	50			
	Model.								
	CA	156	0	100	90	75	100	2	0
	Model.								
426 Pulmonary heart disease	HIS	5		100					
	AMC	*	*	*	*	*			
	Model.								
	CA	200	0	100	90	60	50	1	0
	Model.								
427 Symptomatic heart disease	HIS	1,438		95					
	AMC	2,000	0	100	90	30			
	Model.								
	CA	1,438	0	100	90	37.5	100	1	20
	Model.								
f. Cerebrovascular Disease (430-438)									
435 Transient cerebral ischemia	HIS	135		#					
	AMC	200	0	100	95	30			
	Model.								
	CA	134	0	100	85	40	120		0
	Model.								

Data not available.

* Not judged as a separate 3-digit item.

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		2/	3/	4/	5/	6/	7/	Patients from GPIM Referred		
ICDA 1/	Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GPIM	Percent Referred by GPIM	8/ Percent Referred to CA	9/ Average Number of Visits	10/ Percent Visits to NPP
VII.	DISEASES OF THE CIRCULATORY SYSTEM (390-458)									
	g. Dis. of Arteries, Arterioles, & Capillaries (440-448)									
	440 Arteriosclerosis	HIS	583		92					
		AMC Model.	583	0	100	95	10			
		CA Model.	583	0	50	80	40	50	1	20
	444 Arterial embolism and thrombosis	HIS	26		98					
		AMC Model.	26	0	100	90	60			
		CA Model.	26	0	100	50	100	100	1	10
	446 Polyarteritis nodosa & all. cond.	HIS	4		100					
		AMC Model.	4	0	100	90	20			
		CA Model.	4	0	100	90	80	5	1	0
	R-42 Residuals 441 O. aneurysm, nonsyphil. 442 O. aneurysm 443 O. periph. vascular dis. 445 Gangrene 447 O. dis. arteries & arteriol. 448 Dis. of capillaries	HIS	88		100					
		AMC Model.	88	0	100	90	30			
		CA Model.	88	0	100	80	30	50	1	5

/ Data not available.
* Not judged as a separate 3-digit item.

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		2/	3/	4/	5/	6/	7/	Patients from GFIM Referred		
ICDA 1/	Diagnosis	Data Source	Incidence-Prevalence (Rate/100,000)	Percent Change 1977-90	Percent Requiring Medical Care	Percent Seen by GFIM	Percent Referred by GFIM	8/ Percent Referred to CA	9/ Average Number of Visits	10/ Percent Visits to NPP
VII.	DISEASES OF THE CIRCULATORY SYSTEM (390-458)									
	h. Dis. of Veins & Lymphatics, & Other Dis. of Circulatory System (450-458)									
	450 Pulmonary embolism and infarction	HIS	74		100					
		AMC Model.	74	0	100	90	40			
		CA Model.	74	0	100	70	70	65	1	0
	451 Phlebitis and thrombophlebitis	HIS	397		100					
		AMC Model.	397	0	100	90	10			
		CA Model.	397	0	100	60	20	40	1	0
	R-43 Residuals	HIS	869		98					
	(453 O. venous embolism & thromb.) (456 Varicose veins of o. sites) (457 Noninfect. dis. lymphatic channels) (458 O. dis., circulatory sys.)	AMC Model.	869	0	90	90	10			
		CA Model.	869	0	90	90	10	20	1	10
IX.	DIS. OF DIGESTIVE SYSTEM (520-577)									
	b. Dis. of Esophagus, Stomach, and Duodenum (530-537)									
	530 Dis. of esophagus	HIS	143		99					
		AMC Model.	143	0	100	90	15			
		CA Model.	143	0	100	90	25	10	1	5

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

ICDA 1/ Diagnosis	Data Source	2/ Incidence-Prevalence (Rate/100,000)	3/ Percent Change 1977-90	4/ Percent Requiring Medical Care	5/ Percent Seen by GPIM	6/ Percent Referred by GPIM	Patients from GPIM Referred: 7/ Percent Referred to CA	8/ Average Number of Visits	9/ Percent Visits to NPP
MEDICAL CONDITIONS									
XIV. CONGENITAL ANOMALIES (740-759)									
746 Congenital anomalies of heart	HIS	396		99					
	AMC Model.	396		100	75	60			
	CA Model.	500		100	75	60	100	1	10
XVI. SYMPTOMS & ILL-DEFINED CONDITIONS (780-796)									
a. Symptoms Referable to Systems or Organs (780-789)									
782 Sympt. refer. to cardiovascular & lymphatic system	HIS	920							
	AMC Model.	920	0		95	15			
	CA Model.	920	0		90	15	50	1	10
783 Sympt. refer. to respir. syst. (453 O. venous embolism & thromb.) (456 Varicose veins of o. sites) (457 Noninfect. dis. lymphatic channels) (459 O. dis., circulatory sys.)	HIS	1,140		85					
	AMC Model.	1,140	0	90	90	10			
	CA Model.	1,140	0	90	80	20	20	1	5

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		11/ Patients from Non-GFIM Sources			14/	15/ 16/ Medical Health Care Visits		17/
ICDA 1/ Diagnoses	Data Source	Percent CA Patients	Average Number of Visits	Percent Visits to NPP	Total Required	Total Delegated to NPP	Percent Delegated	Total Required by CA
III. ENDOCRINE, NUTRITIONAL, & METABOLIC DISEASES (240-279)								
a. Diseases of Thyroid Gland (240-246)								
242 Thyrotoxicosis w. or w/o goiter	HIS AMC Model.							
	CA Model.	10	2	0	26,323	0	0	26,323
244 Myxedema	HIS AMC Model.							
	CA Model.	5	2	10	153,224	15,322	10	137,902
b. Diseases, O. Endocr. Gl. (250-258)								
250 Diabetes mellitus	HIS AMC Model.							
	CA Model.	2	4	25	77,936	19,484	25	58,452
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)								
a. Active Rheumatic Fever (390-392)								
R-37 Residuals 390 Rheumatic fever w/o mention heart involv. 391 Rheum. w. heart involv.	HIS AMC Model.							
	CA Model.	2	3	0	34,632	0	0	34,632

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		11/ Patients from Non-GPIM Sources			14/	15/ 16/ Medical Health Care Visits		17/
ICDA 1/ Diagnoses	Data Source	Percent CA Patients	Average Number of Visits	Percent Visits to NPP	Total Required	Total Delegated to NPP	Percent Delegated	Total Required by CA
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)								
b. Active Rheumatic Fever (390-392)								
394.0 specified as rheumatic	HIS							
	AMC							
	Model.							
	CA	30	2	0	17,031	0	0	17,031
	Model.							
394.9 not specified as rheumatic	HIS							
	AMC							
	Model.							
	CA	30	1	0	90,977	0	0	90,977
	Model.							
395 Diseases of aortic valve	HIS							
	AMC							
	Model.							
	CA	10	2	0	8,807	0	0	8,807
	Model.							
R-38 Residuals	HIS							
397 Dis. endocardial struct.	AMC							
398 O. heart dis., spec. rheum.	Model.							
	CA	20	2	0	571,245	0	0	571,245
	Model.							
c. Hypertensive Disease (400-404)								
401 Essential benign hypertension	HIS							
	AMC							
	Model.							
	CA	5	2	50	1,057,697	528,848	50	528,849
	Model.							

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		11/	12/	13/	14/	15/	16/	17/
		Patients from Non-GPIM Sources			Medical Health Care Visits			
ICDA 1/ Diagnoses	Data Source	Percent CA Patients	Average Number of Visits	Percent Visits to NPP	Total Required	Total Delegated to NPP	Percent Delegated	Total Required by CA
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)								
c. Hypertensive Disease (400-404)								
402 Hypertensive heart disease	HIS AMC Model. CA Model.	10	2	25	567,090	141,773	25	425,317
R-39 Residuals 400 Malignant hypertension 403 Hypertensive renal disease 404 Hypert. heart & renal dis.	HIS AMC Model. CA Model.	10	4	0	140,388	0	0	140,388
d. Ischemic Heart Disease (410-414)								
410 Acute myocardial infarction	HIS AMC Model. CA Model.	10	8	30	1,540,149	462,044	30	1,078,105
411 O. acute & subacute forms of ischemic heart disease	NAMCS AMC Model. CA Model.	10	6	20	1,296,968	259,394	20	1,037,574
412 Chronic ischemic heart disease	HIS AMC Model. CA Model.	10	2	0	5,554,145	0	0	5,554,145

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		11/ Patients from Non-GFIM Sources			14/	15/ 16/ Medical Health Care Visits		17/
ICDA 1/ Diagnoses	Data Source	Percent CA Patients	Average Number of Visits	Percent Visits @ NPP	Total Required	Total Delegated to NPP	Percent Delegated	Total Required by CA
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-458)								
d. Ischemic Heart Disease (410-414)								
413 Angina pectoris	HIS AMC Model.							
	CA Model.	20	4	20	1,105,174	221,035	20	884,139
e. Other Forms of Heart Dis. (420-429)								
420 Acute pericarditis, nonrheumatic	HIS AMC Model.							
	CA Model.	20	3	0	171,947	0	0	171,947
421 Acute and subacute endocarditis	HIS AMC Model.							
	CA Model.	20	4	0	736,914	0	0	736,914
423 Chronic disease of pericardium, nonrheumatic	HIS AMC Model.							
	CA Model.	20	3	0	128,960	0	0	128,960
424 Chronic disease of endocardium	HIS AMC Model.							
	CA Model.	10	2	0	187,340	0	0	187,340

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		11/ Patients from Non-GFIM Sources			14/ Medical Health Care Visits			
ICDA 1/ Diagnoses	Data Source	Percent CA Patients	Average Number of Visits	Percent Visits to NPP	Total Required	Total Delegated to NPP	Percent Delegated	Total Required by CA
VII. DISEASES OF THE CIRCULATORY SYSTEM (390-459)								
e. Other Forms of Heart Dis. (420-429)								
425 Cardiomyopathy	HIS AMC Model.							
	CA Model.	10	6	0	510,927	0	0	510,927
426 Pulmonary heart disease	HIS AMC Model.							
	CA Model.	5	4	0	118,940	0	0	118,940
427 Symptomatic heart disease	HIS AMC Model.							
	CA Model.	10	4	20	1,275,543	255,109	20	1,020,434
f. Cerebrovascular Disease (430-438)								
435 Transient cerebral ischemia	HIS AMC Model.							
	CA Model.	10	3	0	22,106	0	0	22,106

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS 1/ Diagnoses	Data Source	11/ Patients from Non-GPIM Sources: Percent CA Patients	12/ Average Number of Visits	13/ Percent Visits to NPP	14/ Medical Health Care Visits: Total Required	15/ Total Delegated to NPP	16/ Percent Delegated	17/ Total Required by CA
DISEASES OF THE CIRCULATORY SYSTEM (390-458)								
g. Dis. of Arteries, Arterioles, & Capillaries (440-448)								
440 Arteriosclerosis	HIS AMC Model.							
	CA	5		20	98,263	[illegible]53	20	78,610
	Model.							
444 Arterial embolism and thrombosis	HIS AMC Model.							
	CA	10	3		31,539	3,194	10	28,385
	Model.							
446 Polyarteritis nodosa & all. cond.	HIS AMC Model.							
	CA	2	4		283	0	0	283
	Model.							
R-42 Residuals	HIS							
441 O. aneurysm, nonsyphil.	AMC							
442 O. aneurysm	Model.							
443 O. periph. vascular dis.	CA	10	2	5	23,484	1,174	5	22,310
445 Gangrene	Model.							
447 O. dis. arteries & arteriol.								
448 Dis. of capillaries								

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

ICDA 1/	MEDICAL CONDITIONS Diagnoses	Data Source	11/ Patients from Non-GFIM Sources: Percent CA Patients	12/ Average Number of Visits	13/ Percent Visits to NPP	14/ Medical Health Care Visits: Total Required	15/ Total Delegated to NPP	16/ Percent Delegated	17/ Total Required by CA
VII.	DISEASES OF THE CIRCULATORY SYSTEM (390-458)								
	b. Dis. of Veins & Lymphatics, & Other Dis. of Circulatory System (450-458)								
	450 Pulmonary embolism and infarction	HIS AMC Model.							
		CA Model.	15	3	0	65,588	0	0	65,588
	451 Phlebitis and thrombophlebitis	HIS AMC Model.							
		CA Model.	10	2	0	42,378	0	0	42,378
	R-43 Residuals (453 O. venous embolism & thromb.) (456 Varicose veins of o. sites) (457 Noninfect. dis. lymphatic channels) (458 O. dis., circulatory sys.)	HIS AMC Model.							
		CA Model.	5	3	10	29,660	2,966	10	26,694
IX.	DIS. OF DIGESTIVE SYSTEM (520-577)								
	b. Dis. of Esophagus, Stomach, and Duodenum (530-537)								
	530 Dis. of esophagus	HIS AMC Model.							
		CA Model.	5	1	5	6,162	308	5	5,854

Table 5

AMBULATORY ADULT MEDICAL CARE: CARDIOLOGY (CA)

MEDICAL CONDITIONS		11/ Patients from Non-GPIM Sources			14/	15/ 16/ Medical Health Care Visits		17/
ICDA 1/ Diagnoses	Data Source	Percent CA Patients	Average Number of Visits	Percent Visits to NPP	Total Required	Total Delegated to NPP	Percent Delegated	Total Required by CA
XIV. CONGENITAL ANOMALIES (740-759) (390-458)								
746 Congenital anomalies of heart	HIS AMC Model. CA Model.	25	2	10	682,327	68,232	10	614,095
XVI. SYMPTOMS & ILL-DEFINED CONDITIONS (780-796)								
a. Symptoms Referable to Systems or Organs (780-789)								
782 Sympt. refer. to cardiovascular & lymphatic system	HIS AMC Model. CA Model.	5	2	10	93,666	9,367	10	84,299
783 Sympt. refer. to respir. syst. (453 O. venous embolism & thromb.) (456 Varicose veins of o. sites) (457 Noninfect. dis. lymphatic channels) (459 O. dis., circulatory sys.)	HIS AMC Model. CA Model.	10	2	5	73,014	3,650	5	69,364

APPENDIX F

HOSPITAL MODEL
REFERENCE AND DELPHI PANEL DATA TABLE

Description of Column Variables in Table 6

Hospital Adult Medical Care: All data refer to the subset of the total U.S. population aged 17 years or older. Medical care requirments for the younger population are accounted for later by means of an estimated add-on.

1/ International Classification of Diseases, Adapted for Use in the United States, Eight Revision (ICDA): Currently the most commonly accepted international categorical classification system for medical diseases. Most Internal Medicine subspecialty panels utilized the "3-digit" level of aggregation (e.g. 019, 135, etc.), with occasional use of the "4-digit" level.

2/ Hospital Discharge Survey: Reference data for 15+ and all ages, as presented to CA Delphi and Modeling Panels; reference year is 1977.

3/ IM-SS Panel Estimates: Cardiology Delphi Panel estimates of true 1977 discharge rate; Modeling Panel changes are indicated in parentheses, below the corresponding IM-SS values.

4/ Percent change, 1977-1990: Panel estimates of predicted change in rate from 1977 to 1990; based on projected changes in the population, psychosocial parameters, medical practice, scientific advances, etc.

5/ Percent Seen by IM-SS: The percent of patients hospitalized in 1990 for a particular ICDA who should be seen directly or indirectly by a cardiologist.

6/ Average Length of Stay (Days): Reference data from Hospital Discharge Survey for 15+ and all ages; the average number of days that patients with a particular ICDA discharge diagnosis remained hospitalized (1977).

7/ Average Length of Stay (Days): The average number of days that adult patients seen by cardiologists for a particular ICDA accurrence should be hospitalized in 1990, according to CA Delphi Panel.

8/ Average Number of CA Visits per Day: CA Delphi Panel estimates of the average number of actual hospital visits per day that cardiologists should provide in 1990 to their patients with a particular ICDA condition.

9/ Percent of CA Visits Delegated to NPP: CA Delphi Panel estimate of the percent of all visits required by cardiologists that should be delegated in 1990 to some kind of supervised nonphysician health care provider.

10/ Total CA Visits: Computation of total number of visits required of cardiology physicians, directly or indirectly, from all sources.

11/ Total Visits Delegated to NPP: Computation of the total number of visits that the cardiologists of 1990 should delegate to nonphysician health care providers.

12/ Total Required by CA: Computation of the total number of visits that should be handled directly and solely by cardiology physicians in 1990.

Table 6

HOSPITAL ADULT MEDICAL CARE: CARDIOLOGY (CA)

Code ICDA 1/	Medical Conditions Diagnosis	Hospital Discharge Rate per 100,000 Hospital Discharge Survey 2/ 15+	Hospital Discharge Rate per 100,000 IM-SS Panel 3/ All	Hospital Discharge Rate per 100,000 IM-SS Panel 3/ 17+	Percent Change 1977-1990 4/	Percent Seen by IM-SS 5/	Average Length Stay (Days) Hospital Discharge Survey 6/ 15+	Average Length Stay (Days) IM-SS Panel 7/ All	Average Length Stay (Days) IM-SS Panel 7/ 17+	Required Medical Health Care Visits: Average Number CA Visits Per Day 8/	Percent CA Visits Delegated to NPP 9/	Total CA Visits 10/	Total Visits Delegated to NPP 11/	Total Visits Required by CA Physic 12/
III.	ENDOCRINE, NUTRITIONAL, AND METABOLIC Diseases (240-279)													
	a. Disease of Thyroid Gland (240-246)	67.2	51.4	51.4	0	20	6.9	6.9	6.9	0.5	0	64,532	0	64,532
	240 Simple goiter													
	241 Nontoxic nodular goiter													
	242 Thyrotoxicosis with or without goiter													
	243 Cretinism of congenital origin													
	244 Myxedema													
	245 Thyroiditis													
	246 Other diseases of thyroid gland													
	b. Diseases of other endocrine glands (250-258)													
	250 Diabetes mellitus	342.9	270.7	270.7	5	15	9.9	9.8	9.8	0.4	0	304,100	0	304,100
VII	DISEASES OF THE CIRCULATORY SYSTEM (390-458)													
	a. Active Rheumatic Fever (390-392)	3.1	3.8	3.0	-20	80	8.0	7.9	7.5	0.6	5	15,721	786	14,935
	390 Rheumatic fever without mention of heart involvement													
	391 Rheumatic fever with heart involvement													
	392 Chorea													

Table 6

HOSPITAL ADULT MEDICAL CARE: CARDIOLOGY (CA)

Code ICDA,1/	Medical Conditions Diagnosis	Hospital Discharge Rate per 100,000 Hospital Discharge Survey 2/ 15+	Hospital Discharge Rate per 100,000 IM-SS Panel 3/ All	IM-SS Panel 3/ 17+	Percent Change 1977-1990 4/	Percent Seen by IM-SS 5/	Average Length Stay (Days) Hospital Discharge Survey 6/ 15+	Average Length Stay (Days) IM-SS Panel 7/ All	IM-SS Panel 7/ 17+	Average Number CA Visits Per Day 8/	Required Medical Health Care Visits Percent CA Visits Delegated to NPP 9/	Total CA Visits 10/	Total Visits Delegated to NPP 11/	Total, Visits Required by CA Physic 12
	b. Chronic Rheumatic Heart Disease (393-398)	65.3	50.9	65.0	-20	80	10.9	10.8	10.5	1.0	5	794,774	39,738	755,036
	393 Diseases of pericardium													
	394 Diseases of mitral valve													
	395 Diseases of aortic valve													
	396 Diseases of mitral and aortic valves													
	397 Disease of other endocardial structures													
	398 Other heart disease, specified as rheumatic													
NOS-A		#	#				#	#				269,001	43,041	225,960
	c. Hypertensive Disease (400-404)													
	401 Essential benign hypertensive	140.6	107.1	125.0	-20	50	6.2	6.2	6.5	0.5	50	295,675	147,837	147,838
	d. Ischemic Heart Diseases (410-414)													
	410 Acute myocardial infarction	256.4	194.6	250.5	-10	100	13.4	13.4	10.5	1.2	25	5,168,711	1,292,177	3,876,534
	411 Other acute and subacute forms of ischemic heart disease	95.8	72.6	250.0	-8	90	9.3	9.3	8.2	1.1	15	3,397,335	509,600	2,887,735
	412 Chronic ischemic heart disease	793.4	602.2	685.0	-10	72.5	9.5	9.5	8.6	0.8	52	5,595,264	2,909,537	2,685,727
	413 Angina pectoris	73.4	55.4	101.5	-5	65	6.2	6.2	6.0	0.8	10	547,401	54,740	492,661

Data not available

Table 6

HOSPITAL ADULT MEDICAL CARE: CARDIOLOGY (CA)

Code / Medical Conditions	Hospital Discharge Rate per 100,000					Average Length Stay (Days)				Required Medical Health Care Visits			
	Hospital Discharge Survey 2/	IM-SS Panel 3/		Percent Change 1977-1990 4/	Percent Seen by IM-SS 5/	Hospital Discharge Survey 6/	IM-SS Panel 7/		Average Number CA Visits Per Day 8/	Percent CA Visits Delegated to NPP 9/	Total CA Visits 10/	Total Visits Delegated to NPP 11/	Total Visits Required by CA Physic 12/
ICDA 1/ Diagnosis	15+	All	17+			15+	All	17+					
e. Other forms of heart disease (420-429)													
420 Acute pericarditis, nonrheumatic	4.4	3.1	4.1	0	51	10.4	10.4	8.2	0.6	0	18,719	0	18,719
421 Acute and subacute endocarditis	4.4	3.4	4.2	0	90	26.1	28.9	25.0	0.9	0	154,752	0	154,752
422 Acute myocarditis	1.2	0.9	1.0	0	100	4.5	4.5	4.5	1.1	0	9,007	0	9,007
423 Chronic disease of pericardium, nonrheumatic	7.5	5.6	7.1	0	88	7.5	7.6	8.2	1.0	0	93,222	0	93,222
424 Chronic disease of endocardium	3.7	3.9	3.8	0	88	8.8	8.5	8.6	0.9	0	47,094	0	47,094
425 Cardiomyopathy	18.0	13.9	17.5	5	85	9.3	9.4	8.6	1.0	5	244,403	12,220	232,183
426 Pulmonary heart disease	6.2	4.7	6.2	-5	50	8.4	8.6	8.6	0.6	5	27,650	1,382	26,268
427 Symptomatic heart disease	360.9	276.5	339.0	0	55	9.2	9.1	8.6	0.8	5	2,334,062	116,703	2,217,359
429 Ill-defined heart disease	8.7	7.2	9.0	1	88	10.5	10	10.1	0.5	19	73,502	13,965	59,537
f. Cerebrovascular disease (433-436)	397.0	301.6	280	-11	26	12.8	12.8	11.4	0.2	5	191,995	9,600	182,395
430 Subarachnoid hemorrhage													
431 Cerebral hemorrhage													
432 Occlusion of precerebral arteries													
433 Cerebral thrombosis													
434 Cerebral embolism													
435 Transient cerebral ischemia													
436 Acute but ill-defined cerebrovascular disease													

Table 6

HOSPITAL ADULT MEDICAL CARE: CARDIOLOGY (CA)

Code ICDA 1/	Medical Contitions Diagnosis	Hospital Discharge Rate per 100,000 Hospital Discharge Survey 2/ 15+	Hospital Discharge Rate per 100,000 IM-SS Panel 3/ All	Hospital Discharge Rate per 100,000 IM-SS Panel 3/ 17+	Percent Change 1977-1990 4/	Percent Seen by IM-SS 5/	Average Length Stay (Days) Hospital Discharge Survey 6/ 15+	Average Length Stay (Days) IM-SS Panel 7/ All	Average Length Stay (Days) IM-SS Panel 7/ 17+	Required Medical Health Care Visits: Average Number CA Visits Per Day 8/	Required Medical Health Care Visits: Percent CA Visits Delegated to NPP 9/	Required Medical Health Care Visits: Total CA Visits 10/	Required Medical Health Care Visits: Total Visits Delegated to NPP 11/	Required Medical Health Care Visits: Total Visits Required by CA Physic 12/
d.	Diseases of Arteries, Arterioles, and Capillaries (440-448)													
440	Arteriosclerosis	62.9	48.3	63.0	-10	42.5	12.1	12.1	11.0	0.5	18	241,155	43,408	197,747
441	Aortic aneurysm (nonsyphilitic)	*	*	20.8	-5	80	*	*	12.0	0.8	0	276,127	0	276,127
444	Arterial embolism and thrombosis	26.8	20.6	26.8	-5	51	13.2	13	12.9	0.4	15	121,910	18,286	103,624
445	Gangrene	*	*	20.7	0	60	*	*	21.3	0.2	0	96,270	0	96,270
446	Polyarteritis nodosa and allied conditions	5.6	4.1	5.2	0	20	18.4	18.6	16.7	0.2	7.5	6,920	474	5,846
h.	Diseases of veins and lymphatics, and other diseases of circulatory system													
450	Pulmonary embolism and infarction	57.2	43.3	52.9	-12.5	65	13.2	13.2	12.8	0.4	22	280,290	61,663	218,627
451	Phlebitis and thrombophlebitis	107.7	81.7	94.4	0	27	10.6	10.6	10.3	0.3	16	143,303	22,928	120,375

*not judged as a separate 3-digit item

APPENDIX G

Reference Data Sources

The panelists were provided with several sources of reference data to aid them in their deliberations. In addition to the judgments of the Adult Medical Care Delphi Panel (AMC) and the Modeling Panel, they were provided with data from a number of studies.

The Health Interview Survey (HIS) provides national data on the incidence of illness and accidental injuries, the prevalence of diseases and impairments, the extent of disability, the utilization of health care services, and other health related topics. The interviewees of this study are the patients themselves or their immediate family members. Because of technical and logistical problems several segments of the population are not included in the study. Persons excluded are: patients in long-term care facilities for the handicapped; persons on active duty with the Armed Forces; and persons who have died during the calendar year preceding the interview. The result is that the HIS data somewhat underestimate levels of disability and health services utilization when the total population is considered. Although the effect on cardiology may be minimal, it should also be noted that there is severe underreporting of certain diseases such as mental illnesses, venereal diseases and cancer in the HIS data. This latter problem stems from varing prevalence estimates of patients as opposed to physician reported measures. Previous studies have indicated that patients often do not know, or deliberately hide the precise diagnosis of their condition.

The Standards for Good Medical Care (Schonfeld) survey utilized peer judgments by a sample of physicians concerning various aspects of standards for good medical care. These judgments pertained to contacts and encounters in relation to location such as office or hospital, the number and purpose of the visits as well as the required hospitalization days and desirable specialist referrals. An important aspect of the study is that it focuses on what should be the standards for good medical care rather than on the present situation as it exists. Schonfeld data having particular relevance to cardiology include norms of care and the percentage of patients which should be referred to the specialty from the generalist within one year. Several limitations of the study should be noted. A serious deficiency of the study is that only 242 diseases were studied. As a result, there were no data for many of the ICDA codes considered by the panelists. A related disadvantage for these deliberations resulted from the variations in the specificity of the disorders considered. Sometimes the Schonfeld study used 4-digit ICDA, sometimes a 3-digit, and at still other times a composite across the entire classification system was used. The study specified 87 referral specialties and subspecialties. Still another limitation of the Schonfeld study is the relatively small sample of primary physician internists interviewed. The median number of judges across all adult diagnoses was less than two.

The Hospital Discharge Survey (HDS) produces statistics that are representative of the experience of the U.S. civilian population discharged from short-term hospitals. The survey provides information on the characteristics of patients, the lengths of stay, discharge diagnoses and surgical operations and patterns of use of care in hospitals of different size and ownership in the four regions of the country. The scope of the HDS is limited to discharges from non-Federal hospitals in the 50 States and the District of Columbia. Only short-stay hospitals with six or more beds and an average length of stay for all patients of less than 30 days are included in the study. A serious limitation of the study is that only discharge diagnoses are listed when in actual practice there may have been many diagnostic impressions of a patient during his hospitalization, each of which may have required one or more visits from the subspecialist. Therefore use of the HDS as reference implicitly assumes that the Delphi panelists were able to link discharge diagnoses with those diagnostic impressions subsumed in that hospital stay.

The American Medical Association data on Profiles of Practice are based upon questionnaire responses to 11,121 non-Federal office-based patient care physicians. Data were collected from October 1975 to February 1976 on work patterns and practice characteristics of physicians. The data taken from the AMA survey relate to the questions on the productivity of physicians in both the ambulatory and hospital models. A serious limitation of the data source stems from the fact that the response rate of the survey was only about 50 percent. It has been hypothesized that the less busy physician is more heavily represented than the busier one. The data may, therefore, indicate a lower productivity rate than would be true if the sample were truly representative of the total physician population.

University of Southern California, Cardiology Practice Study Report (Mendenhall) is one study of a series that was conducted under contract to the Health Resources Administration. The reports describe the professional activities of the subspecialist on a national basis. The studies which present information describing patient volume, the specific characteristics of physician/patient encounters and the organization to the subspecialty practices are based upon responses to a log-diary survey. Several limitations of the Mendenhall data should be noted. There is a potential for observational bias, the extent of which is unknown. There is an undetermined number of diagnoses that were not reported in the study, and the possibility exists that this may represent selective reporting on the part of the respondents rather than an occasional (random) failure to report data. There is also a possibility that the time of year that the study was conducted may have an effect on the results. A further limitation of the data is that the estimates are only for the physician while at work. No adjustment was made for those who are on vacation or otherwise not professionally active which may reasonably be expected to be about 8 to 10 percent.

The National Ambulatory Medical Care Survey (NAMCS) is a national probability sample survey conducted annually by the National Center for Health Statistics to explore the provision and utilization of ambulatory care in the physician's office. It was designed and developed from 1966-1972 by a number of organizations and individuals in the medical

community, the staff of NCHS and contractors with acknowledged expertise. The survey is performed on a sample of physicians in non-Federal, office-based practice and therefore do not include encounters taking place in the patient's home, in hospitals, nursing homes, or other institutional settings. In addition, care provided by the physician on the telephone is not included. All specialties are included except the hospital-based specialties of anesthesiology, pathology, and radiology.

The questionnaire requests information from the provider on the following: date of visit; age; sex; race of patient; patient's principle diagnosis whether acute or chronic, initial visit or follow-up, well care, family planning, counseling, referral, etc.; physician's principal diagnosis services rendered (18 categories listed); disposition of visit (eight categories listed), and duration of visit.

In 1977, of the 3,069 physicians who were eligible for the study, 80.5 percent responded. A total of 570.5 million office visits were reported. An estimate of 10 million extrapolated visits has a relative standard error of 7.5 percent (standard error of 750,000 visits).

When extrapolated nationally, NAMCS visit rates to physicians appear lower than HIS visit rates because they exclude telephone, clinic, hospital and emergency room visits. However, in designating the specialty of the physician, NAMCS data are probably more accurate, because the provider rather than the consumer (who must rely on recall in filling out the questionnaire) supplies the information.

In the Delphi, panel members may use NAMCS data in estimating the percent of patients with need requiring medical care in an ambulatory setting that should accrue to a particular specialist and in developing norms of care per condition. NAMCS data provide current estimates on the percent of ambulatory visits made to a particular specialist, to help in the former estimation and average number of visits made for specific conditions to assist in the latter.

APPENDIX H

Algorithm developed by GMENAC staff for calucation of total nondelegated visits from two tracks as indicated by figure II.

1819.54* x 3 x (*1+4) x 5 x 7 x 8 x 9 x (*1-10) = total nondelegated visits from GFIM, Tg 1/

8 x *1-11 x 12 x (*1-13) = total nondelegated visits from non-GFIM sources, Tn

Tg + Tn = V, total nondelegated visits required by cardiology, column 17 of Table 5.

As indicated, the number of visits accruing to cardiologists from non-GFIM sources represents a percentage of the total number of visits, rather than a percentage of the visits from generalist.

Although simpler, the algorithm for hospital based visits (Table 6) is fundamentally the same as that for ambulatory visits:

1819.54* x 3 x (*1+(4)) x 5 x 7 x 8 - (x(9))

1/ Numbers without asterisks refer to columns of Table 5 and 6 (hospital model). The number 1819.54 is the 1980 U.S. population 17 years and above in hundreds of thousands. Columns 3 x 4 x 5 x . . . 8 give morbidity in rate units. By multiplying the results of these columns by the population figure, rate is converted into actual cases of disease.

APPENDIX I

PREDICTION OF CERTIFIED ADULT CARDIOLOGISTS

1980 - 1990

Year	Certified Adult Cardiologists (Predicted)	July 1 Graduates	Attrition (2%)	December 31 Total (Predicted)
1980	4,500	+700	90	5,110
1981	5,110	+700	102	5,708
1982	5,708	+700	114	6,294
1983	6,294	+700	126	6,868
1984	6,868	+700	137	7,431
1985	7,431	+700	149	7,982
1986	7,982	+700	160	8,522
1987	8,522	+700	170	9,052
1988	9,052	+700	181	9,571
1989	9,571	+700	191	10,080
1990	10,080	+700	202	10,578

Source: American College of Cardiology, Ad Hoc Manpower Advisory Committee

U.S. GOVERNMENT PRINTING OFFICE 1981-0- 523-507/150

U.S. DEPARTMENT OF
HEALTH AND HUMAN SERVICES
Public Health Service
Health Resources Administration

DHHS Publication No. (HRA) 82-617 October 1981