GMENAC: Its Manpower Forecasting Framework

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Abstract: The Graduate Medical Education National Advisory Committee (GMENAC) was an advisory group to the Secretary, US Department of Health and Human Services. Its charter ended September 30, 1980. It submitted 107 recommendations to achieve a better balance between future physician requirements and future physician supply, by specialty and geography. Among its contributions were the development of a manpower forecasting framework and series of models which are described here, together with the results of these models. These models may have significant utility in future human resource planning at both national and local levels. (*Am J Public Health* 1981; 71:1116–1124.)

Introduction

The Graduate Medical Education National Advisory Committee (GMENAC) was chartered by the Secretary, Department of Health, Education and Welfare [now the Department of Health and Human Services (DHHS)], for the period April 20, 1976 through September 30, 1980. The purpose of the committee was ". . . to analyze the distribution among specialties of physicians and residents and to evaluate alternative approaches to ensure an appropriate balance . . ." Among several assigned functions to accomplish that purpose, it was instructed to ". . . make recommendations to the Secretary on overall strategies on the present and future supply and requirements of physicians by specialty . . . ; (and) translation of physician requirements into a range of types and numbers of graduate training opportunities needed to approach a more desirable distribution of physician services . . ."[1]

The committee consisted of 19 to 22 members, three of whom were federal ex-officio members. The remainder, appointed by the Secretary, held various private sector positions in clinical and academic medicine, nursing, law, hospital administration, economics, and insurance. Fifteen of the 22 members who served at the completion of the charter period were physicians.

GMENAC conducted extensive research and analytic activities, consulted with many individuals and organizations, and published numerous interim reports on its progress.[2–15] Its early history has been described previously by Holden.[16] Its final report contained in seven volumes was submitted to the Secretary on September 30, 1980.[17–23] It contained 107 recommendations and over 800 pages of analysis and supportive materials. The DHHS will likely produce 15 or more additional reference volumes on the GMENAC work over the next year. The magnitude of the GMENAC effort is reflected in the facts that over 300 consultant experts assisted it in its work, a full time staff of over 20 people was devoted to its day-to-day work, and its total budget from inception to completion was over $5 million.

The committee was organized into five working groups, called Technical Panels, addressing issues in manpower modeling, financing, nonphysician providers, the educational environment, and geographic distribution. Each of these panels submitted an extensive report detailing its activities and recommendations.[18–22]

The Technical Panel on Modeling developed an analytic framework and series of manpower models, a description of which is the basis of this report. The major emphasis will be a description of a new model for forecasting future requirements for physicians, by specialty and subspecialty. The other models and their uses will be described briefly. This paper illustrates the implementation of the generic requirements model and the results in a more succinct manner than the other GMENAC reference documents.

GMENAC Modeling Framework

Figure 1 shows the relationship between the current and future supply of physicians and trainees and the counterbalancing future requirements for physicians based on the needs of the population for services in the target year 1990. GMENAC's purpose was to determine future physician manpower requirements, as shown on the left side of the scale in Figure 1, and to recommend policies that would keep the future supply of physicians, as shown on the right side, in reasonable balance with those requirements. In developing and implementing the modeling framework, GMENAC's staff and Technical Panel on Modeling developed three

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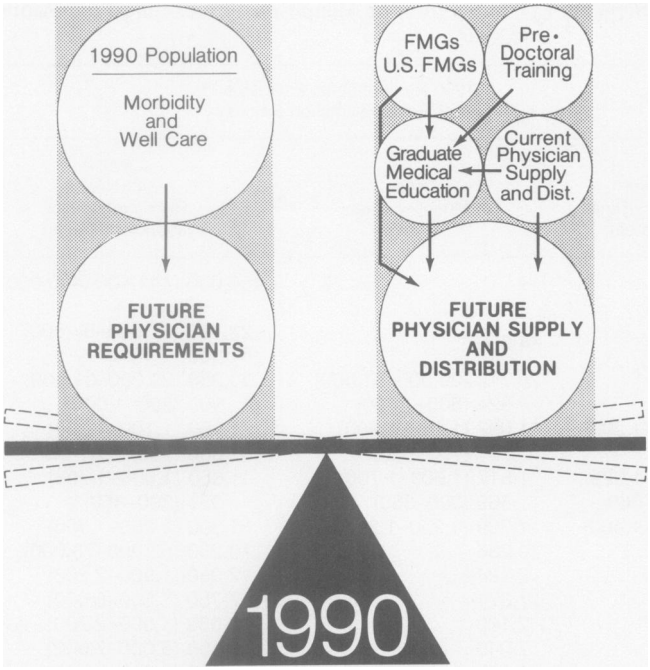


FIGURE 1—GMENAC Analytic Framework: What Balance between 1990 Physician Supply and 1990 Physician Requirements?

SOURCE: Figure adapted from GMENAC Summary Report, page 55, Figure 4.[17]

mathematical models—the supply model, the graduate medical education (GME) model, and the requirements model.

The Supply Model

The supply side of the scale in Figure 1 poses complex enumeration problems, but generally data on the current (or very recent) numbers of predoctoral and postdoctoral trainees, foreign medical graduates (FMGs), graduate medical education (GME) positions, and practitioner supply and attrition rates are available and reasonably accurate. The difficult problem is to estimate the future supply of physicians by specialty and subspecialty since so many conditional forces are at work to alter the future supply, including the force of GMENAC's own recommendations. The future balance will be affected by the answers to such questions as: Will medical and osteopathic school enrollments expand or contract if Congress terminates capitation support? Will individual states expand their medical or osteopathic training capacities without respect to the national supply balance? Will Congress open the immigration flood gates to alien foreign medical graduates if more hospitals experience substantial disruptions in services? Will even greater numbers of United States citizens seek medical training opportunities in the growing number of offshore medical schools? Will the primary care tracks in internal medicine and pediatrics and the popularity of family medicine training programs fade under the pressures of expanding technology, greater sophistication of the population, and perpetuation of the reimbursement disincentives? Many similar questions suggest that it is hazardous and perhaps even foolhardy to project the future of various specialists in face of such uncertainty. Ultimately, it is anybody's guess how the various market forces, differing state and federal policies, foreign medical school entrepreneurship, changing career preferences of students, and other factors will meld to impact on the future physician supply. And yet, that may not be the pertinent question, except from the viewpoint of the traditional planners.

Traditional planners in the past have made future supply projections based on "what if" sorts of questions. What will happen to the future supply of specialty "x" if a certain grant program is altered, all else being held constant? Given a continuation of the status quo, what will be the future supply of subspecialty "y"? Politicians and planners have begun only recently to consider targeted planning or management by objective. In such an approach to manpower planning, the pertinent questions are: How many specialists "x" and subspecialists "y" are required to meet all or a given per cent of the health service needs of the population? The next question would be: How many of each provider do we have now? And the third question would be: What changes are needed in current training rates or immigration policies to meet our objective? GMENAC's recommendations grew out of the latter approach.

GMENAC also dealt with the traditional approach. Thus, on the supply side of Figure 1, GMENAC developed a model to project the future supply of specialists and subspecialists based on alternative assumptions about the myriad forces generating that supply. Policymakers may choose a set of assumptions they consider most likely and the supply model will show what the physician supply would be if those assumptions were to prevail. At the same time, the supply projection model can show what variables may be changed, at what rates, and in what combinations to achieve a predetermined supply (i.e., requirement) and distribution of physicians among the specialties. In this case, the supply model permitted GMENAC to recommend certain combinations of medical and osteopathic residency training positions and numbers of immigrants which, when added to current supply (minus deaths and retirements), would achieve a prescribed balance with need or requirements for specific physicians' services in the target year.

The GMENAC supply model is straightforward and will not be described further in this report. Its development has been documented elsewhere[10] and a complete report on the supply model is available from the former GMENAC staff office.* The future supply projection figures derived from the supply model and considered most likely by GMENAC are shown in Table 1.

The GME Model

Another GMENAC model is the graduate medical education (GME) model. The GME process is complex, in part because each trainee has multiple routes that can be fol-

*Office of Graduate Medical Education, Health Resources Administration, DHHS, 3700 East-West Highway, Hyattsville, MD 20782.

Table 1—GMENAC's Specialty-Specific Physician Supply and Requirements Estimates from its Manpower Forecasting Framework and Models

	Supply Estimates*		1990 Requirements Estimates Three Level Estimation Process		
	1978	1990**	Level-1 Delphi Panel (Implicit)‡	Level-2 Modeling Panel (Range)	Level-3 GMENAC's Recommendation Midpoint (Range)
All Physicians	374,800	535,750	—	—	466,000 (441,400–490,050)
Specialties Modeled					
Osteopathic General Practice	13,550	23,850	(a)	84,000	22,700 (81,000–87,000)
General/Family Practice	54,350	64,400	(a)		61,300
General Pediatrics	23,800	37,750	38,965	28,712 (29,000–31,500)	30,250 (29,000–31,500)
Pediatric Allergy	450	900	3,234	924 (800–1,000)	900 (800–1,000)
Pediatric Cardiology	600	1,000	1,133–1,298	1,092 (1,100–1,200)	1,150 (1,100–1,200)
Pediatric Endocrinology	N/A	250	899	791 (700–850)	800 (700–850)
Pediatric Hematology-Oncology	N/A	550	1,856–1,929	1,617 (1,600–1,700)	1,650 (1,600–1,700)
Pediatric Nephrology	N/A	200	290–369	369 (300–350)	350 (300–350)
Neonatology	N/A	700	1,158–1,460	1,309 (1,250–1,350)	1,300 (1,250–1,350)
General Internal Medicine	48,950	73,800	(a)	70,236	70,250 (65,000–75,000)
Allergy and Immunology	2,100	3,050	2,327	2,124	2,050 (1,900–2,200)
Cardiology	7,700	14,900	7,408	7,371	7,750 (7,500–8,000)
Endocrinology	1,400	3,850	3,126	2,129	2,050 (1,900–2,200)
Gastroenterology	2,900	6,900	8,700	7,040	6,500 (6,000–7,000)
Hematology-Oncology	3,000	8,300	9,312	9,073	9,000 (8,900–9,100)
Infectious Diseases	850	3,250	3,661	1,936	2,250 (2,000–2,500)
Nephrology	1,450	4,850	3,931	2,120	2,750 (2,500–3,000)
Pulmonary Diseases	2,800	6,950	3,611	3,606	3,600 (3,500–3,700)
Rheumatology	1,000	3,000	1,514	1,476	1,700 (1,500–1,900)
Dermatology	5,000	7,350	12,762	6,952	6,950 (6,700–7,200)
Psychiatry (General)	25,250	30,500	43,000	38,890	38,500 (37,000–40,000)
Child Psychiatry	3,050	4,100	10,320	8,000–10,000	9,000 (8,000–10,000)
Obstetrics-Gynecology	23,100	34,450	26,164	22,701	24,000 (23,000–25,000)
General Surgery	30,700	35,300	24,514	23,097	23,500 (23,000–24,000)
Neurosurgery	3,000	5,100	2,496	2,793	2,650 (2,500–2,800)
Ophthalmology	11,750	16,300	14,688	11,396	11,600 (11,400–11,800)
Orthopedic Surgery	12,350	20,100	19,688	14,821	15,100 (14,700–15,500)
Otolaryngology	6,100	8,500	9,732	7,779	8,000 (7,900–8,100)
Plastic Surgery	2,600	3,900	3,113	2,549	2,700 (2,550–2,800)
Thoracic Surgery	2,100	2,900	1,781	1,942 (2,000–2,100)	2,050 (2,000–2,100)
Urology	7,100	9,350	8,383	7,900	7,700 (7,500–7,800)‡‡
Emergency Medicine	5,000	9,250	14,686	13,000–14,000	13,500 (13,000–14,000)
Preventive Medicine (b)	6,100	5,550	6,810–8,410	6,010 (6,000–7,000)	7,300 (6,800–7,800)
Specialties Not Modeled					
Anesthesiology	14,850	19,450	—	19,000–23,000	21,000 (19,000–23,000)
Nuclear Medicine	N/A	N/A	—	3,500–4,500	4,000 (3,500–4,500)
Pathology	12,650	16,850	—	14,000–15,000	13,500 (12,000–15,000)
Physical Medicine and Rehab.	2,000	2,400	—	2,400–4,000	3,200 (2,400–4,000)
Radiology	18,550	27,800	—	15,500–17,000	18,000 (17,000–19,000)
Neurology	4,850	8,650	—	4,000–6,000	5,500 (5,000–6,000)
All other and unspecified	14,000	9,700	—		— —

*Includes 0.35 of all residents in training.

**Considered most likely by GMENAC (See ref. 17, pp 11–12).

‡None of the Delphi Panels were asked to vote adoption of a numerical estimate of physician requirements in 1990. These figures were derived by integrating separate judgments about each parameter, as developed in the Generic Model by the respective Delphi Panels.

‡‡Upper limit cited as 7,700 in GMENAC Summary Report (p4)[17] and 7,800 in Modeling Panel Report (p191).[18]

(a) The Adult Medical Care Delphi Panel was not asked to consider the proportion of general adult medical care to be rendered by internal medicine subspecialists or pediatricians nor did it distinguish the proportion of care to be rendered by general/family practitioners vs general internists. Its estimate of morbidity visits required in 1990 by the over age 17 population from all general care physician providers was 1,399,767,366. The panel did not specify how many morbidities, on the average, would be handled at each visit (simultaneity factor). It estimated annual productivity for family practitioners in 1990 to be 6,900 ambulatory encounters, and for general internists 3,600 encounters. The Modeling Panel reduced the morbidity visits to 971,766,419, and reduced the expected productivity to 5,520 for general internists and raised it for family practitioners to 3,680 ambulatory encounters (Table 111.A.3, page 34, Modeling Panel Report).[18]

(b) Preventive Medicine was partially modeled by GMENAC, but not based on the generic model. GMENAC recommended that preventive medicine be examined more carefully by a GMENAC successor body.

NA. Not available.

lowed to reach specialty and subspecialty practice. Once in practice, physicians may change specialty either through continuing medical education courses or by reentering the GME process.

Holden and Levit have described career migration of physicians,[24] but prior to the development of the GMENAC GME model, there had not been a study of all the pathways that physicians had actually followed to reach a given self-described practice specialty at a point in time. GMENAC's GME model is derived from a detailed analysis of the training histories of 112,610 physicians who graduated from medical school between 1961 and 1975. The GME model permitted GMENAC to deal with the number and mix of GME positions by year of training from two directions: it can specify what the supply of GME positions by year of training and by specialty must be in order to yield a desired mix of practitioners at any future point in time; or it can show the practitioner supply that will result in the future from a given mix of GME positions and number of entrants to GME over the intervening years, with or without changes in certain policy variables that impact on the training process.

The GME model was developed by Jacoby[25] and Hunt[11] with the assistance of several contractors.[10, 12] The results from the GME model are incorporated in the specialty specific supply projection figures given in Table 1. Jacoby has described elsewhere its potential use by policymakers,[25] and it will not be dealt with any further in this paper.**

Physician Manpower Requirements Model

The steps in the operation of the GMENAC requirements model include: 1) development of assumptions by GMENAC about the future role of each specialty in the health care delivery system; 2) constitution by GMENAC of an advisory panel of experts in each specialty, called Delphi panels; 3) assembly by staff of briefing books for each specialty, containing all available data on the content of the specialty and characteristics of the practitioners in the specialty; 4) convening of the Delphi panels to review the data and make necessary adjustments to the data or synthesize new "data outputs" for use in the model; 5) operation of the model by staff and presentation of the model results to the GMENAC Modeling Panel; 6) adjustments of the model results by the Modeling Panel and development of its recommendations to the full GMENAC committee; 7) discussion of the Modeling Panel's recommendations by the full GMENAC in the presence and with the participation of Delphi panel representatives, specialty society representatives and the public; and 8) adoption by GMENAC of its physician requirements estimates and policy recommendations to move closer toward the achievement of a better balance of physicians.

As a starting point in developing and applying its requirements forecasting model, GMENAC made the following assumptions. Physician manpower requirements should be based on an assessment of the total burden of disease and disability in the target year 1990, for all people, and should also include that amount of well person or preventive services currently thought to be efficacious. The standards of quality should be based on the combined judgments of consumers and skilled practitioners from several disciplines and what they believe should be the standards for good—not utopian—medical care in 1990. Such standards should not be compromised on the basis of practice arrangements, care setting, or geographic location. The cost of obtaining services or other economic access barriers should not be a constraint on the definition of what is needed. Over- or inappropriate utilization or prescription of services should be prevented by strict peer review and utilization review mechanisms while public and patient education programs would be intensified and promote the consumption of needed and efficacious services. The competencies of providers would be assured by nearly all medical graduates entering the board certification process through properly reviewed and accredited training programs. Providers would practice more narrowly within the confines of their specialty or subspecialty and area of training. The educational environment would serve to attract and foster the development of a mix of physician specialists in the numbers needed and with geographic preferences that match more closely the needs of various geographic areas. While technological developments and breakthroughs will occur, only those close to widespread implementation should be considered but continuous reassessment of these developments must be built into an ongoing monitoring process. These and other conditional assumptions are addressed by GMENAC in its interim and final reports.[8, 17–23] If the assumptions prove to be inaccurate with the passage or time, then GMENAC recommends that its successor body repeat the operation of the model in the light of the altered variables.

The intent of GMENAC was to develop the first generation of requirements models that are comprehensive in terms of capturing all that all physicians do or should be doing, can be applied uniformly to specialties and subspecialties that deal with similar tasks and units of output, permit the identification and inclusion of unmet needs of underserved populations, can highlight preventive and well person care and services, and yield unduplicated counts of physicians required to deliver specific quanta of serivces.

The committee has variously referred to its model as a *needs* based model, an *epidemiology* based model, an *adjusted* needs based model, or a *generic* model. Whichever name is used, the two key features of the model are: 1) that the physician manpower requirements are related to the incidence and prevalence or *epidemiology* of disease, and, 2) through a three-tiered evaluation process, the GMENAC model and process *adjust* the manpower requirements estimates developed strictly on the basis of need to conform with what the committee believes is achievable, reasonable, and likely to be employed or utilized in 1990. The adjustment process is described more fully later on.

Although it was not adopted, Roddy presented to GMENAC in October 1977, the first generation, epidemiol-

**The GME model derivation and specification documents are available from the Office of Graduate Medical Education, Health Resources Administration, DHHS 3700 East-West Highway, Hyattsville, MD 20782.

ogy based manpower requirements model.[2, 26] It was based in part on earlier models developed by Lee and Jones in 1933[27] and Schonfeld, *et al*, in 1972.[28-29] The existing GMENAC Generic Model is more complex than the earlier ones, and surfaces many more variables that impact on physician manpower requirements.

Central to the operation of the Generic Model are the Delphi Panels of experts, generally a separate panel addressing each specialty or group of closely related specialties. Panelists were selected by GMENAC from nominees submitted by national organizations. On the average, each panel contained three to five experts in the specialty being modeled, along with complementary specialists from overlapping or referral specialties, and nonphysician providers involved in the specific field of care, e.g., a nurse midwife on the obstetrics-gynecology Delphi panel. In one case, a consumer advocate was also a panelist. The average panel size was eight to ten people.

The Delphi panels were convened by one or two GMENAC members, usually for two, two-day sessions. (One panel met five separate times.) The panels rendered professional judgments through a consensus building technique about a host of variables for which valid empirical evidence did not exist or was subject to challenge.

Prior to the first meeting of each Delphi panel, GMENAC staff assembled in workbooks all the epidemiological data available—international, national and local—on the morbidities and other types of care generally rendered by the practitioners in each specialty and subspecialty. Data on the practice and demographic characteristics of physician specialists were also included.

Figure 2 illustrates the GMENAC generic requirements model. The top section of the figure depicts the decision points: P1 . . . . . P5 for the Delphi panels of experts in each specialty and subspecialty. These points are represented by separate sections in the workbooks presented to each panel. Figure 2 also depicts the key mathematical steps and examples of the data bases used in the Generic Model. Shown in the lower section is a sample implementation work sheet from one of the Delphi panel of experts.

The GMENAC model is called a generic model because its basic structure is applied to all of the clinical specialties. The specialties to which it has been applied include: pediatrics and six of its subspecialties; family and general practice; internal medicine and its ten subspecialties; obstetrics-gynecology; dermatology; emergency medicine; psychiatry and child psychiatry; and the eight surgical specialties for which primary boards exist—thirty-one specialties and subspecialties. The other major specialties for which certification boards exist are pathology, preventive medicine, neurology, radiology, nuclear medicine, anesthesiology, and physical medicine and rehabilitation. GMENAC did not fully model these specialties and recommended their further study by a successor group. Within the osteopathic profession, GMENAC did not consider manipulative therapy apart from general practice.

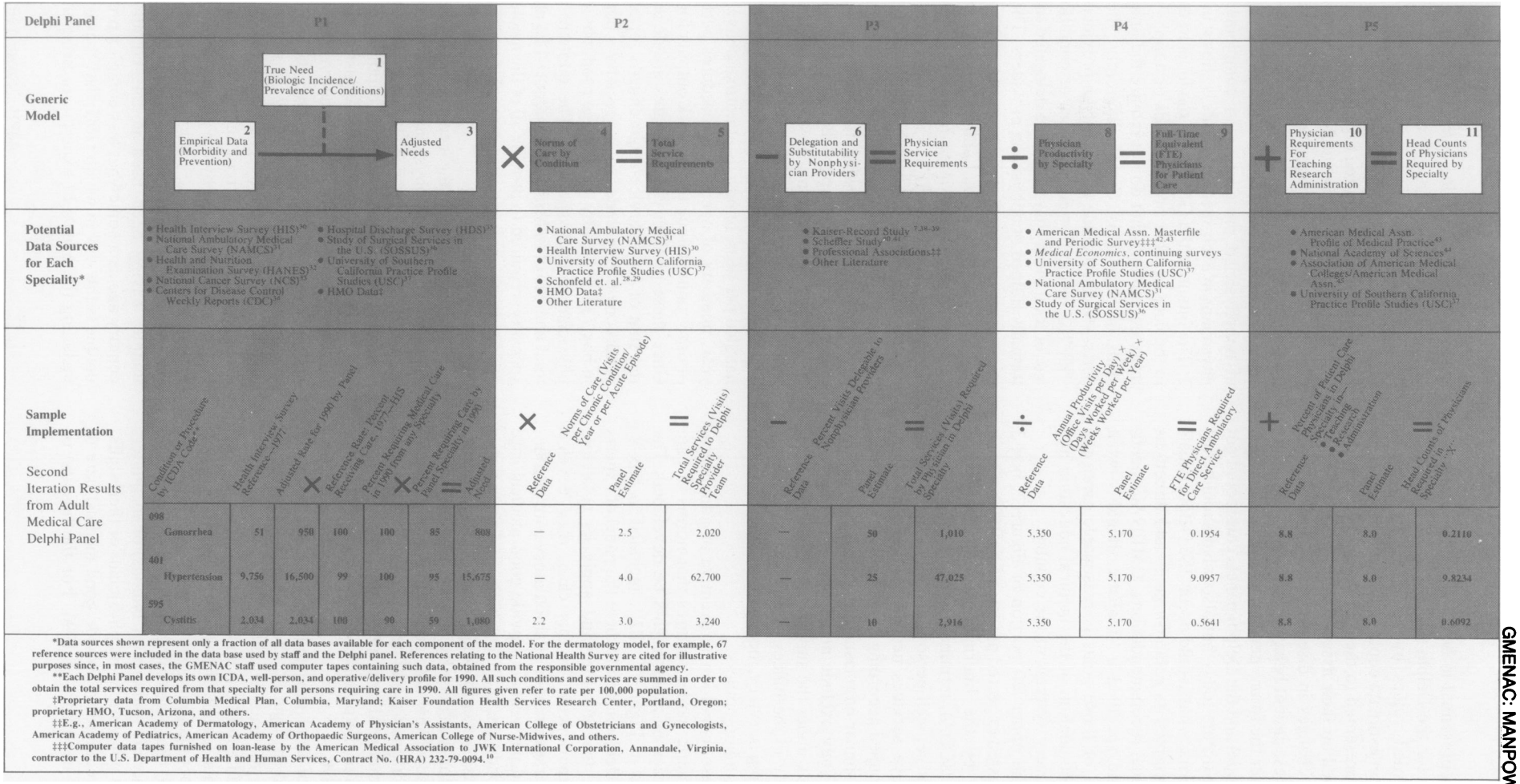
The GMENAC epidemiology based model, as shown in Figure 2, begins with a representation of "true need" for health services, denoted by the box numbered 1 in the upper left portion of the figure. At this stage in the model, the objective is for the Delphi panelists to focus on an intellectual representation of all of the health care needs, including preventive and administrative services, of the entire population of the country—both the "haves" and the "have-nots."

The definition of need is any disability or morbidity which renders an individual unable to pursue the "normal" activities of life, or any condition for which medical services are recognized as effective and beneficial to the well-being of the individual (e.g., venereal disease contact investigation or other screening for latent or suspected disease), or any preventive or rehabilitative services that would likely assure maintenance of existing health status, avoidance or postponement of deterioration of existing health status or restoration of functions or sense of well-being lost through previous adversity. The model recognizes "true need" as an abstract quantity, existing "in the mind of the beholder," and this is denoted in Figure 2 by a dotted line connecting true need to the solid line from box 2, "empirical data." An attempt is made at this stage of the process to give expression to the concept that the practice of medicine and, to some extent, the provision of medical or health services, represents an art rather than a pure science—services may be sought or demanded by people for a variety of reasons other than failing physical health. "Functional bowel disturbances," for example, may be a result of social or economic forces quite apart from specific organic diseases. The role of the physician in such circumstances is to listen, examine, and render a judgment that social services—if available—will more adequately "cure" the patient's or client's problem than specific medical intervention.

Box 2 in Figure 2, labeled "Empirical Data," represents the data sources GMENAC has examined and presented to the expert panels. These data are used in the model as surrogates for estimates of "true need." They are generally national prevalence and incidence estimates for specific diseases, conditions or practices (e.g., contraception uses), and represent the best quantitative estimates available.

In Figure 2, boxes 1 and 2 lead to box 3, labeled "Adjusted Needs". The point "P1" in the model, noted at the top of the Figure, represents the immersion of the Delphi panel in assessing the data and generating figures through a consensus building process for inclusion in the implementation table, shown at the bottom of Figure 2.

The panels debated the adequacy, relevancy, and accuracy of the data for their specialties and recommended adjustments when necessary. They also "synthesized" data based on their collective knowledge and experiences if national data did not exist. Each Delphi panel organized the data on the universe of diseases and conditions into "packages" that it believed represent the spectrum of conditions dealt with by that specialty or subspecialty in the base year and as the specialty *should* develop through 1990. Changes in technology, treatment modalities, patient preferences, and other factors that affect the epidemiology of disease, care-seeking behavior, and provision of care were among the types of questions faced by the panels of experts at this juncture. The results of the deliberations of all Delphi experts in each specialty were recorded in their workbooks.



*Data sources shown represent only a fraction of all data bases available for each component of the model. For the dermatology model, for example, 67 reference sources were included in the data base used by staff and the Delphi panel. References relating to the National Health Survey are cited for illustrative purposes since, in most cases, the GMENAC staff used computer tapes containing such data, obtained from the responsible governmental agency.

**Each Delphi Panel develops its own ICDA, well-person, and operative/delivery profile for 1990. All such conditions and services are summed in order to obtain the total services required from that specialty for all persons requiring care in 1990. All figures given refer to rate per 100,000 population.

‡Proprietary data from Columbia Medical Plan, Columbia, Maryland; Kaiser Foundation Health Services Research Center, Portland, Oregon; proprietary HMO, Tucson, Arizona, and others.

‡‡E.g., American Academy of Dermatology, American Academy of Physician's Assistants, American College of Obstetricians and Gynecologists, American Academy of Pediatrics, American Academy of Orthopaedic Surgeons, American College of Nurse-Midwives, and others.

‡‡‡Computer data tapes furnished on loan-lease by the American Medical Association to JWK International Corporation, Annandale, Virginia, contractor to the U.S. Department of Health and Human Services, Contract No. (HRA) 232-79-0094.[10]

FIGURE 2—GMENAC Generic Requirements Model, Illustrative Data Sources and Sample of Implementation Results by a Delphi Panel

These results are represented in box 3—"adjusted needs". A median estimate for the Delphi panel was obtained from anonymously recorded values by each panelist on each variable. The median estimate could result from adoption of the reference data presented to them or deviations from the reference rates based on their assessment of their accuracy or expectations of changes in disease profile, treatment or preventive modalities, patient behavior, or any other factors they believe will alter the future need for physician services.

The generic model and the Delphi panels considered not only what exists or occurs today but also what should exist in 1990. By considering what should occur, the Delphi panels and GMENAC attempted to establish goals and directions for change. In its final recommendations, GMENAC identified these goals and specified a "realistic should"—what level of attainment of those goals is reasonable given the complexities and momentum of the medical education and health services delivery systems of the country.

Returning to the upper left portion of Figure 2, box 3 symbolizes the adjusted expected prevalence in 1990 of each disease, described by the International Classification of Diseases, Adapted (ICDA), terminology and code.[46] It also includes the preventive, well-person, and other medical and related administrative services needed by the population. These needs are grouped according to the specialty or group of specialties with similar emphasis that should provide the required services. They exclude needs that have not traditionally been directly under the supervision of physicians or provided exclusively in the offices of physicians—e.g., social services, nursing services, occupational therapy, and audiology services, among others.

For each disease, condition, preventive or administrative service the generic model requires that norms of care and service intensities or requirements be developed. The process is reflected in Figure 2 "P2", included in box 4. "P2" is the second decision point where the panel of experts is asked to assess the literature and apply its collective knowledge and experiences. In this case, they develop estimates of the average number of ambulatory care encounters (visits) required per year to provide good medical care for each chronic condition, by ICDA code, and the number of encounters (visits) per episode for each acute condition. When appropriate for the specialty under consideration, the Delphi panelists also review data on hospital admission and discharge rates by diagnosis, and operative rates by name of procedure, and recommend reasonable rates for each consistent with the needs of the population and standards of good medical care for 1990.

The product of total adjusted needs (e.g., cases per 100,000 population) in Figure 2, box 3 and norms of care (e.g., annual visits for each condition) in box 4 at "P2", when summed for all conditions and procedures, yields total service requirements for all diseases, conditions and well care by the target population, from the specialty at hand, as reflected in box 5. For the ambulatory care sector, the product will be generally millions (or billions) of encounters between the patient population and physicians or their staffs, in each specialty, required to provide good medical care to everyone who will need care in 1990. For the hospital or other institutional service component of box 5, the product of prevalence or incidence of conditions or operative procedures and norms of care per population unit will be expressed as thousands or millions of operations, deliveries, or hospital-day visits required for the entire population in 1990.

Having obtained the total service requirements by specialty, for the entire population needing care in 1990, the model next subtracts from total services those services that should be delegated to or provided by the various categories of nonphysician providers who complement the work of physicians in each specialty. This is shown in box 6 of Figure 2. The intent of the GMENAC model is to delegate or leave to the care of other professionals or nonphysician providers those encounters that do not require the unique training and skills of physicians. Stated differently, the panels of experts—which include nonphysician providers—are asked at "P3" to specify for each disease or condition, the percentage of total visits that should be delegated to or provided by formally trained nonphysician providers. These units of care are subtracted from the total units of service required (box 5) and the difference is total units of care that require specific services by physicians in each specialty, box 7.

The generic model, in Figure 2, box 8, illustrates the productivity estimates developed for each specialty by its panel of experts, "P4". A modified Delphi process is used again and, after reviewing trends and current data from multiple sources, the specialists are asked to estimate how the average physician in that specialty will distribute his/her time among direct and indirect patient care activities in 1990. The units might be thousands of office visits that can be handled per year, hundreds of normal deliveries assisted per year, numbers of operative procedures performed per year or other units unique to the work outputs for each specialty. Once these productivity estimates are developed at box 8, the sum of total service requirements for all disorders and conditions falling under each specialty's purview remaining in box 7 is divided by the average productivity of one typical physician in each specialty. The quotient obtained is the total number of full-time equivalent (FTE) physicians in that specialty, required to provide all of the medical care services needed by the population in 1990. This is shown as box 9 in Figure 2.

The final step in the generic model is for the Delphi panel at "P5" to add physician requirements for nonpatient care activities in each specialty and any other demands on physicians that have not been captured elsewhere in the model. This is shown in box 10. Adjustments usually include teaching, research, and administration activities of physician specialists for which a "percentage add-on" to the numbers obtained at box 9 is developed by the panels of experts. The final result shown as box 11 is the actual number of physicians ("head counts") required in each specialty to provide all the services needed by the population and the health care system in 1990.

As mentioned earlier, the model is not particularly unique, having been used in this country nearly half a century ago as a somewhat less complex prototype. What is unique is the way in which GMENAC has used the model—including the panels of experts—to bring the many profes-

sional organizations and their expertise into the process of developing a national physician manpower policy. The process, with the model at the center, minimizes the opportunity for any one group or viewpoint to control or dominate the process or the outcome. Another advantage of the modeling process as it has evolved, although not a unique one, is that it forces to the surface explicit questions about the continuum of medical education and practice and all their underpinnings. In order to fully exercise the model, many difficult questions along these lines must be answered by explicitly stated goals and assumptions.

The results from this process—i.e., the Delphi Panel outputs represent the first of three levels of analysis before final recommendations were developed by GMENAC. The second level was a review by the Modeling Panel of GMENAC in which it carefully considered the input from all Delphi panels, together with other information it collected and assessed. It adjusted the results from each Dephi panel to avoid duplication in the shares of total work claimed by panels with overlapping practice content and strove for consistency in the data that were developed across the panels. The third level of review occurred in public forum by GMENAC, which invited Delphi panel members and authors of other viewpoints—including spokespersons from specialty organizations and public representatives—to critique the process and justify alternative recommendations. The final recommendations of GMENAC were developed by secret ballots, with a majority rule. However, several ballots were taken over two or more public meetings if less than a unanimous vote occurred. The results from this three-phase process, as contained in GMENAC's final report, are summarized in Table 1.

Future Directions

The GMENAC has developed a comprehensive approach to physician manpower planning, involving a workable public-private partnership. It developed recommendations in a public forum to fulfill its charter mandate, beginning with a statement of its assumptions and goals. It has carefully examined available data and noted the shortcomings of those data. The findings of the committee in this area should stimulate major improvements and innovations in data collection for manpower planning.

The committee has also consulted and involved in its decision process hundreds of expert witnesses and national organizations in its assessment of norms of care, future technological developments, and contributions of other health and medical services providers. The process of projecting into the future—even a decade—is fraught with considerable uncertainty, hence the use of the modified Delphi process. In adopting the generic model and the Delphi process, the committee has emphasized the weakness of other existing manpower planning technologies and established a new direction in manpower planning. Yet, it has urged caution throughout its final report that its quantitative assessments and recommendations be reexamined periodically in the light of improved data and more acceptable assumptions.

The GMENAC process, while unrefined in this first iteration, would seem to offer the possibility of linking resource requirements to measures of health status outcome, when these become available. The GMENAC process can be refined to permit greater accuracy, specificity, and ease of implementation of its models in future iterations. It also brings to the surface for explicit consideration and further research many educational and health services issues that are not addressed by other planning processes.

The GMENAC effort terminated on September 30, 1980, like all previous manpower commissions, councils, and task forces. As in some of the draft health manpower legislation in 1974–1976, there is now draft legislation in one house of the Congress to institutionalize a GMENAC-like effort. In light of the potential consequences of its recommendations, even if only partially implemented, it would seem reasonable to try to replicate the GMENAC process, and assess its utility for future manpower planning at both national and local levels.

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