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G-201

# DEVELOPMENT OF A PROTOTYPE CONTINGENCY PLAN SUITABLE FOR USE BY FEMA IN COORDINATING THE WARTIME ALLOCATION OF HEALTH MANPOWER BETWEEN THE MILITARY AND CIVILIAN SECTORS

FINAL REPORT

Contract No. EMW-C-0937

September 30, 1983

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## ACKNOWLEDGEMENTS

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## EXECUTIVE SUMMARY

The objective of this contract was to develop a prototype methodology for the Federal Emergency Management Agency (FEMA) to use to monitor, coordinate, and, if necessary, adjudicate the equitable distribution of the nation's health manpower resources under wartime conditions. It is envisioned that the methodology (when fully developed) would also have wide applicability for peacetime national catastrophes, and for the allocation of other types of scarce resources.

The Department of Defense (DoD) maintains peacetime strength of just over 10,000 active duty physicians, and almost twice that number in the Reserve Components. However, both of these groups are below authorized strength levels for many specialties--many of which would be critical under any significant wartime scenario. Even if both groups were at the authorized strength levels, a major mobilization effort would generate requirements exceeding the available supply.

The most currently available information on total supply of physicians places the non-military supply at approximately 450,000. Of this number, just under 380,000 deliver direct patient care--the remainder are involved in research, administration, and other non-patient care activities.

Recent simulations conducted by the three services concluded that under certain general scenarios, as an example, the DoD would require about 4,500 additional physicians over and above the activy duty and reserve pools to satisfy their M+ 120 day requirements. This figure takes into account substitutability among specialties, and resource constraints, i.e., the maximum availability of facilities and equipment to provide patient care.

At face value, these figures appear quite modest when compared to the 380,000 physicians available to provide patient care in the civil sector, even when this number is decremented by the reservists leaving the civilian sector to assume active military duty status. As such, the requirements levied on the civilian sector seem to be quite modest.

However, the formulation to this point assumes that physicians are a homogeneous resource both in terms of geographic distribution, and according to practicing specialty. This is not the actual situation. In fact, two types of maldistribution do exist. There are many areas of the country which are medically underserved, in general, and further, shortages also exist in certain of the specialties and especially in these practice specialties. To compound the problem, the wartime military requirements are for the most sought after medical specialists--such surgical specialists as neurological and orthopedic, anesthesiologists, etc.

Similar shortage conditions exist for other health care professions such as nursing where operating room, and intensive care, nurse anesthetist, etc. specialty shortages exist at both the national level and in medically underserved areas. Again, these specialties would be in great demand by the military in the event of mobilization. Other health care occupations such as laboratory technicians and paramedic E.M.T. personnel would be also impacted by mobilization.

When DoD mobilization requirements are considered, it is necessary that the needs of the war effort be balanced against those of the civilian population. While other agencies such as the Department of Health and Human Services (DHHS), Department of Labor (DoL), the Selective Service System (SSS), and the Veterans Administration (VA) will influence these decisions, FEMA is specifically charged with the task of coordinating all mobilization activities for the Executive branch of the government and adjudicating differences among claimant agencies.

Achieving a smooth, orderly, and effective transition from a steady state of peacetime to a full mobilization posture will require significant advanced planning as well as detailed coordination among the several federal agencies involved. What is required is the development of adequate data bases for the civilian sector health manpower supply and requirements, for

both the physician and non-physician components. This then could be integrated with the military planning for supply and requirements, to serve as the basis for a system which could provide continuous and systematic monitoring of health manpower demand and supply, to deal with mobilization and wartime health manpower requirements.

If the available civilian health manpower inventories could be standardized, made time consistent, and placed in a usable form and format, the system, by employing an allocation methodology, could be designed to provide decision makers the tools for addressing health manpower needs under wartime and major national catastrophic conditions. Such a system could assist in ameliorating the potential adverse impact of random drafting on the existing problems of geographical maldistribution and shortages in certain physician and nursing specialties.

Examination of supply and requirements data from both the civilian and military sectors provided evidence that meeting projected net DoD requirements would, in fact, generate severe shortages in the civilian sector. This results from a combination of the two existing problems noted above (geographical maldistribution and specialty shortages) and the removal of reservists from civilian practice to military duty, even considering the constraint of available facilities, and skill substitution. This was quite noticeable for several specialties.

Even at this initial stage of problem development, the allocation formulation remains within the bounds of normal optimization procedures. However, it is the remaining portion of the problem statement that confounds the issues--that is, in the ultimate decision process (whether or not to move a critical resource from the civilian sector to the military sector, a number of objectives must be taken into consideration. For example, if a single objective function, such as win the war, could be posed that satisfied the range of concensus, the problem could be solved with standard linear programming methods. However, the decision maker (in this case, FEMA acting as the allocation agent for the President), must take into consideration the viability of the nation's war production capacity, the stability of the civilian population, the protection of certain politically important areas and/or individuals, etc.

The mathematical programming technique known as goal programming was selected for dealing with the multiobjective nature of this relatively complex problem. Goal programming allows decision makers to extend mathematical models to situations requiring multiple objective decision making by assigning weighted priorities to each objective. Specifications for a goal programming based health manpower monitoring and allocation system were developed to provide decision support and contingency planning products to accomplish the following:

1. Build and maintain a matrix containing the most accurate inventory of the civilian health manpower supply, by geographic area and by medical specialty;

2. Construct a transition matrix that will permit the adjustment of the steady-state or peacetime supply inventory to predict available supply in the event of an emergency;

3. Adjust the supply inventory in response to DoD demands;

4. Predict the degree of satisfaction of multiple objectives regarding the need for and availability of medical personnel; and

5. Present the results of the system in formats usable by decision makers.

The goal programming approach is especially relevant for application to this multiobjective probabilistic problem where even the very definition of goals is tenative. Such goals may result from consensus among relevant public agency representatives, the impact of different weighting schemes being substantial. Therefore, the involvement of policymakers in the process of identifying an optimal strategy for allocating health manpower between sectors may improve the specification of national goals under emergency conditions, obtain better solutions, and illustrate the trade-offs involved.

Issues addressed in the design included:

- Potential system users;
- Data base creation and maintenance;
- Input data requirements;
- The allocation process
- Output generation;

- Supply adjustments; and
- Implementation.

If fully implemented, the suggested approach would offer benefits which could:

- Enable FEMA to assess individual manpower requests within the contest of national goals and objectives;
- Provide the Selective Service System with area-specific manpower information for use by its local Boards;
- Provide information to the various claimant agencies on the status of health manpower in both sectors; and
- Provide quantitative assessments of the implications of decisions.

It was also concluded that while the system is designed for health manpower allocation purposes, it also has applicability to the allocation of other resource scarcities that might be expected in wartime or a major National calamity. These include transportation, energy, communications, etc.

In the analysis of legislation and Executive Orders supporting authority for manpower allocation under conditions of war and major national catastrophes, and the role and responsibilities of FEMA, the following factors were apparent:

- The multiple inter-agency planning and execution processes are extremely complex and there is evidence of conflicting responsibilities;
- There is a need for clear definition of agencies' rules;
- Demands from multiple claimant agencies having differing objectives will create inordinately conflicting requirements;
- Having the coordination and adjudication responsibilities, it will be necessary for FEMA to have at its disposal sophisticated management support systems;
- The overall level of authority of FEMA within the Executive Branch is less than that of agencies it is called upon to coordinate and adjudicate among.

The principal conclusions arising from the study were:

CONCLUSION I. There is a demonstrable requirement for implementing, maintaining, and integrating into the fabric of health sector contingency planning, a health manpower monitoring and allocation system.

CONCLUSION II. A more systematic approach is needed for health sector contingency planning.

The four resultant recommendations were:

RECOMMENDATION I: A health manpower monitoring and allocation system should be implemented and installed within FEMA.

RECOMMENDATION II: Once developed, the system should be maintained on an ongoing basis and should be included in periodic mobilization exercises.

RECOMMENDATION III: A senior, multi-sector advisory panel should be established to advise the Director of FEMA on the status of mobilization preparedness.

RECOMMENDATION IV: The applicability of the recommended system to other resource allocation problem areas should be explored.

With respect to the latter recommendation, determining the applicability of such an approach should be integral to the heightened and extensive emergency preparedness planning currently being undertaken by FEMA.

# 1

## INTRODUCTION

The objective of this procurement has been to develop a prototype methodology for the Federal Emergency Management Agency (FEMA) to use in peace and war to monitor, coordinate, and if necessary, adjudicate equitable distribution of the nation's health manpower resources. Although the methodology, when fully developed, will be applicable to peacetime catastrophic disasters, its primary purpose will be to assist FEMA in coordinating mobilization of the nation's health manpower assets in time of war. Further, as will be pointed out in later sections of this report, there is every indication that the methodology will apply to the allocation of other scarce resources, as well as health manpower.

The Department of Defense (DoD) maintains in its peacetime force, a pool of active-duty health care personnel significantly smaller than would be required in wartime. To expand this active-duty pool, DoD first would call upon its pre-trained medical personnel in the reserve components. However, these forces are below authorized strength level for physicians in many medical specialties. To round out its full complement of health care personnel then, it is assumed that some form of conscription would be legislated. The source of DoD's health manpower expansion plans are the pool of health care providers that supports the civilian sector.

The DoD health manpower requirement to meet the mobilization demand could impose a hardship on the civilian population as mobilization proceeds. Overall, there may be a sufficient supply of medical personnel to meet both the needs of the war effort and the civilian population. However, difficulties may arise in the haste of mobilization wherein

inordinately heavy demands are placed on certain specialties in certain geographic areas, leaving these areas with less than adequate health care support. Although other agencies, such as the Department of Health and Human Services (DHHS), Department of Labor (DOL), the Selective Service System (SSS), and the Veterans Administration (VA), will have an influence on these decisions, it is important to note that Executive Order (EO) 10480 "Further Providing for Administration of Defense Mobilization," (under revision), charges FEMA with the task of coordinating all mobilization activities for the Executive branch of government.

Through the use of computer modeling techniques, Defense medical planners are currently engaged in developing and refining estimates of the number and type of medical personnel needed at various times to support a range of wartime scenarios. Understandably, the central focus of this effort is on the military requirement, not the needs of the civilian population. DHHS in coordination with other agencies such as DOL, is charged by EO 11490 "Assignment of Emergency Preparedness Functions to Federal Departments and Agencies" (under revision), with the responsibility of assuring that the essential medical needs of the civilian population are met even though the military requirement may be given a high priority.

Achieving a smooth, orderly, and effective transition from a peacetime state to a full mobilization posture will require significant advanced planning, as well as detailed coordination among the various federal agencies involved. As mentioned earlier, it is FEMA's responsibility to ensure that there is proper coordination between federal agencies so that throughout the mobilization process, resources are distributed in a manner which assures that all critical needs are met.

## 1.1 DEPARTMENT OF DEFENSE SUPPLY AND REQUIREMENTS

Defense planners project that the health care personnel available to DoD in mobilization will not be sufficient to meet the wartime requirements under full mobilization conditions and additional manpower will be needed from the civil sector. In a typical full mobilization

scenario, the requirement for medical personnel rises very rapidly in the early stages of the conflict, then stabilizes and later falls off. Exhibit 1 forecasts the general trend of projected need for health care manpower over time. With reference to this Exhibit, the dashed line represents in relative terms, the number of personnel currently available to DoD in the active force, and the solid line represents the relative net wartime requirements.

The cornerstone of every plan for meeting health manpower needs in mobilization is to maintain a peacetime cadre of highly trained personnel in the active forces that can respond quickly to the needs in a combat theater. Beyond these active duty forces, the principal supplementary source of health manpower is the reserve components, including the National Guard. As far as military planners are concerned, only these sources assure the availability of trained personnel. (In this context, the term "trained" is used to denote military as well as health professional experience). The next source that the military can expect to call upon is the group of professionals who will have chosen to volunteer their medical skills to the war effort. Finally, a draft would be required to fill in the remaining requirements. However, a draft may have limited use in meeting the needs of a hasty mobilization, because the gearing up and personnel training process is likely to require more time than is available. In any case, it is anticipated that in a full mobilization, DoD would require the services of health personnel who are now in the civilian sector.

Mobilization would also impact the private sector health community through implementation of the Civilian Military Contingency Hospital System (CMCHS). CMCHS is a system whereby military casualties returning from a combat theater to the U.S could be treated in VA and/or civilian hospitals that have agreed to provide medical services should the military patient load exceed DoD's medical capacity. A simple diagram of the foregoing mobilization process is shown in Exhibit 2.

Medical planners at the DoD staff and military service levels have developed procedures for estimating health manpower requirements for various mobilization situations. The general approach used is as follows.

Exhibit 1

PROJECTED HEALTH MANPOWER REQUIREMENTS CURVE: FULL MOBILIZATION

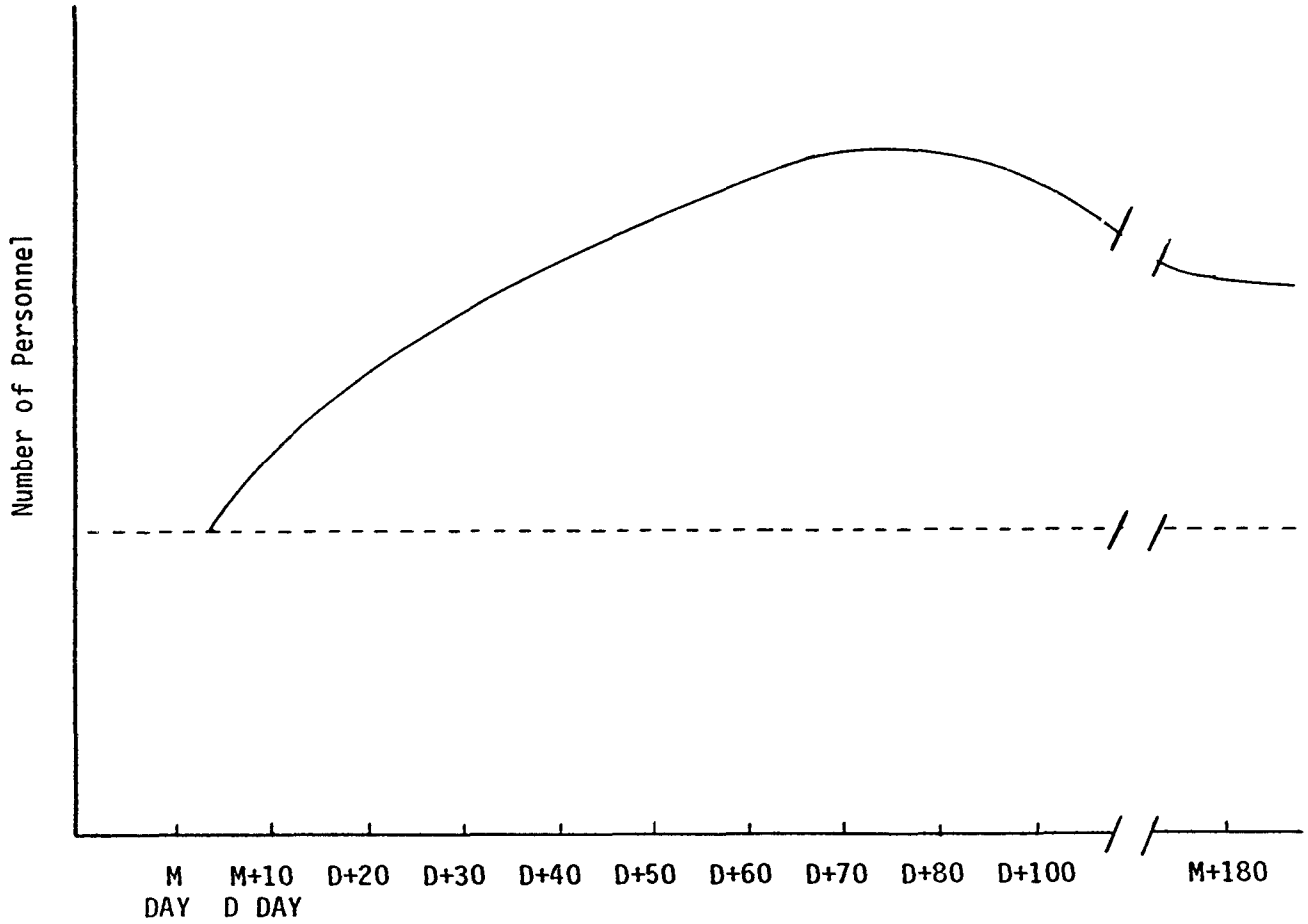
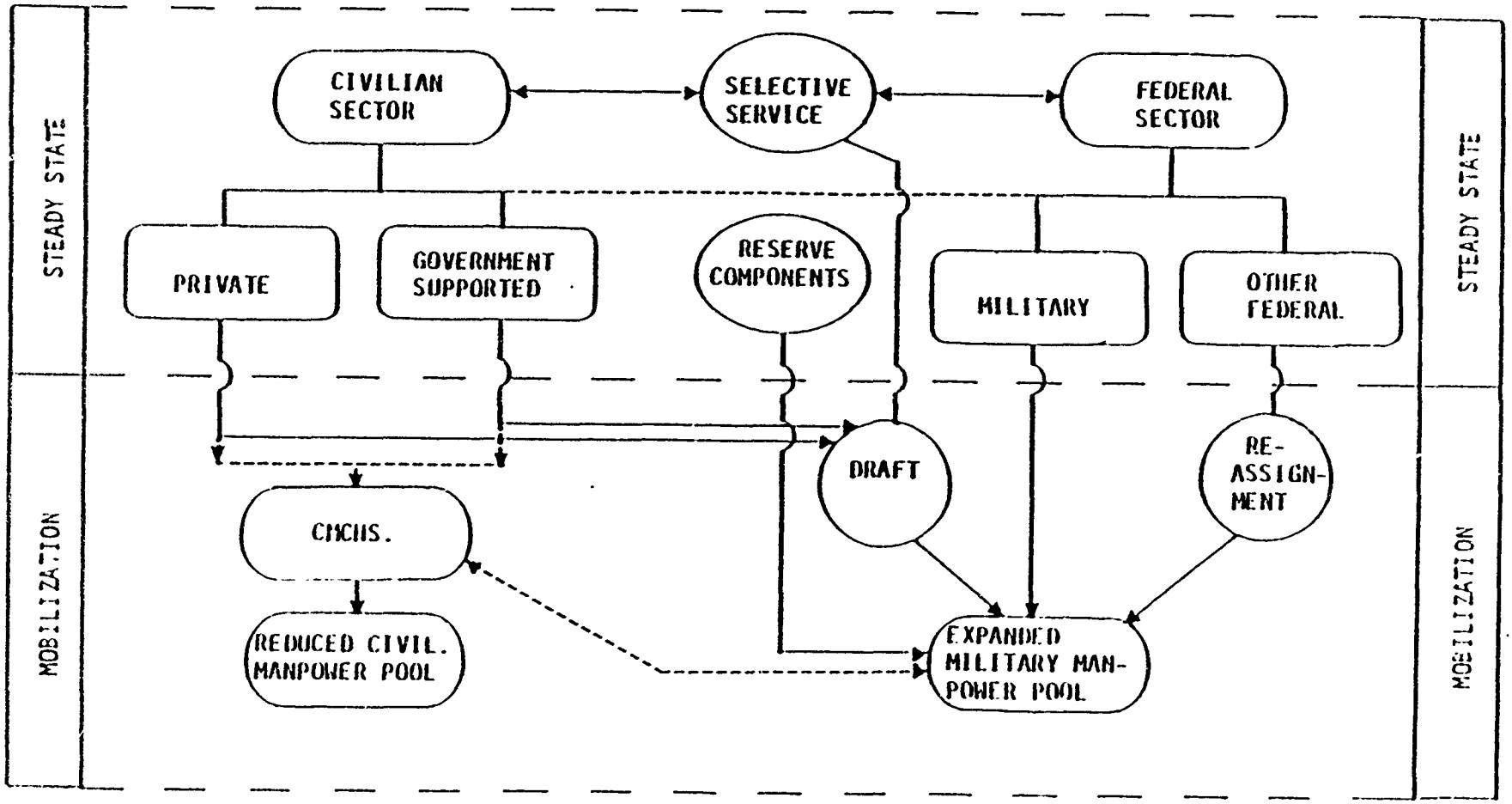


Exhibit 2

MOBILIZATION PROCESS



For each scenario examined, the Office of the Joint Chiefs of Staff assesses the threat and determines the casualty rates for the forces at risk. Based on the estimated casualty rates, theater evacuation policy, and other factors, the number of medical units required to support the scenario is projected. From the manning documents of the individual military service medical units, medical planners are able to determine the number of personnel required, by specialty, to meet the contingency in question. A number of computer models are used to assist in this estimating process.

The entire procedure used by each military service is discussed in greater detail in Chapter 3.

## 1.2 CIVIL SECTOR SUPPLY AND REQUIREMENTS

When considering the overall peacetime or steady-state health manpower supply and requirements, a major factor to be considered is that the two components do not respond naturally to a balancing effect as occurs in economic theory. Several issues underlie this phenomenon, including:

- Artificial demands are generated by specialization within both the physician and non-physician segments. This results in increased referral patterns; consequently, multiple practitioners tend to become involved in single episodes of care.
- Evolving technologies and treatment approaches create other forms of artificial demands--in some cases, almost to the point of abuse. Examples often cited are cosmetic surgery, respiratory therapy, over-utilization of CAT scanners, etc.
- Increased third-party coverage in terms of both benefits and payment schedules, tends to decrease the incentive among patients in seeking unnecessary services.
- Arbitrary uniform fee structures for the same service are found in any given area. This is particularly the case for physicians.
- The consequences of these factors are lack of competition, lack of efficient practice management, and a tendency that when additional physicians are added to a given pool, the dilution of patient distribution results in higher service unit fees.

In the case of physicians, relatively good data on supply exists. These data indicate that the overall current supply of physicians appears adequate for the nation's requirements, but when the distribution is examined in smaller geopolitical areas, two factors become apparent:

1. Some areas, notably rural communities, and socially and economically depressed areas, tend to be medically underserved.

2. Specialty and sub-specialty physicians tend to be concentrated in the more urban and suburban communities.

While some estimates for desirable physician/population ratios have been made, these only cover about half of the specialties, and often for any given specialty, wide ranges in the estimates exist. However, the Graduate Medical Education National Advisory Committee[1] has projected that by 1990, there will be approximately 65,000 more physicians than required. Some specialties will experience surpluses of up to 195 percent, while others will have shortages.

Less precise supply data is available for non-physician health manpower for a variety of reasons. These include:

- Definitional problems for some occupations;
- Lack of specialty distinctions in certain professions, such as dentistry and nursing;
- Practitioners holding multiple-state licenses;
- Non-differentiation between those trained in a given profession and those actually employed; and
- For some occupations, variations in occupational titles and education/training requirements, etc.

For most of these occupations, virtually no requirements estimates exist. However, as with physicians, it is suspected there is some geographical maldistribution, and especially in the more specialized professions and technical positions.

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[1]Summary Report of Graduate Medical Education Advisory Committee, Volume 1, DHHS Publication (HRA) 81-651, April 1981.

In the event of wartime mobilization, there will be varying effects on the civil sector for both physician and non-physician health manpower. For instance, the demand for virtually every surgical specialty will be great, whereas for specialties such as obstetrics/gynecology and pediatrics, the demand will be small up to the point these specialists are called on to substitute for providers in short supply. The same can be said for nursing specialties; for example, operating room nurses will be in great demand whereas geriatric nurses will not generally be needed. The demand for other health care professions, such as dental hygienists, will be virtually nonexistent.

Another important factor in considering mobilization effects on the civil sector is the manner employed to select the required supplemental manpower. While it is expected reservists will be the first to be called upon, irrespective of their location, random drafting of others from the civil sector to meet the required manning levels could very well exacerbate the geographical maldistribution that already exists.

## 1.3 EXPECTATIONS FOR THIS CONTRACT

The principal objective underlying this contract has been development of a prototype system to provide explicit guidance to senior decision makers in supporting the allocation of health manpower between the military and civilian sectors in the event of war. To achieve this end, six areas of activity were undertaken.

| | | |
|---|---|---|
| 1. | Identified Data Sources-- | Data sources for military and civilian supply were identified for both physician and non-physician providers. With the latter, the emphasis was placed on those professions and occupations for which the DoD projects a shortage in the event of wartime mobilization. |
| 2. | Evaluated Procedures-- and Began Establishing An Allocation Methodology | Procedures for establishing health manpower requirements were evaluated, and used as the first step in establishing an allocation methodology |

| | | |
|---|---|---|
| | | to define the preliminary system needs, and generate an integrated system design to interface with related systems as necessary. |
| 3. | Developed Procedural Basis--and Criteria For Health Manpower Requirements Validation | A procedural basis for the review and validation of health manpower requirements was developed that would analyze the requirements definitions currently employed, using existing or generated thresholds, and develop criteria to perform requirements validation on a routine basis. |
| 4. | Developed Final System--Specifications | The allocation methodology, developed from tne above assessment of relationships between supply and requirements, served as the basis for designing final system specifications. These would define a set of workable procedures and protocols to support the methodology underlying operation of the health manpower allocation system, which is to serve a managerial function and therefore, must be general in nature, efficient, easy to maintain and update, and simple to operate. |
| 5. | Considered Administrative--and Legal Aspects to System Implementation | Special consideration was given tc the administrative and legal aspects associated with implementing the allocation system. The system will probably be multi-faceted, requiring access to various other systems and interagency communications; hence, implementation may require changes in existing rules and regulations. |
| 6. | Prepared Recommendations | Recommendations were prepared addressing issues underlying implementation amd and maintenance of the prototype system, associated costs, changes in existing and proposed legislation, and administrative activities. |

## 1.4 CONTENTS OF THIS REPORT

This report consists of six chapters, including this Introduction. Chapter 2 is a statement of the problem; Chapter 3 presents a first-order assessment of civilian and military sector supply and requirements; Chapter 4 describes a proposed system for monitoring health manpower supply and

requirements, and reallocation of resources in time of war or national emergency; Chapter 5 is an analysis of legislation and administrative action; Chapter 6 presents conclusions and recommendations.

# 2

## STATEMENT OF THE PROBLEM

The DoD medical manpower requirements to meet mobilization demands could impose hardships on the civilian population. Examination of the interaction between civilian and military supply and requirements gives; (1) a first indication that potential problems exist in planning, and (2) data to support the process.

### 2.1 EXISTING CIVILIAN SECTOR HEALTH MANPOWER SUPPLY

For planning purposes, it is possible to make a relatively accurate estimate of the current number of physicians in the United States. The American Medical Association Annual Distribution of Physicians, which summarizes AMA's annual survey of physicians, contains responses from over ninety percent of all physicians in the United States. The classification breaks extend to:

- Non-federal and federal physicians (the latter including the U.S. Armed Forces);
- Physicians primarily providing direct patient care in office and hospital settings, and those primarily involved in other professional activities such as teaching, administration, research, etc.;
- Listings in 35 different medical specialities. It is to be noted that the "specialties" are those reported by the respondents as their primary practice area--it does not necessarily mean they are board-certified in that specialty.

More detailed information, such as secondary and tertiary specialties, type of practice, practice location, etc. is on file but not necessarily published by the AMA in routine survey reports.

The extent to which the physician supply by specialty is adequate under steady-state conditions is truly not known. However, it is known that in certain areas of the country, shortages exist. This is the raison d'etre for the National Health Service Corps.

Comparable data are available for some of the other "primary" health care providers. Professions such as dentists, nurses, pharmacists, veteranarians, optometrists, and podiatrists are covered by reasonably accurate data. Further, the supply data on these professions are available by small geographic areas of the United States.

However, in the case of non-physician health manpowers, varying degrees of difficulty exist in obtaining accurate and specific data on the population of medical specialists broken down by skill area. In the first place, there is no systematic series of surveys conducted on an on-going basis. The four most common sources are surveys conducted by professional associations, Census data on occupational groupings compiled by the Department of Labor (DoL), hospital-based personnel data collected by the American Hospital Association as part of their Annual Survey, and State licensure/certification records. There are problems associated with these sources, including:

- Surveys by professional associations tend to concentrate on their membership--not necessarily on all who would qualify for membership by virtue of their training--and complete data on a practicing specialty (such as O.R. nurse vs medical-surgical nurse) is difficult to determine.
- States requiring certification or licensure provide only broad classifications such as "nurse," "dentist", etc., of those permitted to practice in the state. This does not reflect the number in active practice, type of practice, or holding licenses in multiple states.

When the focus is broadened to the non-primary care professions (i.e., the so-called "allied" or associated health professions), the problem worsens substantially. Among the factors that contribute to this problem are.

- For occupations not requiring any form of certification, many categories have differing levels of education/training requirements, and reporting often fails to (1) consider the definitional problems, and (2) distinguish among training, occupation, job titles, or position designations. For instance,

a "dietary aide" position in one setting might be filled by an entry-level graduate dietitian, and in another, by an individual essentially trained on-the-job.

- The periodicity, accuracy, and general comprehensiveness of supply data for these health manpower groups is problematic.

The veracity of any system for health manpower mobilization planning will depend to a great extent on resolution of the above issues, and the timeliness of the data supporting decisions. This will facilitate the tracking of supply changes for any given profession over time.

Another implication for mobilization (which will be addressed more fully in the following chapter) is the geographic distribution (or maldistribution) of health care manpower throughout the United States. This can apply to manpower shortages for a profession in general (physicians), or a specialty (radiologists) in particular areas of the country, whereas the supply for the nation as a whole may be adequate. However, it has been projected that by 1990, while the total physician supply will exceed requirements by about 20 percent, for certain physician specialties, e.g., anesthesiologists, urologists, plastic surgeons, etc., overall shortages will still exist.[2]

In the case of non-physician health manpower, forecasting is less precise--especially where new specialities are emerging. For instance, while there are established overall nursing shortages in rural areas, in urban areas, the shortages tend to be confined to subcategories requiring specialized training such as intensive care, oncology, geriatric, etc.

## 2.2 CIVILIAN REQUIREMENTS

The concept of requirements refers to the personnel necessary to perform specific tasks to achieve stated objectives within designated constraints. This is somewhat distinct from "needs" and demands" which, however, do impact on the net result.

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[2]Op. Cit.

The term "need" implys that there has been a professional determination as to certain levels of personnel necessary to provide health care, irrespective of national or economic "demands" for such services. Within the civilian health care professions, notions of a balancing between supply and demand are somewhat artificial. This is confirmed by spiralling health care costs, increases in the number of health care professionals, and no real commensurate increase in health status.

As will be discussed more fully in the following chapter, techniques for estimating requirements tend to rest on judgemental approaches with resultant wide ranges of opinion. The consequence is that it is difficult to address manpower planning with a high degree of accuracy. This is particularly the case for non-physician providers where estimates are not available for most fields.

The lack of competition in the health marketplace, and somewhat artifically generated demands tend to obfuscate the true requirements for the civil sector. In considering a wartime or national catastrophic scenario, it is highly probable that requirements will be somewhat scaled down for the unaffected population, while at the same time, there will be an increase in the supply side. Two opposing sets of factors have to be considered.

On the one hand:

1. There will be a return to practice of retired providers. Related to this, and especially in the case of physicians, those in teaching and administrative positions could be called upon to provide direct patient care.

2. Practitioners will probably increase their hours, thus contributing to an apparent increase in the supply; and

3. Demands for services will most likely be reduced, with a resultant lowering of utilization under the emergency conditions. This reduction in demand for services could very well be self-generating to a degree, for if it becomes difficult or inconvenient to arrange for services, attention to minor complaints or routine services such as physical examinations could be postponed or waived.

Offsetting these factors are:

1. Depending upon the availability of DoD and VA facilities and casualty loads, it can be expected that civilian manpower and facilities will be employed to supplement these resources;

2. Increases in employment could lead to increased demand due to changed lifestyles, increased industrial accidents due to lack of experience, etc.; and

3. Removal of reserves from the civilian provider pool will reduce availability to the civilian sector.

While the full implications of these countervailing influences are not known precisely, it can be expected that the net impact will be an increase in supply. The work in this area has not been sufficient to provide even reasonable estimates of the incremental effect on the civilian sector health manpower pool.

## 2.3 NET DoD REQUIREMENTS

Through the process to be described in Chapter 3, DoD and Service medical planners develop health manpower requirements for wartime. The requirements are expressed by medical specialty, and are projected over time from the beginning of mobilization (m-day), through 180 days after m-day (m+180) and beyond.

DoD medical planners have elected to express the mobilization requirements as the net number of personnel needed beyond those who are currently available to DoD. In other words, the net requirement is that number of medical personnel who must be obtained from assets not under the control of DoD. This net requirement is determined as follows.

Net Requirements = Gross Requirements[3] - [Active Duty[4] + Civilian Employees + Reservists[4]]

A recent medical personnel requirements report generated by DoD contained the net requirements by the time frames indicated in Table 1.

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[3]This requirement is constrained by available hospital equipment assemblages.

[4]Skill substitution rules applied.

TABLE 1: NET DOD REQUIREMENTS BY TIME AFTER MOBILIZATION

| SKILLS | M+20 | M+30 | M+40 | M+70 | M+100 | M+130 | M+160 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Physicians | 2,048 | 968 | 585 | 663 | 108 | 4 | 2 | 4,378 |
| Nurses | 2,156 | 940 | 228 | 1,917 | 124 | 75 | 0 | 5,440 |
| Dentists | 127 | 34 | 0 | 0 | 0 | 0 | 0 | 161 |
| Veterinarians | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| Other Professionals | 7 | 19 | 0 | 30 | 43 | 1 | 0 | 100 |
| Technicians | 7,271 | 2,790 | 1,497 | 14,420 | 3,412 | 0 | 0 | 29,390 |
| TOTAL | 11,638 | 4,751 | 2,310 | 17,030 | 3,687 | 80 | 2 | 39,498 |

While approximately 39,500 medical personnel required from the civil sector does not appear to be excessive compared to the total available supply, several factors should be considered before dismissing the issue as non-problematic. First, the net requirement expressed above is constrained by medical equipment-assemblage availability. Therefore, the unconstrained net requirement could very well be two to three times larger. Second, in addition to filling the net requirements, Services will activate members of the reserve components who will also be removed from the private sector for military duties elsewhere. The number of reservists who might be called to active duty could range as high as 87,000; including 19,000 physicians, 18,000 nurses and 50,000 technicians and other occupational categories. Therefore, it is possible that more than 128,000 medical personnel could be called up for military service during full mobilization. Finally, the potential allocation problem is exacerbated further by the less well defined requirements to support the Civilian Military Contingency Hospital System (CMCHS).

CMCHS is a contingency system whereby the Veterans Administration and civilian hospitals have committed beds and staff to care for returning military casualties in the event that the capacity of the DoD medical system is exceeded. At this writing, over 50,000 beds have been voluntarily committed to CMCHS by civilian hospitals in more than 48 communities throughout the United States. Although it is anticipated that the health providers participating in CMCHS will remain in their communities, the demands on their time generated by military casualties will reduce their availability to care for non-military patients. There is very limited information available on the number and types of providers who would be involved in CMCHS, and there is even less information on how CMCHS would impact the civilian sector if it were activated.

In accordance with Public Law 97-174, dated May 4, 1982, the Veterans Administration may furnish care to members of the armed forces on active duty, if these individuals require care as a result of a war or national emergency declared by the President or the Congress. Since this is relatively new legislation, it has not yet been determined what impact this will have on the health manpower of the VA. VA Central Office

personnel report, however, that approximately five percent of VA personnel engaged in patient care are members of the reserve components and would no longer be available upon mobilization. They indicate further, that a recent study concluded that the VA could absorb a five percent loss of personnel and continue to perform its mission adequately. However, since the number of active-duty patients who might be sent to VA facilities during mobilization is unknown, it is possible that the VA may develop a requirement for additional medical personnel. These additional personnel would, of necessity, come from the civilian sector.

These combined demands placed on the civil sector for health care personnel does indeed indicate that potential health manpower allocation problems between the military and civil sectors may arise in a full mobilization. The problems may become quite severe when the impact of a military call-up is examined by geographic area and by health care specialties and subspecialties. Certain geographic areas of the country are currently identified as medically under-served, and a further depletion of their health personnel resources could completely destabilize such areas. Therefore, a military call up of subspecialties already in short supply would certainly cause the shortage in the civil sector to become more acute.

## 2.4: THE NEED FOR A HEALTH MANPOWER MONITORING AND ALLOCATION SYSTEM

The foregoing discussions provide a strong indication of the need for a system to ensure continuous and systematic monitoring of health manpower demand and supply to deal with mobilization and wartime health manpower requirements. The system developed must be sufficiently flexible to permit identification of potential problems by geographic area (e.g., county or SMSA), and by health manpower subspecialties. Further, the system should include a means of collecting, compiling, and manipulating available information so as to be of maximum assistance to decisionmakers in allocating health manpower between the civil and military sectors in the event of a major natural catastrophe, or in wartime during a period of mobilization.

It is this latter requirement that is the specific objective of the contract effort. While civilian sector health manpower inventories will be demonstrated as being readily available (see Chapter 3), and the military sector requirements are available directly from DoD (also described in Chapter 3), there is a fundamental need to bring these disparate data together. In addition, these data must be standardized, made time-consistent, and placed in a usable form and format for decisionmaking.

While the activities associated with these requisites are straightforward, it is suggested that no systematic approach is now in place for satifying the requirements. Further, as has been identified earlier, simply dealing with the reallocation of health manpower at the national level tends to mask a host of problems that are both spatial (i.e., geographic), and specific as to medical specialities.

With regard to this latter point, the civilian sector has been beset with a variety of structural problems for the past 15 to 20 years. Whereas the problems originally were manifest as an inadequate supply of primary care providers, actions on the part of the Federal Government and the private sector has, to a large extent, reduced this problem, at least at the national level. However, a variety of other problems have become apparent in the past 5 to 10 years; among the more important of these problems are the following:

1. While the aggregate supply of physicians is considered to be sufficient to care for the U.S. civilian population, the geographic distribution of these providers is found to be heavily skewed to the more affluent urban and suburban areas of the country. This has resulted in a substantial shortage of physicians in rural, inner city and other unique population/geographic situations.

2. Again, while the total numbers of physicians are thought to be sufficient, there has been a tendency for physicians to be trained, and then practice, in various medical subspecialties. This has resulted in shortages of physicians in such practice areas as family medicine, general practice, pediatrics, and internal medicine.

The net result of these tendencies has been the realization that the provider supply in the civilian sector is maldistributed in two dimensions--location and practice type.

The implications of these maldistributions are important in this study for a variety of reasons. First, it is suggested that if the movement of providers from the civilian to the military sectors is considered only from a national perspective (i.e., looking at the total supply of each provider-type), the existing geographic maldistribution could become critical. Next, the same example could be extended to cover the specialty maldistribution. In practice, these phenomenon must be dealt with simultaneously.

Hence, what appears to be required is the collection of data sufficient to permit recognition of the location and specialties of the health manpower pool. To provide an indication of the implications of this suggestion, the following "sizing" parameters are offered:

1. Practice specialty: The DoD has net requirements for approximately 70 health manpower categories (about 35 categories of physicians and a comparable number of associated and dental health personnel).

2. Geographic location: The Public Health Service of DHHS normally uses the county as its unit of geographic analysis, and, there are about 3,300 counties in the U.S.

Therefore, if these factors are taken into consideration, a specialty-location matrix is required containing over 230 thousand cells.

Even if this represented the full scope of the problem at hand, the justification for an automated approach could be demonstrated. However, the problem is further complicated by the need to assess the implications and impacts of reallocation decisions.

Since FEMA will be called upon to adjudicate conflicting requirements only when the principal claimant agencies have reached an impasse, the situation that will confront senior FEMA staff will be highly problematic. Further, since it is assumed that each claimant agency will be representing realistic concerns regarding its constituency, there simply will not be an easy remedy. For example, the

DoD will likely describe the potential increased loss of life and the diminution of fighting capacity, and DHHS will likely describe destabilization of society in various jurisdictions and the loss of production capacity, with a corresponding fall-off in war materials. As such, both sectors will be representing real and pressing concerns: the question confronting FEMA will be how to make the best, hard decision.

Before dealing with the question posed, it is of interest to explore the concept of a "best" decision. Clearly, there is no good decision in that whatever is concluded, lives will be lost. Hence, the better way of viewing the problem is to make the decision(s) in terms of the optimal results from a national perspective--that is, how the overall goals of the United States are best served. It is suggested that a grander set of decision rules are required when dealing with universally unpalatable solutions.

Returning now to the question posed, the best decisions will be those that further the goals of the United States.

Rather than simplifying the decision process, this recognition tends to further complicate the problem. Briefly, the series of issues that must be dealt with in reaching an informed decision include:

1. The military requirements, and in particular, the number of health manpower needed, by specialty;
2. The civilian supply of health manpower, by specialty and by geographic location;
3. The civilian population requirement for health care, by specialty and by geographic area;
4. A formulation of national goals and objectives to aid in decisionmaking; and
5. A tool for handling all of the foregoing.

It is the conclusion of the project staff that the problem outlined cannot be handled intuitively, nor can it be handled manually. As such, this contract addressed the preliminary design of a system for collecting, assimilating, processing, and offering constructive decision alternatives for the problem described.

# 3

## FIRST ORDER ASSESSMENT

This chapter presents a first order assessment of the civilian sector supply of health manpower and the DoD requirements for manpower over and above the resources available. This effort was undertaken for two purposes. The first of these was to establish, with some degree of precision, whether or not FEMA would likely be called upon to adjudicate a problem--that is, to determine whether or not a sufficiently compelling allocation problem will exist. Second, the effort was undertaken to develop procedural and methodological approaches for satisfying the contract objectives. In order to satisfy both purposes, a series of analyses were conducted to develop methodologies that would lead to design parameters for the proposed health manpower monitoring and allocation system.

### 3.1 ANALYSIS OF MILITARY REQUIREMENTS

One portion of the allocation effort was an analysis of the techniques used for estimating health manpower requirements in DoD. Because of the distinctively different missions of the Army, Navy/Marine Corps, and Air Force in a combat environment, each Service develops its own estimates of health manpower required for mobilization. The typical approach by the Services is to base estimates on scenario-specific situations developed by the Joint Chiefs of Staff from Strategic Threat Analyses. Major friendly force components sufficient to neutralize the enemy threat are then identified. These forces become the population at risk from which casualty estimates are derived. Casualty estimates drive the requirements for hospital beds in the theater and ultimately in the

Continental U.S. (CONUS). The beds required are then translated into the number and type of medical units needed to support the composite operations.

The type and number of medical personnel required are then determined by adding the personnel requirements of all the medical units' manning documents. The Joint Chiefs of Staff, Joint and Unified Commands, and the Services, use a variety of models to assist them in developing manpower requirements. The foregoing process is summarized in Exhibit 3. The models used by medical planners are discussed in more detail later.

The actual procedure for estimating medical manpower needed in mobilization is quite complex and deserves additional discussion. In the next several pages, the process used by each Service is described.

Army

Army medical manpower planners rely on a methodology called the Total Army Analysis (TAA) as the basic elements of the manpower forecasting process; the unit of analysis in the TAA is the theater of operations. Based on the particular scenario selected, casualty rates, theater evacuation policy and other similar variables are applied to the methodology and manipulated to produce a Master Force List of units in the theater. The number of support units, including medical units, is determined by a support unit allocation submodel, which is based on Army doctrine and specifies a ratio of medical units to combat units supported. The resulting support units are identified on the Army Master Force List for each specified scenario. After the type and number of medical units are identified, the manpower required to staff these units is obtained from Tables of Organization and Equipment (TO&E) which are part of the Army Authorization Document System (TAADS). Personnel requirements on the TO&E are determined with the assistance of a Facilities Model, described in greater detail later in this chapter.

CONUS medical manpower requirements are determined by summing the various Army beneficiary populations likely to require medical support in the CONUS base and applying specially developed staffing estimates to determine the number and type of medical support personnel required.

## SUMMARY OF REQUIREMENTS FORECASTING TECHNIQUES

| PHASES | ACTIVITIES | MODELS |
|---|---|---|
| PHASE 1<br>Strategic threat and Scenario analysis<br>(Theater of Operations) | • Determine population at risk<br>• Estimate casualties<br>• Apply evacuation policy<br>• Estimate theater bed requirements<br>• Estimate physicians required in theater | Medical planning module of the Joint Operations Planning Model (MPM) JOPS |
| PHASE 2<br>Medical Unit Support | • Determine mission to be supported medically<br>• Determine medical units required (by ECHELON)<br>• Apply assemblage constraints | Service specific based on doctrine and other matters |
| PHASE 3<br>Medical Manpower Required | • Determine medical mission to be accomplished<br>• Develop medical unit manning documents<br>• Compute total number of medical personnel required<br>• Apply skill substitution rules | "Facilities Model" assists in developing manning documents |

Navy

Navy medical manpower requirements for mobilization are generated from at least three mission support components, including, but not limited to:

- Medical support to the Fleet Marine Force;
- Medical support to the Navy Fleet; and
- Medical support in CONUS.

As a general rule, the Navy relies on the Medical Planning Module of the Joint Operations Planning System (JOPS) for scenario analysis, casualty data, and hospital bed requirements.

Determining medical personnel requirements to support the Fleet Marine Force and the Navy Fleet is a two-step process. First, the personnel requirements to fill the medical unit Tables of Organization (TO) organic to Marine combat units and ships are determined. The second step is to determine the number of medical units from the Fleet Hospital Program required to back up the organic medical units. Since the proposed units in the Fleet Hospital Program will have a Manpower Authorization Document, the medical personnel required is determined by summing the type and number of personnel identified in the Manpower Authorization Documents of the Fleet Hospital Program units. The Fleet Hospital Program is currently under development, and Manpower Authorization Documents for deployable medical units in this program are not yet complete. The Facilities Model is being used to assist in determining the type and number of medical personnel for the manning documents.

As the Hospital Ship Program becomes operational, medical personnel required to staff hospital ships will also be included in the overall requirement.

CONUS medical manpower requirements are determined by extrapolating the CONUS peacetime requirements to accommodate the increased patient load anticipated for wartime.

Air Force

The Air Force has two principal missions for which it programs medical manpower requirements in mobilization. These are:

- Support of Air Force requirements; and
- Support of all Services aeromedical evacuation requirements.

Generally, the programmed manpower requirements to support Air Force medical needs are developed as follows:

- For each scenario under consideration, a population at risk is determined;
- Casualty rates and the theater evacuation policy are applied to the population at risk and casualties per unit time in the theater are estimated;
- The number of hospital units required is determined, based on the number of patients anticipated in the theater by time frame;
- The number and type of medical personnel required to staff each type of medical unit is determined by a preestablished manning document, called a Unit Type Code (UTC), for each type of medical unit involved;
- The type and number of medical personnel per UTC is determined with the assistance of the Facilities Model, discussed later in this chapter; and
- For second echelon care (principally outpatient care), the number of medical units required is determined based on the population at risk. The type and number of medical personnel required to staff these units is then determined from the UTC for each type unit.

Medical personnel required to support the aeromedical evacuation mission are determined by the following process:

- For each scenario, the Medical Planning Module (MPM) of the JOPS model is used to determine the total number of patients (all Services) who will require evacuation from the theater;
- Requirements for Air Force medical crews are determined by calculating the number of missions required to move the patients considering casualty loads, transit time, etc.; and
- The number of Aeromedical Staging Units (ASUs) are determined in a similar fashion The number and type of medical personnel are then calculated from the UTC of each ASU.

### 3.1.1 Military Manpower Requirements Models

Since the requirement methodologies employed by the Services depend heavily upon computer-based models, an attempt was made to determine the makeup and underlying assumptions imbedded in these models. As such, this section presents the results of an analysis of available documentation on the Facilities Model and the Medical Planning Module (MPM) of the Joint Operations Planning System (JOPS) model. As noted above, these are the principal tools employed by the Services for requirements estimations.

3.1.1.1 Facilities Model. The documentation available for review on this model is quite old and does not reflect a number of changes that the model developers indicate have been made. Although outdated, the material reviewed was the only documentation made available to the project staff on the model.

The Facilities Model was developed and is maintained at the U.S. Army Academy of Health Sciences at Ft. Sam Houston, Texas.

Model Description

The "Facilities Model" is a computer model that simulates certain functions performed in hospitals in the theater of operations. The hospital functions simulated include the following:

- Preadmission
- Admission
- Transportation
- Non-Treatment Support Activities
- Dispensary Service
- Treatment Services
  - -- Surgical
  - -- Medical
- Disposition.

As patient diagnoses are entered, the model simulates the flow of patients through the various Services assessing patient condition, elapsed time, provider time to perform various tasks, supply and equipment requirements, and a number of other factors.

There are 12 categories of data that the model can process. These categories are:

- Initialization inputs;
- Main parameter inputs;
- Hospital description inputs;
- Personnel staffing inputs;
- Personnel replacement inputs;
- Patient class inputs;
- Patient class independent time curves;
- Miscellaneous patient class dependent curves;
- Treatment time curves;
- Survival time curves; and
- Action modification inputs.

In addition to a host of outputs not relevant to this study, such as supply and equipment utilization, the model displays average personnel (treater) utilizaton times expressed in hours and minutes by shift, and by day. These utilization times are listed for each of the 8 functional areas in the hospital for up to 15 provider types, which can be defined by the user.

Comments

From the user documentation provided, it appears that the model is a sound means of analyzing medical manpower utilization in certain specifically defined areas of a hospital. The real key to the model's veracity as a tool to assist in projecting medical personnel needed is in the judgments contained in the clinical data base. For example, the clinical data base contains professional judgments about the time required for each skill category to perform certain procedures on patients with specified diagnoses/conditions. Reportedly, these judgments were made by professional advisory groups within the Services and coordinated with the American Medical Association for further validation. Since these judgments are so key to the manpower requirements determination process, there must be some assurance that users of the model are restricted from arbitrarily modifying them to manipulate more favorable outputs. Contact with the model custodian on

this matter indicates that the clinical database cannot be changed by individual users. Rather, changes are made only through a formal joint user assessment of database elements.

3.1.1.2 Medical Planning Module (MPM) of the Joint Operations Planning System (JOPS) Model. This model was developed under the auspices of the JCS Ad Hoc Medical Steering Committee by the Office of the Joint Chiefs of Staff.

Model Description

The MPM is a subsystem of the Joint Operation Planning System. It is designed to be compatible with the organization and unit structure of each of the Services, and to recognize the unique requirements of each.

The main inputs to the MPM are already stored in the form of the Time-Phased Force Deployment Data (TPFDD), a geolocation file, and a medical data base. However, the users' manual indicates that many inputs can be provided manually, as summarized below.

The MPM can provide the following output:

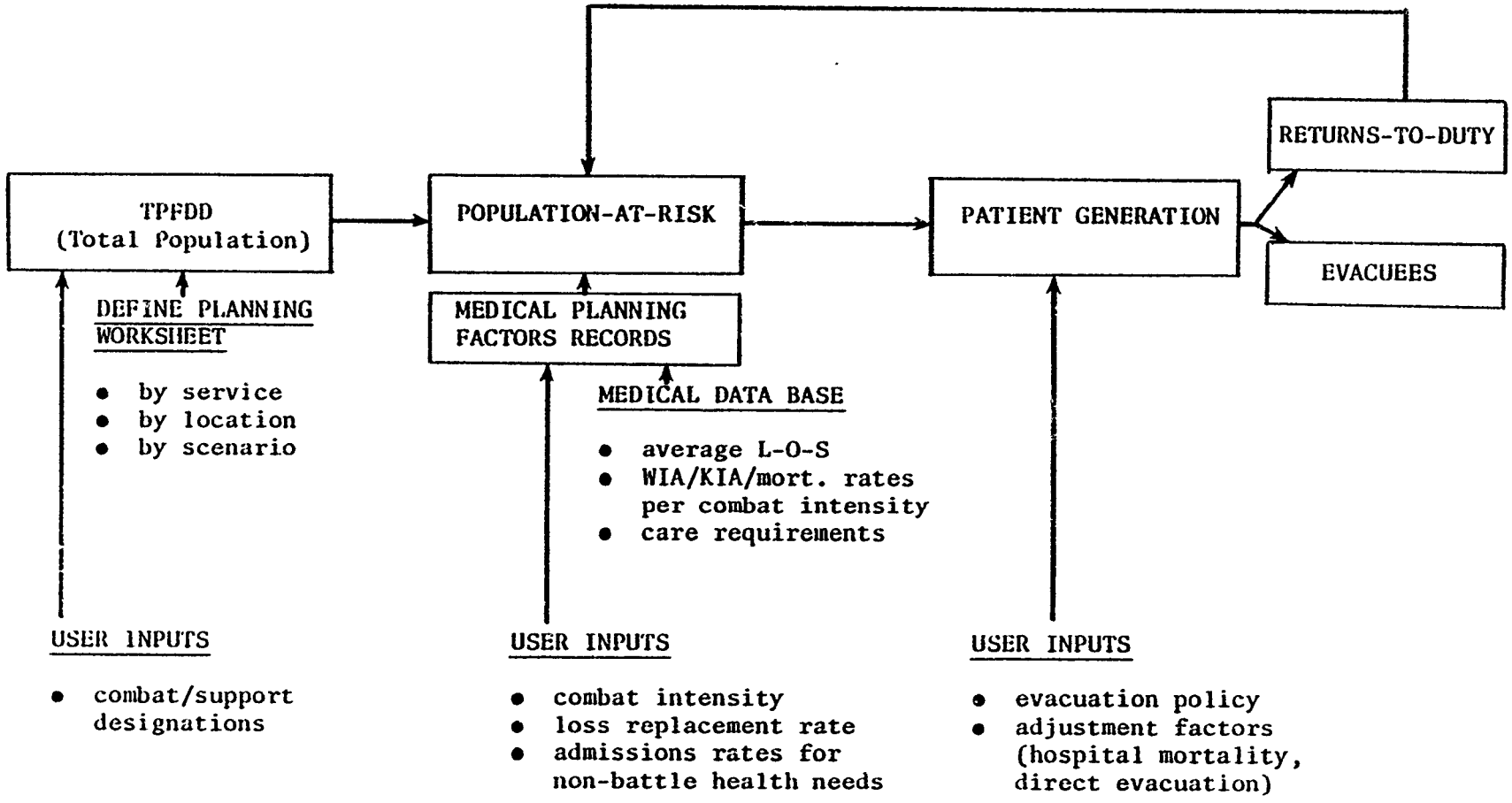
- Planning worksheet, listing units by echelon, institution type, and location;
- Population-at-risk report;
- Medical planning factors records listing disease, non-battle injury, outpatient admissions, the evacuation policy selected, and care requirements (if supplied by the user) for each echelon and day under given combat intensity rates;
- Return-to-duty reports; and
- Requirements for operating rooms, physicians, blood, hospital beds, and medical supplies.

Model Functions

The flow chart in Exhibit 4 provides an overview of the MPM Model. The population-at-risk is obtained by identifying valid TPFDD records in terms of geographic location, Service designation, and user-specific assignment as combat force (rather than support forces). Medical planning factors are applied to the population-at-risk to generate patients evacuated or returned-to-duty, subject to predefined lengths-of-stay, evacuation policy, delays, and other adjustment factors.

Exhibit 4

FLOWCHART DESCRIBING THE MEDICAL PLANNING MODULE



A planning worksheet is initially defined for each Service location, and scenario, consisting of valid records from the TPFDD. The user will assign combat or support force designations to each echelon in a valid TPFDD record, thereby generating an estimate of the population-at-risk.

Medical planning factors combining already defined and user-supplied inputs are applied to the population-at-risk to generate patients. The annually updated medical data base defines the following of specific variables Service scenarios:

- Average length-of-stay by patient class;
- Average length-of-stay for patients evacuated from echelon 1 to echelon 2 and returned-to-duty, and similarly for patients returned-to-duty from echelon 3;
- Wounded-in-action (WIA), killed-in-action (KIA), and hospital mortality rates for given combat intensities;
- Multipliers for care requirements due to outpatient, disease, and non-battle injury admissions; and
- Care requirements by patient class.

Users can choose to override the inputs on the medical data base and can supply the following inputs:

- Combat intensity for echelons 1 and 2 (maximum of 18 changes of 5 intensity levels per day per echelon). A support-unit offset intensity level may also be defined.
- Combat loss replacement rate.
- Admission rates for such non-battle related health needs as disease, injury, and outpatient care (maximum 18 changes per echelon and patient class).
- Evacuation policy for the three echelons. Seven standard policies are available: 5, 7, 10, 15, 30, 45, and 60 days. Non-standard policies can also be selected.
- A bed dispersion factor to reduce the estimated bed capacity due to transportation delays, sex segregated wards, etc.
- A maximum of five unique care requirements may be added to the standard data base.

Comments

From the documentation provided, the model appears to be adequate for its intended purposes. In its current configuration, however, the only manpower data model provides is total physicians aggregated without reference to specialty. The users' manual, although very complete, does not provide sufficient detail on the underlying mathematical model to permit a judgment on its adequacy.

### 3.1.2 DoD Requirements Control Mechanisms

The Secretary of Defense has an obligation to ensure that the manpower needed in wartime is sufficient to prosecute the war successfully, but at the same time, not excessive so as to cause needless hardship in the civilian sector. The Office of the Assistant Secretary of Defense (Health Affairs), OASD(HA), has established mechanisms designed to keep the wartime health manpower needs expressed by the Services from being artificially inflated. Three of these mechanisms are discussed below.

Skill Substitution

To meet their obligations to care for retired personnel and dependents of active duty and to conduct training programs, the Services have on their rolls, more of certain medical specialists than are required in wartime. For example, peacetime levels of pediatricians, obstetricians, and gynecologists are in excess of wartime needs. Clearly, under the emergency circumstances of wartime, these excess personnel could be substituted for others in short supply. Appropriately, OASD(HA) requires the Services to apply skill substitution rules as a step in the process of developing mobilization manpower requirements. The Army and Air Force have published skill substitution rules, copies of which are included in Appendix A and B, respectively. It should be noted that the Air Force rules encompass a considerably greater number of specialties than do the Army's. Navy medical planners indicate that the Navy uses skill substitution in developing its requirements as well, but attempts to obtain copies of the rules by which they are made were not successful.

## Facility Constraints

Currently, none of the Services have the full complement of medical equipment assemblages in inventory it would need for war time. Therefore, OASD(HA) requires each Service to express its wartime requirements only to that level for which there are unit assemblages currently in inventory. Each Service has documented in its Program Objective Memorandum (POM) submission the requirements for additional assemblages. However, they are not permitted to project full staffing until the assemblages are funded, procured, and actually placed in inventory.

In some cases, the difference between the constrained and unconstrained manpower requirements are significant. For example, for physicians and nurses in the Army, the following figures apply:

| | Physicians | Nurses |
|---|---|---|
| Assemblage Constrained Estimates(NET) | 1,009 | 3,869 |
| Unconstrained Estimates (NET) | 4,505 | 15,082 |

The differences should not present a problem as long as those reviewing the requirements are aware that they are constrained, and that periodic requirement updates are prepared as assemblages are added to the inventory.

Appendix C presents a listing of the DOD net health manpower requirements for full mobilization. Specialty substitution and facility constraints have been applied to the data presented.

## Crisis Action System

The Secretary of Defense has established a Crisis Action System by which he will manage requests for resources from a combat theater in wartime. OASD(HA) will participate in this adjudication process when the requests involve medical resources. Generally, the system is designed to work as follows.

A Service element (Army, Navy/Marine Corps, Air Force) in the Theater of Operations generates a requirement for additional resources, in this case, health personnel. The request goes through the Joint or

Unified Command Commander to the Theater Commander. If the Theater Commander is unable to meet the requirement within his assets, assistance is requested from the Joint Chiefs of Staff (JCS). JCS attempts to satisfy the requirement by dealing directly with the Service Headquarters (Army, Navy/Marine Corps, Air Force). If this attempt is unsuccessful, the JCS presents the requirement to the DOD Crisis Action Group composed of all the major staff elemenets of DOD, including OASD(HA). Requirements related to health are referred to the Health Affairs Board, which develops a recommended course of action for consideration by the DOD Crisis Action Group, headed by the Secretary of Defense.

If the issue can be resolved within the assets available to DOD, remedial action is taken. If not, the problem, along with a recommended solution, is referred to the National Security Council where a final decision is made and appropriate action directed.

Exhibit 5 contains a diagram of the process described above. The principal point to be observed here is that DOD has a relatively sophisticated mechanism in place to deal with resource requirements generated in a theater of operations. It should be noted that there is heavy emphasis placed on attempting to satisfy a requirement at each level before it is passed to the next higher level. Properly administered, this mechanism will serve as a powerful requirements validation tool. This mechanism was recently established and has not been used in a wartime situation. It has been tested in exercises, however, with reportedly good results.

### 3.1.3 Veterans Administration Manpower Requirements

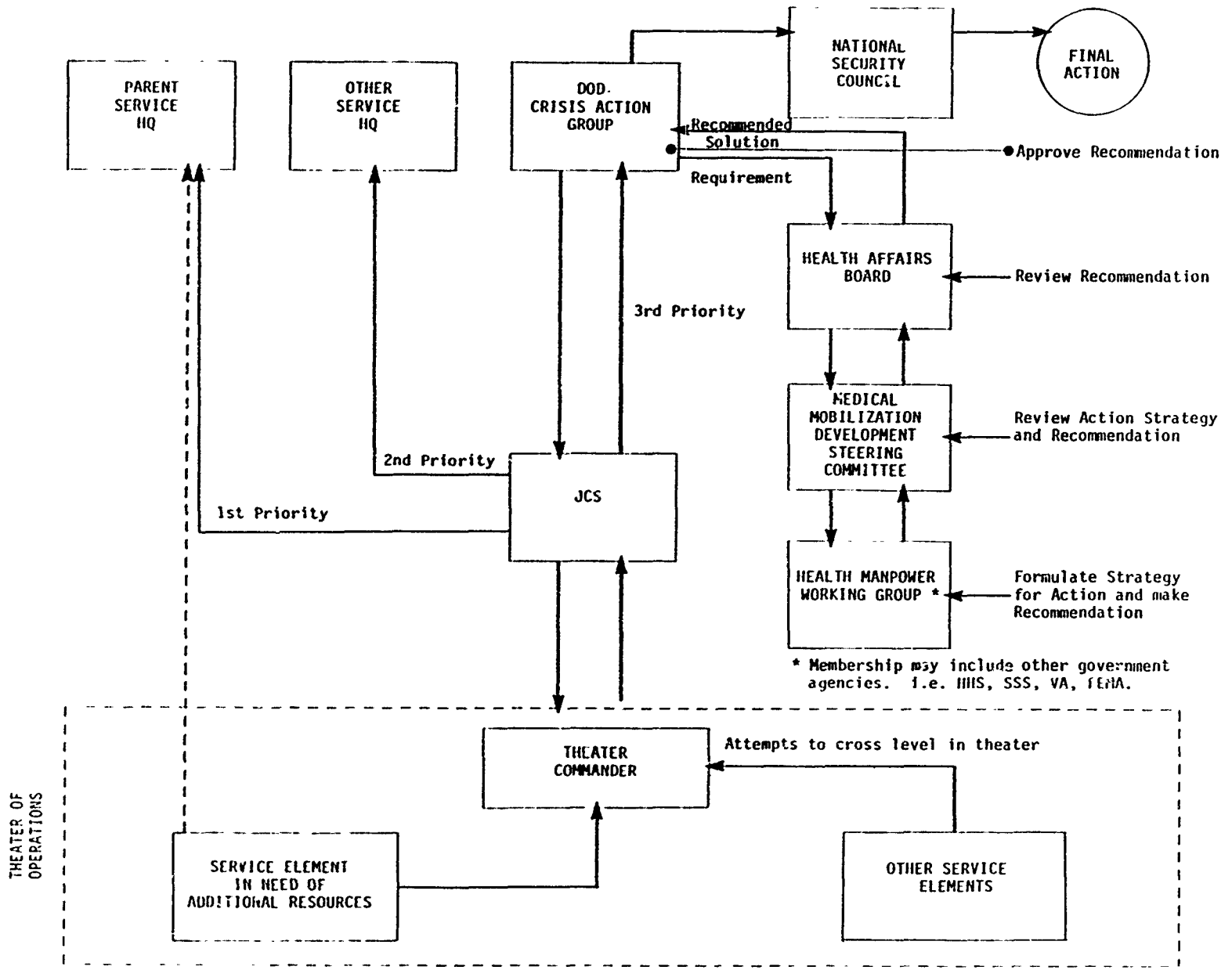
Since it is possible that the VA could become a claimant agency for health manpower resources during mobilization, two VA health manpower issues were examined in some detail. These were:

- The VA's method of determining manpower requirements, and
- The availability of data on VA medical personnel.

The number of health personnel in the VA is determined through the budgeting process. A portion of the annual Congressional appropriation to the VA is earmarked to support a prescribed number of Full Time Equivalent (FTE) health provider spaces. Each year there are adjustments

Exhibit 5

DOD CRISIS ACTION SYSTEM DIAGRAM



to the previous year's allocation to accomodate known expansions, added missions, technology advances generating new skills, and other similar developments.

Within the VA medical structure, there are opportunities to shift FTE and accompanying funds between districts and among VA medical centers to meet shifting workload patterns and mission changes. This is a zero sum environment, however, in that for every increase in funded FTEs in one area, there must be an equivalent decrease in another area.

There have been attempts in the past to establish staffing standards that would be used in a building block fashion to develop VA-wide health manpower requirements, but none has been implemented to date. One such effort was undertaken by the National Academy of Sciences at the request of Congress, in about 1977. This study resulted in recommendations that the VA develop staffing standards internally. There have been a number of efforts to develop such standards, but none has come to fruition.

The most recent approach to developing an expression of health personnel staffing needs is through the Medical District Initiated Planning Program, or MEDIPP. This is a comprehensive planning initiative designed to involve administrative and clerical personnel at all levels of the Department of Medicine and Surgery, in defining the changes considered necessary to meet future health care delivery needs in all elements of the VA's health care system. Each organizational level in the VA has a specific responsibility designed to enhance cooperation at all levels of the Department, and to ensure implementation of the planning process. Manpower requirements will be one of a number of resource issues to be addressed in MEDIPP. Since MEDIPP is relatively new, there are as yet no data developed in the manpower requirements area.

With regard to forecasting emergency health manpower needs for mobilization, the Director of Manpower Services at the VA Central Office indicated that this is an area that needs to be explored further by the VA.

It was mentioned earlier in this report that in the judgment of certain VA officials, the VA could continue to perform its mission after

losing 5 percent of its health provider staff through activation of the reserve forces. This estimate was probably based on the fact that currently, 70 percent of the patients cared for are veterans who are in low priority care categories. Therefore, under emergency circumstances, DoD patients would have a higher priority, and the lower priority beneficiaries could be legally deferred, delayed, or cared for under other programs.

One important observation to be made here is that it may be inappropriate to assume that, because the VA can continue to perform its overall mission, each VA medical center will be able to do so as well. It could be that certain VA medical centers will be unable to perform their mission, should there be an increase in workload and a decrease in staffing. This would have to be examined on a case-by-case basis before any conclusions could be drawn.

### 3.1.4 The Availability of Data on VA Medical Personnel

Personnel involved in providing care to veterans represent over 90 percent of all personnel employed by the VA. For FY 1984, it is expected that there will be approximately 220,000 health care personnel in the VA. The full time equivalent for medical personnel is approximately 187,000. This figure breaks down by occupational skill category as follows:

| | |
|---|---|
| • Physicians | 13,141 |
| • Physicians Assistants | 485 |
| Dentists | 1,048 |
| • Podiatrists | 78 |
| • Optometrists | 77 |
| • Registered Nurses | 31,041 |
| • LPNs, LVNs, Nurse Aides, and Nurse Assistants | 29,258 |
| • Technical and Allied Health Personnel | 29,804 |
| • Administrative and Clerical Personnel | 45,227 |
| • Other (Maintenance, etc.) | 37,369 |
| TOTAL | 187,528 FTE |

There is an extensive data base maintained on all personnel employed by the VA, which is incorporated into a system known as PAID, Personnel and Accounting Integrated Data System, operated out of the VA Data Processing Center in Austin, Texas. The data base includes such information as medical specialty, age, location, certification, and other similar items. VA personnel interviewed indicated that magnetic tapes of personnel information from the PAID system would be made available to other government agencies upon request from appropriate authority.

## 3.2 ANALYSIS OF CIVILIAN SECTOR HEALTH MANPOWER SUPPLY

The analysis of civilian sector health manpower supply had two basic thrusts--first, a common set of occupational titles were established between the military and civilian sectors; second, estimates were prepared of the total civilian supply of professionals in each of the occupational categories. The first part of the effort was accomplished by comparing DoD's "Listing of Enlisted Personnel and Officers by Occupation," with information published by the Department of Health and Human Services (DHHS) and the Department of Labor (DoL). The second part was accomplished by accessing data prepared by DHHS (and contained in the Area Resource File) and DoL. It should be noted that when data were available from both sources, DHHS was used as the preferred source because it tended to be more specific. Next, analyses were conducted to assess the impact of projected military requirements on the resultant civilian supply/requirements

The comparison of occupational classifications between civilian and military manpower specialties was accomplished with some degree of difficulty. In the case of physician specialties, it was generally straightforward and in most instances, there was a one-to-one correspondence. The only difficulty encountered was when certain military delineated sub-specialties, such as peripheral vascular surgeon and nuclear medical specialties, were not separated out as specialties in civilian data bases.

The physician specialties were analyzed at two levels:

- Four general groupings--"General Practice," "Medical Specialties," "Surgical Specialties," and "Other Specialties": and
- Thirty-five designated specialties among the four general groupings, e.g. thoracic surgery as a surgical specialty.

In the case of non-physician health manpower occupations (in matching the civilian counterpart to military specialties), consideration was given only to those for which DoD has projected that a mobilization shortage will exist. These are listed in Appendix C. While some were easily matched, e.g. podiatrist, physical therapist, etc., others were problematic. Some of the factors encountered were:

- The nursing and veterinary specialties cited, while compatible with civilian titles, are not identified in civilian data bases. Accordingly, these were grouped into the general categories of "veterinarians" and "nurses."
- It had to be recognized that differences in title, function, and training exist between the civilian and military sectors. For instance, a Navy Hospital Corpsman is considered comparable to a civilian LPN.
- Recognition that there is variation in training requirements for a given occupational title within the civilian sector, among the Services, and between the civilian and military sectors.
- Titles for similar positions varied widely among the Services. For instance what the Army designates as a "Medical Specialist" is termed a "Hospitalman Apprentice" in the Navy, and a "Medical Service Specialist" in the Air Force. However, these are not strictly comparable in terms of either training or responsibilities.
- Some positions did not exist in all of the three Services.

The non-physician manpower occupations were classified as follows:

- The six major groupings of professional occupations, clerical occupations, service occupations, maintenance occupations, clerical occupations, and other occupations were constructed; and
- The six groupings, in turn, were subdivided into 31 classifications e.g., psychologist as a professional occupation.

In instances where questions existed about comparability between the military and civilian sectors, consultation was held with DoD

personnel to resolve the issues. The civilian titles and corresponding general DoD Occupation Codes for the three Services are shown in Appendix D against formats that could be used for planning purposes.

### 3.2.1 Civilian Sector Physician Supply

Based on the AMA Physician Distribution for 1980, Table 2 presents a listing of civilian physicians by major groups and the specialties within these groups. These data are a good approximation of the aggregate physician supply.

The two residual categories under "Other Specialties" are:

- "Other" is a grouping of minor subspecialties, and those subspecialities not accorded AMA recognition as yet; and
- The "Unspecified" denotes those physician-respondents to the survey who elected not to declare a specialty.

With reference to the table, three values are presented for each group and specialty:

1. The first column presents the total supply of physicians excluding those on active duty in the Services;
2. The second column represents those physicians providing direct patient care as their primary practice activity. Actually, this is to some degree an understatement of the total number of physicians in patient care as many in teaching, administrative, and research positions provide patient care as part of their responsibilities; and
3. The third column provides the ratios of population to providers i.e., the total population of the United States divided by the number of patient care physicians in each group specialty.

### 3.2.2 Civilian Non-Physician Manpower

Table 3 shows the non-physician providers for each of the 31 occupational categories where DoD expects to encounter a shortfall. The comparable general title employed by the military is shown in parentheses. Only two columns are provided--the total, and provider to population ratios--since all personnel shown are assumed to be involved in patient care. This represents an overstatement as many could be unemployed or in administrative, research, or other positions. However, more detailed information was not available from either the DoL or DHHS.

TABLE 2: FEDERAL AND NON-FEDERAL PHYSICIANS BY SPECIALTY. CIVILIAN AND MILITARY SECTORS. U.S. AND POSSESSIONS. 1980.

| SPECIALTY | TOTAL SUPPLY | | |
|---|---|---|---|
| | Total Physicians (A) | Physicians in Patient Care (B) | POP/PHYS Ratio (C=226505K/B) |
| TOTAL PHYSICIANS | 467,679 | 376,512 | 601 |
| GENERAL PRACTICE | 60,049 | 58,633 | 3,863 |
| GP-Gen. Practice | 32,519 | 31,920 | 7,096 |
| FP-Fam. Practice | 27,530 | 26,713 | 8,479 |
| MEDICAL SPEC. | 125,755 | 109,543 | 2,068 |
| A-Allergy | 1,518 | 1,419 | 159,523 |
| CD-Cardiovasc. Dis. | 9,823 | 7,759 | 29,193 |
| D-Dermat. | 5,660 | 5,356 | 42,289 |
| GE-Gastroent. | 4,046 | 3,086 | 73,397 |
| IM-Int. Medic. | 71,531 | 62,959 | 3,597 |
| PD-Pediat. | 28,342 | 25,435 | 8,905 |
| PDA-Ped. Allergy | 461 | 395 | 573,430 |
| PDC-Ped. Cardiol. | 659 | 466 | 486,062 |
| PUD-Pulmon. Dis. | 3,715 | 2,668 | 84,896 |
| SURGICAL SPEC. | 110,778 | 106,486 | 2,147 |
| GS-Gen. Surg. | 34,034 | 32,587 | 6,950 |
| NS-Neurol. Surg. | 3,341 | 3,198 | 70,827 |
| OBG-OB/GYN | 26,305 | 25,261 | 8,966 |
| OPH-Ophthalm. | 12,974 | 12,448 | 18,196 |
| ORS-Ortnop. Surg. | 13,996 | 13,596 | 16,659 |
| OTO-Otolaryng. | 6,553 | 6,333 | 35,765 |
| PS-Plastic Surg. | 2,980 | 2,873 | 78,839 |
| CRS-Colon & Rect. Surg | 719 | 699 | 324,041 |
| TS-Thoracic Surg. | 2,133 | 1,976 | 114,628 |
| U-Urol. | 7,743 | 7,515 | 30,140 |
| OTHER SPEC. | 118,334 | 101,850 | 2,223 |
| AM-Aerosp. Med. | 587 | 370 | 612,175 |
| AN-Anesthes. | 15,958 | 14,945 | 15,155 |
| CHP-Child Psyc. | 3,271 | 2,649 | 85,505 |
| DR-Diagn. Radiol. | 7,048 | 6,568 | 34,486 |
| FOP-Forensic Pathol. | 240 | 137 | 1,653,321 |
| N-Neurology | 5,685 | 4,776 | 47,425 |
| OM-Occup'l Medic. | 2,358 | 1,702 | 133,081 |
| P-Psych. Med. & Rehab. | 27,481 | 24,469 | 9,256 |
| PTH-Pathol. | 13,402 | 11,067 | 20,466 |
| PM-Phys. Med & Rehab. | 2,146 | 1,927 | 117,542 |
| GPM-Gen. Prev. Med. | 810 | 394 | 574,885 |
| PH-Public Health | 2,316 | 621 | 364,742 |
| R-Radiology | 11,653 | 10,770 | 21,031 |
| TR-Therap. Radiol. | 1,581 | 1,495 | 151,508 |
| OTHER 3/ | 11,509 | 8,395 | 27,306 |
| UNSPECIFIED | 12,289 | 11,565 | 19,585 |

Source: AMA Physician Distribution for 1980 (Columns A and B), List of Total Enlisted Medical Personnel in 3.31.82 (Columns D and E), Selective Services Needs constrained by available facilities and skill substitution in 2.4.83 (Column F)

TABLE 3: SUPPLY OF NONPHYSICIAN HEALTH MANPOWER WITH NET DOD WARTIME REQUIREMENTS BY OCCUPATION

| OCCUPATION | TOTAL SUPPLY | |
|---|---|---|
| Civilian (Military) Title | Total (A) | POP/PROV Ratio (B=226505K/A) |
| Professional Occupations | | |
| • Biological Scientist (Physiologist) | 4,020 | 56,345 |
| • Psychologist (Psychologist) | 15,020 | 15,080 |
| • Dentist (General Dental Officer) | 50,780 | 4,461 |
| • Dietitian (Hospital Dietitian) | 15,240 | 14,863 |
| • Nurse, Professional (General Nurse Officer | 940,850 | 241 |
| • Occupational Therapist (Occupational Therapist) | 13,620 | 16,630 |
| • Physical Therapist (Physical Therapist) | 28,040 | 8,078 |
| • Podiatrist (Podiatrist) | 4,040 | 56,066 |
| • Respiratory Therapist (Respiratory Specialist) | 38,080 | 5,948 |

SOURCES: Occupational Employment in Selected Non-manufacturing Industries. U.S. Department of Labor, Bureau of Labor Statistics, May 1981. (This source provided non-hospital employment in May of 1978 for Column A.)

Occupational Labor Statistics. U. S. Department of Labor, Bureau of Labor Statistics, 1980. (This source provided hospital employment in April of 1980 for Column A.)

TABLE 3: SUPPLY OF NONPHYSICIAN HEALTH MANPOWER WITH NET DOD WARTIME REQUIREMENTS BY OCCUPATION (Continued)

| OCCUPATION<br>Civilian (Military) Title | TOTAL SUPPLY<br>Tot (A) | <br>POP/PROV Ratio (B=226505K/A) |
|---|---|---|
| Service Occupations | | |
| • Dental Assistant (Dental Specialist) | 116,580 | 1,943 |
| • Licensed Practical Nurse (Hospital Corpsman) | 306,270 | 740 |
| • Physician's Assistant (Physician's Assistant) | 19,620 | 11,545 |
| • Surgical Technician (Operating Room Technician) | 31,620 | 7,163 |
| • Radiologic Technician (X-Ray Technician | 64,950 | 3,487 |
| • Medical Record Technician (Patient Administration Specialist) | 30,412 | 6,221 |
| • Medical Laboratory Technician (Laboratory Technician) | 83,350 | 2.718 |
| • Pharmacy Technician (Pharmacy Technician) | 22,800≤ | 9,934 |
| • Physical Therapy Assistant (Physical Therapy Specialist) | 26,380 | 8.580 |

TABLE 3: SUPPLY OF NONPHYSICIAN HEALTH MANPOWER WITH NET DOD WARTIME REQUIREMENTS BY OCCUPATION (Continued)

| OCCUPATION | TOTAL SUPPLY | |
|---|---|---|
| Civilian (Military) Title | Tot (A) | POP/PROV Ratio (B=226505K/A) |
| **Service Occupations** | | |
| • Dietary Technician (Hospital Food Service Specialist) | 38,022 | 5,957 |
| • Psychiatric Aide (Psychiatric Specialist) | 117,610 | 1,926 |
| • Paramedic EMT Personnel (Medical Specialist) | 26,973 | 8,397 |
| • Occupational Therapy Assistant (Occupational Therapy Specialist) | 680 | 333,096 |
| **Maintanance Occupations** | | |
| • Electromedical Equipment Repair (Biomedical Equipment Repair Technician) | 3,270 | 69,268 |
| **Clerical Occupations** | | |
| • Medical Shipping and/or Receiving Clerk (Medical Supply Specialist) | 5,490 | 41,258 |
| **Occupations Not Listed in BLS** | | |
| • Environmental Health Specialist | -- | -- |
| • Entomologist | -- | -- |
| • Orthotic Specialist | -- | -- |
| • Clinical Pharmacologist | -- | -- |
| • Veterinarian | -- | -- |
| • Optical Laboratory | -- | -- |
| • All Other Professional and Technical Occupations | 92,420 | 2,451 |

### 3.2.3 Civilian Sector Requirements

While the military employs simulations to estimate requirements, the civilian sector has no such approach available for widespread use. In order to develop "measures" of the adequacy of the numbers of providers, the civil sector has used various methods. Provider associations have employed panels of experts to develop measures based on professional judgment. Researchers have examined utilization data to develop measures based upon user demand. Further, practitioners and researchers have examined morbidity and provider productivity data to produce estimates based upon expected demand.

These measures suffer from a number of problems, two of which essentially eliminate them from universal acceptance and use. These are: (1) the specialty-specific measures are available principally for the physician specialties and then are only available for about half the specialties, and (2) where more than one measure exists for a particular specialty, these tend to vary so greatly that they are typically dismissed. As an example of the latter problem, the desired population to provider ratio for radiologists estimated from two different sources was 7,400:1 and 20,000:1. With this wide range, the estimates are quite suspect. Where such variation is coupled with the fact that measures are generally not available for about one-half of the physician specialties, the use of such measures is all the more problematic.

An associated problem of substantial importance when considering civilian sector requirements is that of geographic distribution. While many times national data is used to set policy, it is particularly troublesome when attempting to employ measures in small population areas. For example, the range of acceptability for thoracic surgeons is found to be between 100,000:1 and 200,000:1, the question arises as to the utility of such numbers, for example, in a catchment area with only 130,000 people.

Part of this problem, is being able to define health care catchment areas. Geographical entities such as counties have limited value. For instance, at one extreme, an area such as Los Angeles County has numerous catchment areas whereas in some rural areas, a catchment

area may cover several counties. To a great extent, even the delineation of catchment areas is determined by existing health care resources. What has never been satisfactorily developed is an index that combines population density and geopolitical parameters.

With regard to the use of national data, this topic requires considerable attention. Since most of the subspecialty providers tend to be located near population centers, a major segment of the population does not have ready access to the care offered by such providers. Therefore, the use of measures, or alternatively, only examining total numbers of providers on a national basis tends to mask the geographic maldistribution of the providers.

For instance, the estimated population to physican ratio for neurosurgeons is 71,000:1, which is well below the lower bound of the estimated desired population-to-physician ratio of 78,000:1. Obviously, not too many neurosurgeons practice in medically underserved areas if for no other reason, because of the manpower and equipment resources required to support such a practice. Such concerns do suggest the use of disaggregated data, at state and lower levels, to study the true impact of these allocation problems.

### 3.2.4 Civilian Sector Shortages Under Wartime Mobilization

This section describes the procedures used to provide indicators of potential civilian shortages under wartime mobilization. Because the general computational procedures used for physician and non-physician manpower were the same, the approach will be presented before examining the findings. As stated above, the first step in the computational procedures was to obtain the total supply of health manpower by specialty, and for physicians, the supply directly involved in patient care activities. These values were then divided into the total U.S. population to compute a total Population/Provider ratio. Subsequently, the total patient care supply was decremented by the military reservists, who would expected to be the first group added to the active military, and by the estimated wartime shortages forecast by the military. The resultant values represent the net health manpower supply on a national basis available to the civilian population. This result was then used to

compute the Net Population/Provider Ratio. This net ratio was then divided by the Total Population/Provider Ratio to present a rough measure of the pressure placed by total wartime military requirements on the supply of health manpower resources.

In the case of physicians, where measures of the minimum acceptable Population/Provider Ratio were available from the literature, the net ratios were divided by these figures to obtain an indication of the relative shortages that would be experienced in the civilian sector meeting wartime military requirements. The resulting applications of this approach are presented below.

Tables 4 and 5 apply the procedures described above to physician specialties. It will be noted that many of the specialties contain desired Population/Physician Ratios that have been defined through professional judgement or demand-productivity ratios. With regard to Table 4, it will be noted that the first three columns were displayed in Table 2. However, the total supply information is supplemented with military active duty and reserve supply data, as well as the forecast of military wartime shortages. Subtracting the military supply and requirements from the available civilian sector supply yields the net civilian supply. Columns G and H of Table 4 represent the Net Total and Net Patient Care Physicians, respectively. Column I presents the Net Population/Provider ratio for each of the medical specialities in patient care.

The anomaly with respect to the Aerospace Medicine specialty is that in the civilian sector, most holding this specialty are actually board-certified. However, in the active-duty and military reserves sector, while some of the physicians are board-certified in Aerospace Medicine, the occupation in all three services is also a position title.

Table 5 attempts to refine the supply information. The first two columns of this table are simply repeats of the total and net Population/Patient Care Provider Ratios from Table 4. The third column presents the range of literature-based minimum ratios for comparison of

TABLE 4: FEDERAL AND NON-FEDERAL PHYSICIANS BY SPECIALTY. CIVILIAN AND MILITARY SERVICES. U.S. AND POSSESSIONS. 1980.

| SPECIALTY | TOTAL SUPPLY | | | MILITARY SUPPLY & REQUIREMENT | | | NET CIVILIAN SUPPLY | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Military Supply | | | | | |
| | Total Physicians (A) | Physicians in Patient Care (B) | POP/PHYS Ratio (C=226505K/B) | Active Duty (D) | Reserve (E) | Military Shortage (F) | Total (G=A-D-E-F) | Patient Care (H=B-D-E-F) | POP/PHYS Ratio (I=226505K/H) |
| TOTAL PHYSICIANS | 467,679 | 376,512 | 601 | 10,119 | 19,083 | 4,470 | 434,007 | 342,840 | 661 |
| GENERAL PRACTICE | 60,049 | 58,633 | 3,863 | 3,199 | 6,398 | - | 50,452 | 49,036 | 4,619 |
| GP-Gen. Practice | 32,519 | 31,920 | 7,096 | 1,999 | 4,225 | - | 26,295 | 25,696 | 8,815 |
| FP-Fam. Practice | 27,530 | 26,713 | 8,479 | 1,200 | 2,173 | - | 24,157 | 23,340 | 9,705 |
| MEDICAL SPEC. | 125,755 | 109,543 | 2,068 | 2,503 | 2,756 | 179 | 120,317 | 104,177 | 2,174 |
| A-Allergy | 1,518 | 1,419 | 159,623 | 23 | 28 | 10 | 1,457 | 1,358 | 166,793 |
| CD-Cardiovasc. Dis. | 9,823 | 7,759 | 29,193 | 66 | 79 | 13 | 9,665 | 7,601 | 29,799 |
| D-Dermat. | 5,660 | 5,356 | 42,289 | 139 | 162 | - | 5,359 | 5,355 | 42,298 |
| GE-Gastroent. | 4,046 | 3,086 | 73,397 | 35 | 52 | 15 | 3,944 | 2,984 | 75,907 |
| IM-Int. Medic. | 71,531 | 62,959 | 3,597 | 1,298 | 1,735 | 134 | 68,364 | 59,792 | 3,788 |
| PD-Pediat. | 28,342 | 25,435 | 8,905 | 870 | 610 | - | 26,852 | 23,955 | 9,455 |
| PDA-Ped. Allergy | 461 | 395 | 573,430 | 8 | 9 | - | 444 | 378 | 599,220 |
| PDC-Ped. Cardiol. | 659 | 466 | 486,062 | 11 | 7 | - | 641 | 448 | 505,592 |
| PUD-Pulmon. Dis. | 3,715 | 2,668 | 84,896 | 43 | 74 | 7 | 3,591 | 2,544 | 89,035 |
| SURGICAL SPEC. | 110,778 | 106,406 | 2,147 | 1,686 | 5,258 | 4,077 | 99,757 | 94,465 | 2,398 |
| GS-Gen. Surg.5/ | 34,034 | 32,587 | 6,950 | 731 | 1,673 | 1,904 | 29,726 | 28,279 | 8,010 |
| NS-Neurol. Surg. | 3,341 | 3,198 | 70,827 | 54 | 147 | 103 | 3,037 | 2,894 | 78,267 |
| OBG-OB/GYN | 26,305 | 25,261 | 8,966 | 57 | 1,367 | - | 24,881 | 23,837 | 9,502 |
| OPH-Ophthalm. | 12,974 | 12,448 | 18,196 | 166 | 430 | - | 12,378 | 11,852 | 19,111 |
| ORS-Orthop. Surg. | 13,996 | 13,596 | 16,659 | 300 | 722 | 1,927 | 11,047 | 10,647 | 21,274 |
| OTO-Otolaryng. | 6,553 | 6,333 | 35,765 | 154 | 329 | 32 | 6,038 | 5,818 | 38,932 |
| PS-Plastic Surg. | 2,980 | 2,873 | 78,839 | 23 | 107 | 13 | 2,837 | 2,730 | 82,969 |
| CRS-Colon & Rect. Surg | 719 | 699 | 324,041 | 4 | 7 | - | 708 | 688 | 329,222 |
| TS-Thoracic Surg. 9/ | 2,133 | 1,976 | 114,628 | 47 | 161 | 66 | 1,859 | 1,702 | 133,082 |
| U-Urol. | 7,743 | 7,515 | 30,140 | 150 | 315 | 32 | 7,246 | 7,018 | 32,275 |
| OTHER SPEC. | 118,334 | 101,850 | 2,223 | 2,731 | 4,671 | 214 | 110,718 | 94,234 | 2,404 |
| AM-Aerosp. Med. 4/ | 557 | 370 | 612,175 | 935 | 1,626 | - | -1,974 | -2,191 | -103,380 |
| AN-Anesthes. | 15,958 | 14,945 | 15,155 | 264 | 441 | 200 | 15,053 | 14,040 | 16,133 |
| CHP-Child Psyc. | 3,271 | 2,649 | 85,505 | - | - | - | 3,271 | 2,649 | 85,505 |
| DR-Diagn. Radiol. | 7,048 | 6,568 | 34,486 | 391 | 359 | - | 6,298 | 5,818 | 38,932 |
| FOP-Forensic Pathol. | 240 | 137 | 1,653,321 | - | - | - | 240 | 137 | 1,653,321 |
| N-Neurology | 5,685 | 4,776 | 47,425 | 112 | 140 | - | 5,433 | 4,524 | 50,067 |
| OM-Occup'l Medic. | 2,358 | 1,702 | 133,081 | 2 | 10 | 6 | 2,340 | 1,684 | 134,504 |
| P-Psych. Med. & Rehab. | 27,481 | 24,469 | 9,256 | 440 | 709 | 8 | 26,324 | 23,312 | 9,716 |
| PTH-Pathol. | 13,402 | 11,067 | 20,466 | 371 | 470 | - | 12,561 | 10,226 | 22,150 |
| PM-Phys. Med & Rehab. | 2,146 | 1,927 | 117,542 | 84 | 91 | - | 1,971 | 1,752 | 129,284 |
| GPM-Gen. Prev. Med. | 810 | 394 | 574,885 | 73 | 117 | - | 620 | 204 | 1,110,319 |
| PH-Public Health | 2,316 | 621 | 364,742 | - | 22 | - | 2,294 | 599 | 378,138 |
| R-Radiology | 11,653 | 10,770 | 21,031 | 9 | 589 | - | 11,055 | 10,172 | 22,267 |
| TR-Therap. Radiol. | 1,581 | 1,495 | 151,508 | 22 | 75 | - | 1,484 | 1,398 | 162,021 |
| OTHER 6/ | 11,509 | 8,395 | 27,306 | 28 | 22 | - | 11,459 | 8,245 | 27,472 |
| UNSPECIFIED | 12,289 | 11,565 | 19,585 | - | - | - | 12,289 | 11,565 | 19,585 |

Source: AMA Physician Distribution for 1980 (Columns A and B), List of Total Enlisted Medical Personne. in 3.31.82 (Columns D and E), Selective Services Needs constrained by available facilities and skill substitution in 2.4.83 (Column F)

TABLE 5: COMPARISON BETWEEN NET AND TOTAL POPULATION/PHYSICIAN RATIOS BY SPECIALTY. 1980.

| Physician Specialty | Total POP/PHYS Ratio 1/ (A) | Net POP/PHYS Ratio 2/ (B) | Desired POP/PHYS Ratio 3/ (C) | Net as Percent Total Ratio (D=B/A) | Net as Percent of Desired Ratio (E=B/C) |
|---|---|---|---|---|---|
| TOTAL PHYSICIANS | 601 | 661 | 534 - 999 | 1.10 | 1.24 - .66 |
| GENERAL PRACTICE | 3,863 | 4,619 | NA | 1.20 | NA |
| GP-Gen. Practice | 7,096 | 8,815 | NA | 1.24 | NA |
| FP-Fam. Practice | 8,479 | 9,705 | NA | 1.14 | NA |
| MEDICAL SPEC. | 2,068 | 2,174 | NA | 1.05 | NA |
| A-Allergy* | 159,623 | 166,793 | 25,000 | 1.04 | 6.67 |
| CD-Cardiovasc. Dis.* | 29,193 | 29,799 | 25,000 - 77,000 | 1.02 | 1.19 - .39 |
| D-Dermat. | 42,289 | 42,298 | 40,00 - 50,000 | 1.00 | 1.06 - .85 |
| GE-Gastroent.* | 73,397 | 75,907 | 50,000 | 1.03 | 1.52 |
| IM-Int. Medic.* | 3,597 | 3,788 | NA | 1.05 | NA |
| PD-Pediat. | 8,905 | 9,455 | 10,000 | 1.06 | .95 |
| PDA-Ped. Allergy | 573,430 | 599,220 | NA | 1.04 | NA |
| PDC-Ped. Cardiol. | 486,062 | 505,592 | NA | 1.04 | NA |
| u mon. Dis.* | 84,896 | 89,035 | 100,000 | 1.05 | .89 |
| | | | NA | 1.12 | NA |
| GS-Gen. Surg. * | 6,950 | 8,010 | NA | 1.15 | NA |
| NS-Neurol. Surg.* | 70,827 | 78,267 | 77,000 - 162,000 | 1.11 | 1.02 - .48 |
| OBG-OB/GYN | 8,968 | 9,502 | NA | 1.06 | NA |
| OPH-Ophthalm. | 18,196 | 19,111 | 20,000 | 1.05 | .96 |
| ORS-Orthop. Surg.* | 16,659 | 21,274 | 20,000 - 35,000 | 1.28 | 1.06 - .61 |
| OTO-Otolaryng.* | 35,765 | 38,932 | 25,000 - 70,400 | 1.09 | 1.56 - .55 |
| PS-Plastic Surg.* | 78,839 | 82,969 | 50,000 - 150,000 | 1.05 | 1.66 - .55 |
| CRS-Colon & Rect. Surg | 324,041 | 329,222 | NA | 1.02 | NA |
| TS-Thoracic Surg.* | 114,628 | 133,082 | 100,000 - 200,000 | 1.16 | 1.33 - .67 |
| U-Urol.* | 30,140 | 32,275 | 21,000 - 50,000 | 1.07 | 1.52 - .65 |
| OTHER SPEC. | 2,223 | 2,404 | NA | 1.08 | NA |
| AM-Aerosp. Med. | 612,175 | -103,380 | NA | -.17 | NA |
| AN-Anesthes.* | 15,155 | 16,133 | 8,457 - 17,544 | 1.06 | 1.91 - .92 |
| CHP-Child Psyc. | 85,505 | 85,505 | NA | 1.00 | NA |
| DR-Diagn. Radiol. | 34,486 | 38,932 | NA | 1.13 | NA |
| FOP-Forensic Pathol. | 1,653,321 | 1,653,321 | NA | 1.00 | NA |
| N-Neurology | 47,425 | 50,067 | 60,000 - 77,000 | 1.06 | .83 - .65 |
| OM-Occup'l Medic.* | 133,081 | 134,504 | NA | 1.01 | NA |
| P-Psych.* | 9,256 | 9,716 | 4,800 - 14,300 | 1.05 | 2.02 - .68 |
| PTH-Pathol. | 20,466 | 22,150 | 17,400 - 33,000 | 1.08 | 1.77 - .67 |
| PM-Phys. Med & Rehab. | 117,542 | 129,284 | NA | 1.10 | NA |
| GPM-Gen. Prev. Med. | 574,885 | 1,110,319 | NA | 1.93 | NA |
| PH-Public Health | 364,742 | 378,138 | NA | 1.04 | NA |
| R-Radiology | 21,031 | 22,267 | 7,400 - 20,000 | 1.06 | 3.00 - 1.11 |
| TR-Therap. Radiol. | 151,508 | 162,021 | NA | 1.07 | NA |
| OTHER | 27,306 | 27,472 | NA | 1.01 | NA |
| UNSPECIFIED | 19,585 | 19,585 | NA | 1.00 | NA |

Sources: Table 1 (Columns A and B), Area Resource File (Column C).

*Specialities with military wartime shortage.

total physicians and the eighteen specialties for which such estimates are available. Finally, the last two columns present relative indicators of net supply. Column D, The Net Population/Provider Ratio as a percentage of the Total Population/Provider Ratio, indicates the impact of the military drawdown of the total supply of physicians in patient care. This column may be interpreted as follows:

- For values approximating 1.00, the military requirements have little or no impact; and
- As the value grows (e.g., General Practice equals 1.20), the military requirement has an increasing impact.

To continue the interpretation, the value in Column D for General Preventive Medicine is seen to approximate 2.00 (the actual value is 1.93). This indicates that satisfying the projected military requirements will reduce the civilian supply by approximately one-half.

Column E of this table shows that for those groups where desired Population/Physician Ratios are available, if the lower bound estimate is used, the following would be in short supply:

- Total Physicians
- Allergists
- Cardiovascular Specialists
- Gastroenterologists
- Otolaryngologists
- Plastic Surgeons
- Thoracic Surgeons
- Urologists
- Anesthesiologists
- Psychiatrists
- Pathologists
- Radiologists

Table 6 applies the same procedures to non-physician health manpower categories that have wartime military requirements. In most cases, it was possible to identify corresponding civilian titles in the Bureau of Labor Statistics, after discussions with DoD health specialists. However, the task was time-consuming and it is suggested that future efforts should be undertaken to establish common terminology both within the military and civilian sectors, and between the two

TABLE 6: SUPPLY OF NONPHYSICIAN HEALTH MANPOWER WITH NET DOD WARTIME REQUIREMENTS BY OCCUPATION

| OCCUPATION | TOTAL SUPPLY | | MILITARY SUPPLY & REQ | | | NET CIVILIAN SUPPLY | | NET AS PERCENT TOTAL POP/PROV RATIO |
|---|---|---|---|---|---|---|---|---|
| | | | Military Supply | | Military Shortage | | | |
| Civilian (Military) Title | Total (A) | POP/PROV Ratio (B=226505K/A) | Active Duty (C) | Reserve (D) | (E) | Total (F=A-C-D-E) | POP/PROV Ratio (G=226505K/F) | (H) |
| Professional Occupations | | | | | | | | |
| • Biological Scientist (Physiologist) | 4,020 | 56,345 | ? | ? | 3 | -- | -- | -- |
| • Psychologist (Psychologist) | 15,020 | 15,080 | ? | ? | 6 | -- | -- | -- |
| • Dentist (General Dental Officer) | 50,780 | 4,461 | 1,344 (4,861) | 1,788 (9,724) | 161 | 47,497 (36,034) | 4,769 (6,286) | 1.07 (1.41) |
| • Dietitian 1/ (Hospital Dietitian) | 15,240 | 14,863 | 187 (290) | 294 (396) | 26 | 14,733 (14,528) | 15,374 (15,591) | 1.03 (1.05) |
| • Nurse, Professional 21/ (General Nurse Officer) | 940,850 | 241 | 7,143 (10,793) | 12,580 (18,223) | 5,440 | 915,687 (906,394) | 247 (250) | 1.02 (1.04) |
| • Occupational Therapist (Occupational Therapist) | 13,620 | 16,630 | 99 | 160 | 4 | 13,357 | 16,958 | 1.02 |
| • Physical Therapist (Physical Therapist) | 28,040 | 8,078 | 346 | 568 | 2 | 27,124 | 8,351 | 1.03 |
| • Podiatrist (Podiatrist) | 4,040 | 56,066 | 100 | 138 | 17 | 3,785 | 59,843 | 1.07 |
| • Respiratory Therapist (Respiratory Specialist) | 38,080 2/ | 5,948 | 199 | 90 | 506 | 37,285 | 6,075 | 1.02 |

SOURCES: Occupational Employment in Selected Non-manufacturing Industries. U.S. Department of Labor, Bureau of Labor Statistics, May 1981. (This source provided non-hospital employment in May of 1978 for Column A.)

Occupational Labor Statistics. U. S. Department of Labor, Bureau of Labor Statistics, 1980. (This source provided hospital employment in April of 1980 for Column A.)

Listing of DoD Enlisted Personnel and Officers by Occupation. Department of Defense, March 1982 (source for Columns C and D).

Selective Service Needs. Department of Defense, February 1983 (source for Column E).

Area Resource File (for Veterinarians)

TABLE 6: SUPPLY OF NONPHYSICIAN HEALTH MANPOWER WITH NET DOD WARTIME REQUIREMENTS BY OCCUPATION (Continued)

| OCCUPATION | TOTAL SUPPLY | | MILITARY SUPPLY & REQ | | | NET CIVILIAN SUPPLY | | NET AS PERCENT TOT POP/PROV RATIO |
|---|---|---|---|---|---|---|---|---|
| | | | Military Supply | | Military Shortage | | | |
| Civilian (Military) Title | Tot (A) | POP/PROV Ratio (B=226505K/A) | Active Duty (C) | Reserve (D) | (E) | Tot (F=A-C-D-E) | POP/PROV Ratio (G=226505K/F) | (H) |
| Technical Occupations | | | | | | | | |
| • Dental Assistant (Dental Specialist) | 116,580 | 1,943 | 2,274 (7,814) | 1,786 (4,084) | 880 | 111,640 (103,802) | 2,029 (2,182) | 1.04 (1.12) |
| • Licensed Practical Nurse (Hospital Corpsman) | 306,270 | 740 | 4,477 (19,768) | 8,056 (3,630) | 5,313 | 288,424 (277,559) | 785 (816) | 1.06 (1.10) |
| • Physician's Assistant (Physican's Assistant) | 19,620 | 11,545 | 729 | 113 | 32 | 18,746 | 12,083 | 1.05 |
| • Surgical Technician (Operating Room Technician) | 31,620 | 7,163 | 817 (3,714) | 246 (2,899) | 2,442 | 28,115 (22,565) | 8,056 (10,038) | 1.12 (1.40) |
| • Radiologic Technician (X-Ray Technician) | 64,950 | 3,487 | 630 (2,818) | 279 (2,130) | 662 | 63,379 (59,340) | 3,574 (3,817) | 1.02 (1.09) |
| • Medical Record Technician (Patient Administration Specialist) | 36,412 | 6,221 | 1,592 (4,569) | 2,134 (3,898) | 135 | 32,551 (27,810) | 6,959 (8,145) | 1.12 (1.31) |
| • Medical Laboratory Technician (Laboratory Technician) | 83,350 | 2,718 | -- (3,733) | 18 (2,607) | 1,599 | 81,733 (75,411) | 2,771 (3,004) | 1.02 (1.11) |
| • Pharmacy Technician (Pharmacy Technician) | 22,800 2/ | 9,934 | 560 (2,246) | 70 (973) | 609 | 21,561 (18,972) | 10,505 (11,939) | 1.06 (1.20) |
| • Physical Therapy Assistant (Physical Therapy Specialist) | 26,380 | 8,586 | 446 (426) | 307 (308) | 200 | 25,427 (25,446) | 8,908 (8,901) | 1.04 (1.04) |

TABLE 6: SUPPLY OF NONPHYSICIAN HEALTH MANPOWER WITH NET DOD WARTIME REQUIREMENTS BY OCCUPATION (Continued)

| OCCUPATION | TOTAL SUPPLY | | MILITARY SUPPLY & REQ | | | NET CIVILIAN SUPPLY | | NET AS PERCENT TOT POP/PROV RATIO (H) |
|---|---|---|---|---|---|---|---|---|
| Civilian (Military) Title | Tot (A) | POP/PROV Ratio (B=226505K/A) | Military Supply Active Duty (C) | Military Supply Reserve (D) | Military Shortage (E) | Tot (F=A-C-D-E) | POP/PROV Ratio (G=226505K/F) | |
| Service Occupations | | | | | | | | |
| • Dietary Technician 1/ (Hospital Food Service Specialist) | 38,022 | 5,957 | ? | ? | 12 | -- | -- | -- |
| • Psychiatric Aide (Psychiatric Specialist) | 117,610 | 1,926 | 443<br>(2,341) | 565<br>(1,462) | 248 | 116,354<br>(113,559) | 1,947<br>(1,995) | 1.01<br>(1.04) |
| • Paramedic EMT Personnel (Medical Specialist) | 26,973 | 8,397 | 17,743 | 29,152 | 15,395 | 11,578 | 19,653 | 2.33 |
| • Occupational Therapy Assistant (Occupational Therapy Specialist) | 680 | 333,096 | 161<br>(161) | 113<br>(115) | 141 | 265<br>(263) | 854,736<br>(861,236) | 2.57<br>(2.59) |
| Maintenance Occupations | | | | | | | | |
| • Electromedical Equipment Repair (Biomedical Equipment Repair Technician) | 3,270 | 69,268 | 18<br>(979) | 18<br>(909) | 235 | 2,999<br>(1,147) | 75,527<br>(197,476) | 1.09<br>(2.85) |
| Clerical Occupations | | | | | | | | |
| • Medical Shipping and/or Receiving Clerk (Medical Supply Specialist) | 5,490 | 41,258 | 1,583 | 1,987 | 503 | 1,417 | 159,848 | 3.87 |
| Occupations Not Listed in BLS | | | | | | | | |
| • Environmental Health Specialist | -- | -- | 1,312 | 1,003 | 7 | -- | -- | -- |
| • Entomologist | -- | -- | ? | ? | 7 | -- | -- | -- |
| • Orthotic Specialist | -- | -- | 37 | 16 | 35 | -- | -- | -- |
| • Clinical Pharmacologist | -- | -- | 2 | 1 | 18 | -- | -- | -- |
| • Veterinarian | 42,052 | 5,386 | 74<br>(592) | 50<br>(982) | 29 | 41,899<br>(40,453) | 5,406<br>(5,599) | 1.00<br>(1.04) |
| • Optical Laboratory | -- | -- | 192 | 159 | 88 | -- | -- | -- |
| • All Other Professional and Technical Occupations | 92,420 | 2,451 | 1,617<br>(2,130) | 1,229<br>(2,161) | 566 | 89,008<br>(87,563) | 2,545<br>(2,587) | 1.04<br>(1.06) |

sectors for more effective joint-planning activities. In Table 6, the general military titles are shown in parentheses under the most closely related civilian counterpart.

Although wartime military shortages were estimated for each specific occupational title, the total military medical personnel available in March 1982 showed several close or identical substitutes for most titles, the differences sometimes resulting from different occupational titling policies adopted by each of the Services. After reviewing these policies with DoD health manpower specialists, revised estimates for military supply were parenthesized and placed under the original values. Net estimates were computed, using the two estimates to identify the tentative additional military requirements for non-physician health manpower.

Desired Population/Provider Ratios were not available for most of the occupational titles under consideration. Therefore, no conclusion can be reached about possible pre-existing relative shortages. Disregarding any issues of substitutability among occupations for the moment, wartime military requirements do seem to draw significant numbers of paramedic EMT personnel, occupational therapy assistants, and medical shipping and/or receiving clerks, as indicated by the following numbers in Column H: 2.33, 2.57, and 3.87, respectively. Paramedic EMT personnel are the closest civilian counterpart to Medical Specialists. As wartime places great demand upon this occupation, the civilian supply of paramedics would be significantly depleted by the net wartime military shortage.

When the substitutability issues were considered, and additional active-duty and reserve military personnel were subtracted from the total manpower supply, the civilian supply of the following specialties seemed to be significantly affected by wartime military requirements: Dentists, Surgical Technicians, Medical Record Technicians, Pharmacy Technicians, and Electromedical Equipment Repair Technicians, as indicated by the numbers between parentheses in Column H, of 1.41, 1.40, 1.31, 1.20 and 2.85, respectively.

## 3.3 SUMMARY

The general conclusions to be drawn from the findings of this chapter are that mobilization and/or wartime military requirements will cause shortages in the civilian sector by specialty, and possibly further, by geographic location, especially if the Selective Service System uses a purely random selection procedure. Also, it is important that the reserve military components be considered in the analysis rather than just the military wartime shortages. The analysis has shown that the military reserves will subtract about 19,000 physicians, and between about 62,000 - 86,000 allied health personnel from the civilian labor force, the latter total considering the substitutability issue. Therefore, while the estimated wartime military shortages from the strictly civilian sector should not exceed about 4,500 physicians and about 35,000 allied health professionals, the number of reservists that will be drawn from the civilian supply is seen to be substantially greater as these are added to the military manpower pool.

# 4

## SYSTEM DESIGN FOR THE HEALTH MANPOWER MONITORING AND ALLOCATION SYSTEM

The purpose of this chapter is to present a description of a proposed system for monitoring health manpower supply and requirements, and reallocating the supply in time of war or national emergency. Contained in this chapter is a description of the potential user population for such a system, a summary of the supply and requirements data, the adequacy of these input data, creation and maintenance of the data base, methods for making supply adjustments, the recommended allocation process, system outputs and the implementation plan.

The purpose of the Health Manpower Monitoring and Allocation System, described below, is to provide decision makers with information about the anticipated effects on the civilian population of the requisition by the military of scarce health personnel resources. The system is also designed to facilitate the development of contingency plans for use of health manpower resources in military and non-military emergencies.

To provide the decision support and contingency planning products needed, the system has been designed to accomplish the following:

1. Build and maintain a matrix containing the most accurate inventory of the supply of health manpower, by geographic area and by medical specialty;

2. Construct a transition matrix that will permit the adjustment of the steady-state or peacetime supply inventory to predict available supply in the event of an emergency;

3. Adjust the supply inventory in response to external demand;

4. Predict the degree of satisfaction of multiple objectives regarding the need for and availability of medical personnel; and

5. Present the results of the system processing in formats usable by decisionmakers.

The system described below is considered to be a necessary and useful addition to the emergency planning resources of the Federal Government. A significant amount of further design and implementation effort is needed to create a Health Manpower Monitoring and Allocation System, as is detailed in the Implementation section.

## 4.1 POTENTIAL SYSTEM USERS

The first step in the systems design effort was to identify potential users of the system. While the allocation of health manpower in time of war or national emergency is the responsibility of the Department of Health and Human Services, in practice this effort is jointly handled by the Department of Defense, the Department of Health and Human Services, and the Veterans Administration. Also, the Selective Service System is involved as the agent of the DoD responsible for the actual procurement of needed civilian manpower. However, in the event of a dispute, the Federal Emergency Management Agency, acting on behalf of the President, is the arbitrator.

In its role as arbitrator, FEMA needs information concerning the impacts of its decisions to make the most effective decisions. Because FEMA is generally not involved until a shortage exists and there is still a need for additional resources, FEMA needs to be able to consider and assess these impacts quickly and accurately. Also, FEMA is responsible for coordinating contingency planning in this area. As such, FEMA has recognized the need for a system designed to support the rapid development and modification of contingency plans for reallocation of health manpower in an emergency.

Another major user of the system is the Selective Service System (SSS). SSS is charged with fairly and randomly selecting from the available pool of individuals with the necessary skills, those persons who will be inducted into the Armed Forces to meet the need for additional military health care support. In addition, SSS drafts

guidelines for local draft boards, which they use to determine whether or not a person is essential to his community. The proposed system can provide rational guidelines by specialty, and information about the characteristics of each local district, so that judgments of communities can be made more rationally and consistently acrosss the country.

The Department of Defense, Office of the Assistant Secretary of Defense, Health Affairs (OASD/HA), has developed a process for determining and validating its needs for additional health care personnel under differing conditions. This process takes into account expected casualty levels, available personnel, available resources, and the timing and impact of requests for additional personnel on the military. The system could provide supplemental information to this process, including the anticipated impact (by geographical area) on the civilian population on withdrawal of the health manpower, the anticipated impact on the treatment of casualties transferred back to the Continental United States, and the availability of health manpower in the civilian sector, by specialty. With this approach, the system will be especially useful in the development of contingency plans for any extended emergency.

The Department of Health and Human Services, Office of the Assistant Secretary for Health, Emergency Coordinator, is a participant in the process of validating the need for additional military medical personnel. This office is charged with representing the position of the civilian sector, and maintaining at least the minimum level of health care necessary to achieve national goals. his agency is the major provider of civilian supply data, as well as providing input for the processes that determine shortages and select and evaluate goals.

The Veterans Administration, as a supplier of medical support to the Department of Defense, also provides input to the system.

## 4.2 INPUT DATA

Input data for the system is of three types: supply input (which identifies the number of health care providers in each geographic area by specialty), demand inputs (which identify the need for health care personnel in time of emergency), and control data (which provides the parameters for supply adjustments and goal description).

The primary source of civilian health manpower supply data should be the Area Resource File (ARF), which is available from the Bureau of Health Professions of HRSA/DHHS. This file contains the most current counts of civilian sector health manpower, by specialty, for each county in the United States. This information should be supplemented by data from private sources (primarily health profession organizations such as the Amercian Dental Association, and state licensure agencies) as available.

The primary source of military health manpower supply data is the Defense Manpower Data Center (DMDC). Peacetime and wartime assignments for active-duty military health care personnel are available from this source. Additional supply information is available from the Veterans Administration, but most of the data there is also in the ARF.

Civilian demand data is not gathered directly by the system, but rather, is entered from the application of control parameters to the civilian supply data. These control parameters are provided by agencies within DHHS. Health Manpower Shortage Area designation criteria and provider-to-population ratios, emergency response patterns, and substitutability of one specialty for another would be the primary control parameters. Background data for the latter elements also can be obtained from the Department of Defense and the Department of Labor. Additional data must be obtained from the OASD(HA) to permit adjustment of the civilian supply for the removal of reservists from the pool of available personnel, and for the additional burden placed on the civilian supply by the off-loading of military casualties through CMCHS.

Military demand is obtained from the OASD(HA) in the form of requests for additional health care personnel by specialty. This data is already validated against existing military supply.

## 4.3 INPUT DATA ADEQUACY

During the course of this study, the project staff determined the sources of, and actually examined, a considerable amount of health manpower data for the civilian sector and for the Department of Defense, as to its adequacy for use in the system. Three types of data that were considered in the development of the methodology were:

- Health manpower requirements data for both sectors;
- Health manpower supply data for both sectors; and
- Collateral data (potentially useful in assessing validity of DoD-developed wartime requirements).

### 4.3.1 Military Health Manpower Requirements Data

The process by which these data are developed was discussed in detail in Chapter 3. The actual requirements data made available by DoD during the study are as shown in Appendix C. These manpower requirements were developed by the Services and consolidated at OASD(HA). They represent net requirements after the application of skill substitution rules and facility constraints.

Although these data on health manpower requirements by specialty are not available in routine reports, it was reported by the OASD(HA) representative that similar information will be obtained from the Services on a periodic basis in the future. These data are not classified and, according to information obtained from Service representatives, are an accurate representation of the net constrained requirements. Some Service representatives were concerned that reporting only constrained requirements does not reflect the severity of the shortfall, and consequently may mislead the reader to think that health manpower shortages are less critical than they actually are. As mentioned earlier, the solution to this problem is to ensure that all net requirements data be properly labeled and that updates be published as constraints are removed.

### 4.3.2 Military Health Manpower Supply Data

The principle source in DoD for health manpower data is the DMDC in Alexandria, VA. Data are available on active-duty military personnel, civilian employees, reserve components personel, and retired personnel.

Data can be obtained in all these categories by occupational skill. During the course of this study, data were actually obtained from DMDC and these data proved adequate for our needs. As stated earlier, problems were encountered as we attempted to compare certain skill categories between DoD and the civilian sector, and in some cases when we attempted to reconcile skills among the three Services. Each Service has certain skills that are Service-unique and although general comparisons can be drawn, the specific training requirements and duty functions are sufficiently different such that there is not a one-for-one correlation. An example of this is the Army Medical Specialist, the Navy Hospitalman, and the Air Force Medical Service Specialist. Although these are equivalent occupations generally, their training and type of duty differ.

### 4.3.3 Collateral Military Data

Collateral data are defined as those data that might be useful in assessing the validity of health manpower requirements estimates. For example, if one has some feel for the total number of personnel at risk in a combat theater and an appreciation for the bed requirements in the theater and in CONUS, these data may provide a gross order of magnitude benchmark against which to assess the medical manpower requirement.

After some searching, it was determined that total force strengths, both for peacetime and for war, are available from the Assistant Secretary of Defense for Manpower, Reserve Affairs, and Logistics [ASD(MRA&L)]. The wartime projections are highly restricted and would be provided only on a strict "need to know" basis.

Data on projected bed requirements, both for the theater and for CONUS, are reported in the Wartime Medical Posture Study, published in 1980 by ASD(MRA&L). These data, although somewhat outdated, are still considered current by the OASD(HA) medical planners. See Appendix F for sample formats.

### 4.3.4 Civilian Health Manpower Requirements Data

Civilian requirements data are only available for physicians;

then, for only about half the specialties. Further, these estimates tend to be disparate when more than one source is examined.

### 4.3.5 Civilian Health Manpower Supply Data

For the civilian sector, relatively accurate supply data are available for physician manpower, and for some other professionals such as dentists, nurses, pharmacists, optometrists, and podiatrists. This information is available from the Area Resource File referred to above, and is for the most part broken down into county geographical units. However, for dentists and nurses, no specialty breakdown is provided. This could become important in wartime when the requirements would be expected to be higher for oral surgeons than for general practice dentists, and OR and ICU nurses than for general nurses.

A further problem with these non-physician professionals is that there is no indication of how many are in active practice. However, as with physicians, it can be expected that those not in practice would respond as volunteers in the event of a national emergency.

When it comes to other health-related professions, much less precise supply data are available, and only on a national basis from DoL. Further, the validity of these data for direct translation into military equivalents holds some question due to definitional problems, and other considerations as discussed in earlier chapters.

## 4.4 DATA BASE CREATION AND MAINTENANCE

Creating and maintaining a data base involves processing the input data so that the most current data on supply and demand are in the data base, editing and reformatting the input data to ensure accuracy and consistency, and organizing the data so that it can be used by the remainder of the system.

The simplest data base would be a matrix, where each row represents a single geographic unit (county) and each column represents a medical specialty. Each cell in the matrix would contain the number of providers (possibly broken out by age and retirement status) in that specialty, in that geographic area. Other matrices needed for the

system are response to emergency factors (severity of emergency by health care specialty by geographic area), specialty substitutability factors (specialty code by specialty code), shortage factors (by specialty), a matrix containing demand (by specialty), and a goal-constraints matrix.

As inputs are received, they must be converted into standard units, validated (range, type, consistency), and inserted into the proper place in the proper matrix. A record of the source of each data item must be maintained for control purposes. The system must have the ability to back-up (save) each matrix and restore it from previous copies, and keep track of what particular time is represented by each matrix.

One of the most important features of the proposed system is the acceptance of data in the form and format of the supplying agency. It is contended that if FEMA was to impose reporting requirements on DHHS, DoD, and VA that are different from these agencies' normal processing efforts, the system would almost certainly fail. As such, the burden associated with standardization must fall on this system, and the system design must take this factor into consideration. Fortunately, there are relatively few data sources for this extensive amount of input data.

## 4.5 SUPPLY ADJUSTMENT

Supply adjustment involves processing a supply matrix, using the response to emergency factors and/or the substitutability factors, to create a new, emergency-based supply matrix. Supply adjustment is seen as being an interactive process. That is, an initial supply matrix is adjusted, using response to emergency factors to take into account overtime worked, and inactive or retired personnel returning to the labor force, then shortage areas are identified, then substitutability factors are applied to the adjusted matrix to transfer personnel from one specialty to another. The shortage areas are then recalculated, and the whole process repeated until the results are stable. The result of supply adjustment is a civilian emergency health manpower supply matrix.

Once the civilian emergency manpower supply matrix is calculated, then a multi-level matrix of critical shortage areas by specialty is calculated. This matrix will contain information about the severity, according to various measures, of the medical manpower shortages during an emergency for each geographic area. This information would be used to generate reports.

The process of adjusting the civilian supply to take into account demand imposed by the military, and determining the impact of these adjustments, is accomplished through the use of goal programming techniques as discussed in the following section. Inputs to this mathematical modelling approach are a civilian emergency manpower supply matrix, a military demand matrix and a set of goal equations that specify priorities for determining the appropriateness of satisfying military needs.

The final process is the formatting of various output reports. The primary products are the area-specific community essentiality report for the Selective Service System, and a series of reports on the implications of the solution suggested on both the civilian and military sectors.

## 4.6 HEALTH MANPOWER ALLOCATION PROCESS

Once the data base has been established and the necessary supply adjustments made, a decision model must be employed to assist in the allocation process in manipulating the matrices developed.

Decision models are simply a means to an end. A decision model represents, to some degree, an existing problem. The usefulness of the mathematical model is well-appreciated by mathematicians, economists, operations researchers, and management scientists who have repeatedly used such models in the solution of real-world problems. Nevertheless, there has developed the realization of a serious shortcoming in traditional mathematical models--these models and their solution methods are restricted to the analysis of problems having only a single objective. Unfortunately, real problems, such as those posed in this effort, almost invariably are characterized by multiple, conflicting

objectives. Consequently, by attempting to describe multiple conflicting objectives using single objective models, it is inevitable that the answers derived will fail to yield satisfactory results.

Fortunately, recently increased interest in multiple objective modelling has led to the development of an effective methodology for both modelling and solving of virtually all classes of multiple objective decision making problems typically encountered. The methodology described here is based on straightforward extensions to a technique known as goal programming.[5]

Goal programming allows decisionmakers to extend the capabilities of mathematical models to encompass decisions involving multiple objectives. This is accomplished by assigning to each objective a priority (actually, a preemptive priority) that reflects the predisposition of the decisionmaker.

The fundamental problem is to develop a decision model that can provide accurate information to crisis managers (e.g., Director, FEMA) faced with an untenable problem. Therefore, it is essential that the underlying general principles of goal programming be scrutinized to assess the applicability of this approach to the problems described above. There are certain terms that must be defined in order to understand the structure of the goal programming technique; these are:

- Objective--An objective is a relatively general statement reflecting the desires of the decisionmaker.
- Aspiration level--An aspiration level is a specific value that serves to tie the objective to reality. Typically, the aspiration level is expressed in terms of a measure of the achievement of an objective.
- Goal--An objective in conjunction with an aspiration level is termed a goal. For example, the crisis managers may

[5]J. Ignizio, Goal Programming and Extensions, Lexington, Mass.: D. C. Heath Company Lexington Books: 1976.

wish to achieve at least 1 opthalmologist per 20,000 people in each community. Notice, in particular, that resource limitations and other restrictions typically denoted as constraints, also find a natural representation within this framework.

- Goal deviation--Not all aspirations can be achieved and not all restrictions may be strictly satisfied. Consequently, we shall encounter deviations from the problem goals and, normally, seek to minimize these deviations.
- Achievement function--The measure of the accomplishment of a single objective is naturally represented by the objective function and its associated (scalar) value. However, when dealing with multiple objectives wherein we wish to minimize the deviation from the associated goals, an appropriate terminology exists in the concept of the achievement function. In goal programming, we shall rely on the achievement function to represent the optimal compromise and its measure.
- Constraint--A constraint is a mathematical notion that serves to further remove many models from reality. This is because such constraints are treated as being totally rigid and any solution not satisfying all constraints is termed infeasible. However, the concept of a goal provides a natural and more flexible framework for multi-objective models. If a goal is truly a constraint, we term it either an absolute goal or a rigid constraint.
- Decision variables--The decision variables are those factors over which the decision maker has control.

The reader is directed to Appendix E for a presentation of the steps in constructing a goal programming model and a preliminary formulation of the model for health manpower allocation.

## 4.7 OUTPUTS

There are several categories of outputs to be produced by the system . These are control reports, intermediate results, test and performance measures, contingency plan results, and final management reports.

Control reports are produced by the system to inform the operations staff of the status of data in the system. Examples of control reports are input data validation reports, job completion reports (which summarize the activities performed by a job), and data inventories.

Intermediate results, such as the civilian supply matrix (after removing reservists and adjusting for civilian response to emergency conditions), are provided for review by the responsible parties. Various reports would be provided to FEMA, OASD(HA), DHHS/OASH, VA, and others to verify that the results are accurate, and to suggest changes in control parameters. Other intermediate reports should include shortage area designations reports after each step in the adjustment process. Test and performance measure reports are designed to show how the control parameters perform, and to measure the stability and sensitivity of the transformations used. This would involve listing results of several assumptions applied simultaneously, and providing comparison statistics. For example, the effect on the civilian supply caused by the application of two sets of shortage area designation parameters, (after emergency response and substitutability transformations have been made), can be displayed in a report, and measures can be output to show the probability that the two supply distributions are distinguishable.

Contingency plans can be created by inputting various demands and generating reports predicting the effect on civilian health care services. Also, different levels of response to an emergency, and different substitutability criteria can be used to create still other contingency plans.

Management reports showing the impact of military demand on civilian supply in an emergency are the ultimate output of the system. These reports, destined for FEMA, OASD(HA), and DHHS/OASH, would show the status of civilian supply after adjustment, by specialty, for each geographic area in the country, with state, regional, and national summaries. Also, for SSS, a report showing shortage areas by community, and by specialty, with comparisons to national and state norms, will be generated for use by local draft boards in making essentiality decisions.

## 4.8 IMPLEMENTATION

The basic system design outline presented above is not sufficiently detailed to begin a programming effort. The system outlined above is in the first stages of its development. This development should

be followed by a Functional Design, a System/Subsystem Specification, Programming and Data Base Design Specifications, a Program Implementation Phase, a Data Initialization Phase, and finally, a System Operations Phase.

While FEMA has two data centers with Univac 1100 series computers and the DMS-1100 data base management system, the capacity of these systems is not sufficient for implementation of the system. It is estimated that the system will require several hours per month of processing time on a large-scale mainframe computer, plus the use of a sophisticated statistical analysis system such as SPSS, SAS, or OSIRIS. In addition, the ability to receive and transmit data via FIPS standard magnetic tape is mandatory.

It is estimated that the development of the system will require nine people and will take approximately one year to design, implement, test, document, and place in operation. During that time, arrangements for the transfer of data to the system must be worked out. Because some of the data supplied by the military is classified, the system must be designed to segregate and secure the classified data.

Operation of the system must be routinized if it is to be useful during an emergency. The data base(s) must be as current as possible for the system to produce timely and useful outputs. Also, for the system to be useful if the computer facilities are unavailable, various contingency reports must be prepared, updated, and retained on a regular basis. Because much of the data are available on a quarterly basis, at least one data analyst, plus supporting operations personnel, must be asigned to maintain the data base and update the contingency plans. It is estimated that this operation will occupy an analyst full time in tracking-down data discrepancies reported by the input processing, running the contingency plans, and answering ad hoc requests.

# 5

## ANALYSIS OF LEGISLATIVE AND ADMINISTRATIVE ACTIONS

This chapter provides a brief overview of the authorities underlying the establishment of FEMA in 1979, and its assumption of roles formerly held by the President, precursor agencies, and other Executive Branch departments and agencies. It also examines some of the key legislation providing authority for assignment of power under wartime conditions, and resultant administrative action in the form of Executive Orders, which delegates certain of these authorities to specific departments and agencies.

### 5.1 ESTABLISHMENT OF FEMA AUTHORITY

Three Presidential directives paved the way for the formation of FEMA and resultant authorities:

1. Reorganization Plan No 3 of 1978--This directive established FEMA as an independent organization in the Executive Branch. As part of this action, limited authority related to fire prevention, flood disaster, and functions of the Emergency Broadcast System was transferred from the Departments of Commerce and Housing and Urban Development.

2. Executive Order 12127, "Federal Emergency Management Agency"--This Executive Order (E.O.) of March 31, 1979, formalized the transfer of authorities proposed in the Reorganization Plan, to be effective April 1, 1979.

3. Executive Order 12148, "Federal Emergency Management Agency"--This Executive Order dated July 20, 1979 provided for the transfer and reassignment of a wide range of emergency preparedness functions to FEMA that, up to that point, were vested in the President and precursor agencies such as the Federal Preparedness Agency, Defense Civil Preparedness Agency, etc. The numerous specific Codes, EOs,

etc. affected by this directive are cited in detail.

The provisions of Section 2.2 of this Executive Order--"Implementation"--set the tone for the mode of operation to be followed by FEMA. These are:

- Policies for civil defense and civil emergency planning were to integrate the use and resources of existing Federal, State, and local governmental agencies, the private sector, and volunteer organizations.
- Assignments of civil emergency functions were, to the extent possible, to be based on extensions of the regular missions of the Executive agencies.
- The Secretary of Defense was to provide support to FEMA for civil defense programs in the areas of program development and administration, technical support, research, communications, transportation, intelligence, and emergency operations.
- All Executive agencies were to operate and assist in the performance of FEMA functions.

## 5.2 ANALYSIS OF LEGISLATION

Three major legislative actions were reviewed, as discussed below.

1. National Security Act of 1947 as amended (50 U.S.C. Sec 411, 1982 Supp.)--The intent of this legislation was to provide a comprehensive program for the security of the United States and to further provide for the establishment of integrated policies and procedures for the departments, agencies, and functions of the government related to national security. The act formally sets up the Department of Defense and the three military services, and states that each be separately organized under the direction, authority, and control of the Secretary of Defense. This law made specific requirements to provide for unified strategies, direction of the combatant forces, and for their operation under unified command, but does not allow for a single Chief of Staff.

   The direct relevance of the Act to this study was that it was used to authorize the Reorganization Plan of 1973, and under Sections 1 and 3(a)(1) of the Plan, the Office of Emergency Preparedness was abolished and all functions vested in this Office were transferred to the President. This authority, in turn, ultimately resulted in the three Presidential directives discussed above, and E.O. 10480 (see below), which assign key responsibilities in defense mobilization to the Director of FEMA, and grants the authority for FEMA to delegate responsibility to other Executive Branch entities. With respect to health facilities and resources, these were delegated to the Department of Health and Human Services.

2. Defense Production Act of 1950 as amended (50 U.S.C. App. 2061, 1982 Supp.)--This Act, under terms of national defense and national security, provides for mobilization of resources and facilities from civilian use to military and related purposes. The then Office of Defense Mobilization was assigned the coordination responsibility. These functions were later reassigned to the Office of Emergency Planning, and then under the Reorganization Plan of 1973 (referred to above), transferred to the President. Again, the coordination functions were assigned to FEMA.

3. Federal Civil Defense Act, as amended (50 U.S.C Sec. 2251-2297, 1982 Supp.)--The intent of Congress under this Act was to provide a system of civil defense for the protection of life and property in the United States, from enemy attacks and from natural disasters. The responsibility for civil defense was viewed as being vested jointly in the Federal Government, the states, and their political subdivisions. The Federal Civil Defense Administration was assigned the responsibility to provide the necessary direction, coordination, and guidance and to provide any necessary assistance.

   Under P.L. 87-296, the Federal Civil Defense Administration was consolidated with the Office of Defense Mobilization to form the Office of Emergency Planning. Again, the 1973 Reorganization Plan transferred all functions to the Office of the President, and by Executive Order, these were ultimately reassigned to FEMA.

## 5.3 ANALYSIS OF RELEVANT EXECUTIVE ORDERS

With the purpose of developing a concept for a system to monitor and allocate health manpower during mobilization and war, it was necessary to examine the existing policy docments that assign responsibilities to the agencies of government for various emergency response actions during mobilization.

Two Executive Orders were of particular interest; E.O. 10480, "Further Providing For Administration of Defense Mobilization Programs" and E.O. 11490, "Assignment of Emergency Preparedness Functions to Federal Departments and Agencies."

Both were under revision and only draft copies were available for this study. The E.O. 10480 draft was dated March 12, 1982 and the E.O. 11490 draft was dated January 29, 1983. It is our understanding that a later draft of E.O. 10480 had been published, but its content had not yet been coordinated with agencies outside FEMA.

We present our analysis of the two draft documents as follows:.

1. Executive Order 10480, "Further Providing For Administration of Defense Mobilization"--This E.O. derives from the President's authority granted by the Defense Production Act of 1950, as amended and specifies the responsibilities of the Director of FEMA in Defense mobilization. It prescribes that the Director of FEMA "...Shall, on behalf of the President, coordinate all mobilization activities of the executive branch of the government, including all such activities relating to production, procurement, labor force, energy, health facilities, food resources, stabilization and transport."

   It further states that every office and agency of the government having functions under the Defense Production Act, as amended, will perform those functions under the direction and control of the Director of FEMA.

   Specifically related to health resources, the Executive Order provides for the redelegation of matters related to health facilities and resources to the Secretary of Health and Human Services for their performance.

   Although the Director of FEMA's responsibilities for health resources are not finely differentiated from those of the Secretary of Health and Human Services, it is clear that the Director of FEMA is charged with coordinating all mobilization activities of the Executive Branch of government and although functions may be delegated, they remain under FEMA direction and control.

2. Executive Order 11490, "Assignment of Emergency Preparedness Functions of Federal Departments and Agencies"--This E.O. defines the emergency preparedness planning function of 37 departments and agencies of the Federal Government, including the military readiness planning functions of the Department of Defense. These taskings form the foundation for the nation's overall preparedness posture.

   This analysis deals with mobilization functions that may have an impact on health manpower in those agencies assigned manpower and/or health related functions. The relevant departments/ agencies and their functions are discussed below.

   - Federal Emergency Management Agency (FEMA)--Among its many other assigned functions, FEMA is responsible for establishing Federal policies for, and coordinating all emergency preparedness activities and functions of, the Federal Government. In addition, FEMA is charged with preparing guidance for non-military plans and preparedness programs for operating the Federal Government under emergency conditions. The agency is to provide policy guidance and assistance to all of the federal departments and agencies in performing their emergency preparedness

functions as specified in this Order, and advise and assist state and local governments and private organizations, upon request, in responding to emergency situations.

More specifically related to this project, FEMA is charged to develop mechanisms for central management of the nation's resources and to have plans for government intervention into the marketplace if it is clearly required to meet the needs of an emergency situation.

It is within the scope of FEMA's emergency preparedness responsibilities to examine, and cause to be developed, a prototype contingency plan to coordinate the wartime allocation of health manpower between the military and civilian sectors.

- Department of Defense (DoD)--Among the many other functions listed in Executive Order 11490, the DoD has a specific responsibility to:

  > "Advise and assist the Federal Emergency Management Agency in the development of manpower policies to be instituted in the event of an emergency, including information relating to the planned size and composition of the Armed Forces, including military and civilian personnel force levels."

  This is one of several pivotal issues in this study; That is, the fact that DoD is responsible to provide information relating to the planned size and composition of the Armed Forces. Although unstated, it can be assumed that the reason for tasking DoD (a claimant agency) to provide planned wartime manpower requirements information, is to permit a resource agency, in this case, the Department of Health and Human Services (DHHS), to compare the potential demand with the available supply and to ensure that all needs are equitably met.

  Interviews with responsible personnel in the Office of the Assistant Secretary of Defense (Health Affairs), revealed that DoD has recently provided information on estimated net health manpower requirements for mobilization by specialty to officials of the Selective Service System (SSS).

  This report resulted from a special request from SSS. Normally, wartime manpower requirements data are not passed to any agency on a routine basis by DoD. Defense Department staff in the Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics), ASD (MRA&L) did acknowledge that DoD is charged with the responsibility to provide the information, and that these matters had been discussed in several sessions of working groups of the Emergency Mobilization Preparedness Board (EMPB). No

decisions had been made, however, regarding what requirements information was to be provided, by what mechanisms, or to whom.

- Department of Health and Human Services (DHHS)--As the resource agency for health manpower, DHHS is charged with the responsibility to perform two key tasks directly related to this study effort. They are as follows:

  -- Mobilization of Health Resources--Develop nationwide plans, in cooperation with the Departments of Defense and Labor, the Veterans Administration, and other Federal agencies, to mobilize the health industry and health resources, including personnel, materiel, and facilities, in preparation for emergencies.

  -- Optimum Utilization of Health Resources--Develop national plans to set priorities and allocate health resources among civilian and military claimants in coordination with the Department of Defense.

  Regarding the first task, mobilization of health resources, the most significant actions underway are those being taken by the Principal Working Group on Health (PWGH) of the EMPB. The PWGH offers a forum in which multiple government agencies can meet and develop plans for mobilizing health resources in an emergency. Since the chairman of the PWGH is the Assistant Secretary for Health, DHHS is clearly involved in discharging its responsibilities under the aegis of the EMPB. The fact that the PWGH has developed the concept of the National Disaster Medical System (NDMS), and is developing an NDMS implementation plan, is evidence that action is underway toward developing a national medical resources mobilization plan.

  The second task, to develop a national plan to set priorities and allocate health resources among the civilian and military claimants, is less well-developed at this time. Personnel interviewed in DHHS and the U.S. Public Health Service (USPHS) acknowledge the responsibility for developing such plans, but indicate that there are no formalized plans for establishing priorities or allocating health resources among potential claimants, other than under the general umbrella of the Office of Emergency Resources, FEMA, formerly the Office of Defense Resources.

- Selective Service System (SSS)--SSS responsibilities defined in E.O. 11490 that relate to this project are expressed in more general terms and relate to critical skill deferment. The task reads as follows:

"Implement, upon direction of the National Security Council, deferments for persons having critical skills or essential occupations, or deferments for students in specific fields of study."

"edical personnel in certain specialties may well qualify for having a critical skill or essential occupation, particularly if they are located in a medically underserved area. Any system developed resulting in a prioritization/-allocation mechanism during mobilization would be of great assistance to SSS in implementing a conscription which may be legislated. Of particular value to SSS would be information on existing shortages by geographic area.

Currently, there is a proposed amendment to the Military Selective Service Act relative to health care personnel. This would allow the SSS to require that a broad range of persons in health care professions between the ages of 18 to 46 be registered. This range is thought necessary because of the length of time required for education, training, and credentialing of qualified health care personnel, and to provide a pool of qualified registrants large enough to spread the liability for induction over a wider segment of the population.

In contrast to previous requirements, the new measure includes those with technical skills, which were not included in prior registration requirements. This expansion is to meet DoD estimates of the need for ancillary personnel who support professional services. Without an adequate number of nurses, technicians, therapists, etc., physicians will be limited in their capabilities to provide quality health care.

The amendment requires the registration of females, as well as males, who are qualified under the provisions of the bill. This would apply to health care personnel only, and will not extend to regular registrants. Because of the increased number of women entering health care professions and the large numbers of women in nursing and technical specialties, it is felt necessary to require their participation.

Those who have multiple specialties in health care occupations would be subject to call for induction in any one of those specialties. To avoid multiple liability for the individual, a weighting system is being devised to assure random selection equates as much as possible to the exposure to induction for those with single skills.

However, there are many issues to be resolved and it is not likely such legislation will be advanced in the immediate future.

- Veterans Administration--In addition to continuing

to provide care to veterans, the Veterans Administration is obligated to care for active-duty military personnel during mobilization and war. This task requires direct cooperation with DoD, HHS, and SSS to address the personnel requirements of an expanded VA mission. The VA has developed a program guide for the VA-DoD contingency hospital system, which assigns specific responsibilities to individuals at the VA Central Office, and provides detailed guidance to VA medical centers--which may become involved in supporting DoD during a war or national emergency. As mentioned elsewhere in this report, the VA may require additional medical personnel to meet this responsibility. Further study is required to determine more definitely if the VA will need additional medical personnel to perform its emergency mission.

## 5.4 SUMMARY

Overall, the review highlighted a major issue which has several consequences for preparedness and mobilization. While the functions and general authorities have been specified in related enabling legislation, most generally the mechanism for execution has not been stipulated. Rather, this responsibility has been assigned to the Executive Branch which has assigned, withdrawn, and reassigned the functions and authorities to various departments and agencies over time. They, in turn, during this process, are given authority to re-delegate all or part of a given function to other departments and agencies.

As an example of this:

- Under the Reorganization Plan of 1973, certain provisions of the National Security Act which had been originally assigned to the President under the terms of the legislation and reassigned to the Office of Emergency Preparedness were withdrawn. This abolished the Office and all vested functions were transferred back to the President.
- The Reorganization Plan of 1978 established FEMA and the subsequent E.O. 12148 reassigned many responsibilities, including those under the Act and other legislation, to the new agency. This also abolished other precursor agencies such as the Federal Preparedness Agency, Defense Civil Preparedness Agency, etc.
- E.O. 11490 then delegated functions to individual departments and agencies, under the coordination of FEMA, with FEMA retaining a key role in adjudication.

- To further compound the picture, E.O. 11490 also authorizes the head of each department and agency to re-delegate the functions assigned by the Order.

Added to this are the dynamics of multi-agency involvement in the total process. As a result, three factors are apparent:

1. The complexity of the process has tended to result in conflicting statements of responsibility. Even in the limited area of health manpower, for any given situation, the relative authority and responsibilities among FEMA, DoD, and DHHS is not overly clear. While FEMA has the overall policy, coordination, and adjudication responsibilities, DoD is assigned a role in advising and assisting FEMA as to planned size and composition of both military and civilian personnel force levels to meet emergency conditions. On the other hand, DHHS is charged with responsibility for mobilization and optimum utilization of health resources. How this interface is to be effected is not clearly defined.

   In general, as a result of the foregoing, preparedness planning has resulted in numerous overlaps and gaps.

2. There is a need for definitional clarity and constancy among departments and agencies. This becomes a particular problem when one agency has a lead function and several others have supporting roles. For instance, E.O. 11490 states that DHHS shall:

   > "Develop nationwide plans, in cooperation with the Departments of Defense and Labor, the Veterans Administration and other Federal agencies, to mobilize the health industry and health resources, including personnel, material and facilities, in preparation for emergencies."

   Definition of what is subsumed under this assignment, and the relative roles and responsibilities of the specified and unspecified agencies requires a great degree of interpretation.

3. The complexity of the emergency preparedness planning process stems from coordinating requirements among the multiple agencies involved. For instance, at least 22 departments and agencies are involved in either primary or support roles in catastrophic earthquake planning, which has ramifications for this project as it could require an effort comparable to wartime mobilization. Having the overall guidance, coordination, and assignment responsibility, FEMA is faced with many dilemmas in its management role. Among the factors contributing to these are:

   - There are major planning functions which are assigned to FEMA over and above its coordination and assignment roles.

- Emergency preparedness planning is only one aspect of a department or agency's responsibilities.
- Planning for most functions involves multiple agencies.
- Coordination becomes a major problem, even when only the primary agencies are involved. This is compounded when the support activities must also be monitored to ensure the designated planning tasks are affected.
- There is a limitation on resources available for emergency preparedness planning both at FEMA and in the various departments and agencies.

Finally, the Director of FEMA, while responsible for directing and overseeing certain other Executive Department activities as these relate to mobilization, holds only sub-Cabinet rank. With the lack of inter-organizational clarity, it becomes more difficult to resolve, or at least modify conflicting situations. Dealing with this issue in the planning process is difficult enough; under mobilization conditions, it could become a further confounding issue.

# 6

## CONCLUSIONS AND RECOMMENDATIONS

The work performed under this contract has resulted in a series of conclusions and recommendations. These cumulative findings and suggestions are the subject of this chapter.

The two principal conclusions of this contract can be summarized as follows:

CONCLUSION I. There is a demonstrable requirement for implementing, maintaining, and integrating into the fabric of health-sector contingency planning, a health manpower monitoring and allocation system.

CONCLUSION II. A more systematic approach is needed for health sector contingency planning.

The first of these conclusions has been reached as the result of two findings, both of which have been discussed in previous chapters. Throughout the conduct of the study, the relative paucity of comprehensive information on health manpower has been acknowledged by all of the claimant agencies contacted. Whereas each agency was able to identify supply and requirements data/information on its own constituencies, no single source had access to information on the full health manpower assets of the country. While FEMA collects data from the various agencies, the data currently on the FEMA system appears to be obsolete. Hence, the need for a monitoring system has been confirmed.

The second perspective has to do with the need for a health manpower allocation system. Early in the conduct of the study, the project staff was challenged to justify the need for allocating manpower; the thrust of the challenge was--if there are (approximately) 360,000

patient-care physicians in the civilian sector and the DoD requirement is expected to be less than 5,000, is it likely that FEMA will be asked to step in. Alternatively put, is there a problem? The answer is YES. Chapters 2 and 3 of this report provided both the statement of the problem and an explicit series of examples of the problem. Briefly, even at a national level of aggregation, there currently are shortages of certain physician specialties; as such, the simple removal of reservists from the available pool will cause critical shortages, and any subsequent reallocations will substantially worsen the situation. Further, when the geographic distribution of these specialties are taken into account, the problem is aggravated. Even those categories of specialists for which the current supply is thought to be adequate, are problematic. Because the DoD needs will be highly focused on the surgical specialties, about 28 percent of orthopedic surgeons in the civilian sector will be needed by the military services. Hence, these simple examples demonstrate that a problem is likely to exist, and that FEMA will likely be called upon to adjudicate.

The second conclusion essentially follows from the foregoing discussion. Since there is expected to be an allocation problem, and since there is no mechanism currently in place for dealing with this problem, such a mechanism should be developed. As stated, each of the claimant agencies has a good understanding of its supply and needs. However, there is no centralized planning function for advising the Director of FEMA on the status of the civilian sector supply and the anticipated needs of the DoD. While the Principal Working Group on Health (of the EMPB) serves as a forum for all of the claimants, the longevity and authority of this body is subject to question

Although a number of subsidiary findings resulted from this contract and have been presented in previous chapters, these two conclusions are distillations of the most compelling and most policy-relevant of the findings. Based upon these findings, the following recommendations are offered and strongly endorsed by the project staff:

RECOMMENDATION I: A health manpower monitoring and allocation system should be implemented and installed within FEMA.

RECOMMENDATION II: Once developed, the system should be maintained on an ongoing basis and should be included in periodic mobilization exercises.

RECOMMENDATION III: A senior, multi-sector advisory panel should be established to inform the Director of FEMA on the status of mobilization preparedness.

RECOMMENDATION IV: The applicability of the recommended system to other resource scarcity problem areas should be explored.

With regard to the principal recommendation of the study (i.e., implement and install a health manpower monitoring and allocation system), the following elaborations are offered. As had been noted, FEMA has the responsibility to act as agent of the President in arbitrating health manpower claimancy disputes, and, if required, making allocation decisions. Further, the study has demonstrated that claimancy problems are likely to occur in mobilizing for war. While the two previous statements do not necessarily lead to the conclusion that FEMA will be forced into the decision making role, such a possibility can be reasonably postulated. Therefore, without infringing on the prerogatives of the claimancy agencies, FEMA must be in a position of making informed decisions. In order to make such decisions, FEMA needs a decisionmaking tool.

The product of this contract is the overall design for such a tool. The actual physical location of the recommended system is less important than is the fundamental need for the system. Further, the system will provide the best service to all participants if it is available to all of the participants. Specifically, the health manpower monitoring portion of the system is maximally of value to the claimants. This is an important issue for the following reason--each claimant must be in agreement as to the information used to characterize its supply. Such an understanding is fundamental to any claimancy forum.

A substantial detailed design, programming, and testing effort will be required to achieve this planning and operational support tool.

A realistic assessment of the total resources that will be needed is $500 to $600,000, and about one year of elapsed time. The staffing requirements for this effort would be seven data processing professionals (for such activities as specification development, programming, unit testing, documentation, etc.) and two full-time equivalent operations analysts (for developing the matricies discussed in earlier chapters). The implementation staff will need access to senior government personnel at agencies listed, for the following purposes:

1. FEMA — To determine computer hardware/software availability, to discuss the operating environment, to determine the reporting formats (both control and output), and to establish a reasonable set of national goals and objectives for use as decision rules for the allocation methodology;

2. DHHS — To gain access to manpower supply data on a routine basis, to obtain agency-approved shortage area definitions, to obtain substitutability information, and to learn of reporting requirements/expectations;

3. DoD — To gain access to manpower requirements data, and active-duty and reserve manpower supply data, to develop procedures for handling any classified information, to learn of reporting requirements/ expectations;

4. VA — To gain access to manpower supply and requirements data and to develop procedures for handling any classified information, to learn of reporting requirements/expectations;

5. SSS — To determine the specific small-area reporting formats desired, to learn of the monitoring informational needs of the agency, and to deal with procedural matters (e.g., timing of reports).

Further, the system should be designed to reside on FEMA computer equipment, and should be developed using software that will facilitate transportability (as it is likely that FEMA will replace or supplement their UNIVAC hardware over the next few years).

Also, as stated previously, the system design should include periodic reports that could be used independently as a decision-support

tool in the event of a computer system failure and/or should the computer otherwise be rendered inoperable.

With regard to the second recommendation (i.e., maintain the system), the following suggestions are offered: A decision to implement the recommended system must take into consideration the ongoing maintenance and operation of such a system. While the resource implications can be minimized by designing the system properly, there are real on-going costs that must be incurred. For planning purposes, it should be assumed that one full-time equivalent person will be assigned to this effort. This composite person would be responsible for updating the data base on a quarterly basis, re-running the system to provide current status information, and assisting in revising contingency plans. Additionally, the system products should be sent routinely to the various claimant agencies so that they may be integrated into normal operations.

One further operational consideration must be taken into account. For the health manpower monitoring and allocation system to be functional if/when it is needed, the system must be fully integrated into mobilization planning and preparedness activities. To achieve such a level of readiness, the system must be a component of emergency exercises. Therefore, this system should be incorporated into exercise plans. The staffing requirements for such activities is thought to be three professionals, as follows: one person to handle data base/data processing; one to handle adjusting civil sector supply variables/ matricies; and, one person to handle the DoD net requirements, such as reservist call-up.

With regard to the third recommendation (i.e., establishing a panel) the following elaboration is offered. Since the discontinuation of the National Health Resources Advisory Committee in 1978, there has been no formal mechanism for the leaders of the federal health sector to communicate national medical plans and programs to and with the leaders of the private sector. Consequently, there is relatively little sensitivity in either sector for the concerns and problems of the other. Further, because mobilization is likely to occur with limited notice, a coordinated effort is required between the public and private sectors.

The absence of in-place mechanisms is likely to result in substantial inefficiences, particularly as they relate to the critical resource of health manpower.

As such, it is imperative that channels of communication be re-established and used effectively on a continuing basis. This is essential to muster a coordinated and effective medical response to a future national emergency.

One method for fostering communications and providing advice to the Director of FEMA is the establishment of a new panel. (It would be better to select a different name for this panel, as its charter and composition would differ from that of the National Health Resources Advisory Committee). The suggested composition of this new body is as follows:

| | |
|---|---|
| GOVERNMENT: | Assistant Secretary of Health/DHHS<br>Assistant Secretary of Defense(HA)/DoD<br>Deputy Administrator/VA<br>Deputy Director/SSS<br>Assistant Secretary/DoL<br>Deputy Director(RP)/FEMA |
| PUBLIC: | President, American Medical Association<br>President, American Hospital Association<br>President, American Nurses Association<br>President, Council of Medical Specialty Societies<br>President, American Public Health Association<br>President, American Association of Medical Colleges |
| PRIVATE: | Six Presidential appointees |

The cited representatives were selected for the following reasons. To maintain balance among the various contributors six individuals are suggested from each general area. The Federal participants were selected because they represent the different agencies most directly involved in the allocation process. The public sector organizations were selected because they represent six cognizant agencies (i.e., since DoD's most pressing needs will be for physicians and nurses, the AMA and ANA were included; because the decisions will affect the ability of hospitals to render care, the AHA should be included; because specialty physicians are the scarcest of the resources, the CMSS was selected; because the APHA provides the best perspective on all other

health professions, it was selected; and, because certain contingency plans anticipate drafting physicians directly from residency programs to the military, the AAMC was selected for inclusion).

The principal role of this suggested panel would be to advise the Director of FEMA on the implications of alternative strategies being considered in all health-related preparedness issues (not solely in manpower). In addition, the subsidiary role of this panel would be to foster multi-sector, multi-perspective communications on the health sector. In order to be in the position of satisfying both roles, this panel must be aware of the environment (i.e., the critical advisory responsibility to be provided, the amount of time available for decisions, and the importance of the advisory role), the information that will be available for decisionmaking (i.e., the form and format of data on supply and requirements that will be provided by the claimant agencies), and the decision support tools that will be available (e.g., the recommended health manpower monitoring and allocation system).

This awareness can only be accomplished by the following actions:

1. Empanelling the suggested sitting body;

2. Replacing members as the individuals change their positions (e.g., as an association installs a new president, this new officer would be seated on the panel);

3. Initially training, and then, retraining this panel;

4. Involving this panel in mobilization exercises; and

5. Ensuring frequent meetings.

Finally, if this recommendation is accepted, the most efficient method of establishing such a panel would be by Executive Order. In this case, only OMB approval and Presidential signature would be required.

With regard to the fourth recommendation (i.e., applicability of the system to other resource areas), the following elaborations are offered. It is recognized that health manpower is only one of numerous scarcity concerns of FEMA, and that the agency resources are severely limited. This is one reason for considering alternative applications for

the recommended monitoring and allocation system. However, it is suggested that an even more compelling reason exists for considering alternative applications. Basically, the reason is that the resource allocation methodology, the integrated collection and processing approaches, and the work already invested in the specification of this system are directly applicable to a wide variety of other areas.

Clearly, the human resource area in its broader sense is an immediately appropriate application. Since the recommended system has the capacity to deal with manpower supply by small geographic areas and by specialty, and manpower requirements by specialty, the direct applicability needs little further discussion. It is further suggested that similar examples of applicability can be constructed for transportation, (e.g., the various modes are analogous to the health manpower categories, the specific transports are analogous to specialties within categories, the location by small area is the same, the civil sector needs by geographic area are the same, etc.) and communications, among others. The problem in dealing with the allocation of the nation's resources in a future full mobilization is unquestionably a major concern to FEMA officials and to the nation's leadership.

The allocation methodology defined in this study would appear to offer an approach to dealing with such a problem. The methodology enables the decision maker to place the allocation problem in National perspective, and in essence, to separate the claimants' persuasiveness from the substance of the problem. It is suggested that the quality of decisions will be improved if the individual factors can be related to national goals and objectives. The goal programming methodology offers just such a mechanism.

In summary, the methodology developed in this study can serve as a prototype model for other resource areas. Health manpower is a particularly well-suited resource on which to test the applicaton of the methodology since it is a reasonably discrete and well-defined, data are readily available, and a cadre of informed and concerned individuals exists in DHHS, DoD, VA, and SSS who are familiar with the issues and would be supportive of such an undertaking. The implementation of the methodology in the health manpower area would provide invaluable

experience for the development of similar allocation applications in other resource areas.

This is an opportunity for the Director at FEMA to assume a lead role in coordinating the development of a National health manpower monitoring and allocation system, and in the process, create a mechanism for managing other resources of equal or greater importance to successfully mobilize in a future conflict.

# APPENDICES

# APPENDIX A

## Army Medical Corps and Nurse Corps Specialists Substitutions List

Appendix A

ARMY MEDICAL CORPS AND NURSE CORPS SPECIALISTS THAT MAY BE SUBSTITUTED FOR PRIMARY SPECIALTIES

1. MEDICAL CORPS

| PRIMARY SPECIALTY | | SUBSTITUTE SPECIALTY | |
|---|---|---|---|
| 60A | Executive Medical Officer | | Senior Staff Officer |
| 60C | Preventive Medicine Officer | 60D | Occupational Medical Officer |
| | | 61N | Flight Surgeon |
| 60E | General Medical Officer | 60L | Dermatologist |
| | | 60P | Pediatrician |
| | | 60Q | Pediatric Cardiologist |
| | | 60R | Child Neurologist |
| | | 61E | Clinical Pharmacologist |
| | | 61H | Family Physician |
| | | 61N | Flight Surgeon |
| | | 61P | Physiatrist |
| | | 62A | Emergency Physician |
| 60W | Psychiatrist | 60U | Child Psychiatrist |
| 61F | Internist | 60F | Pulmonary Disease |
| | | 60G | Gastroenterologist |
| | | 60H | Cardiologist |
| | | 60M | Allergist/Immunologist |
| | | 60P | Pediatrician |
| | | 60Q | Pediatric Cariologist |
| | | 60V | Neurologist |
| | | 60Z | Hematologist |
| | | 61A | Nephrologist |
| | | 61B | Medical Oncologist |
| | | 61C | Endocrinologist |
| | | 61D | Rheumatologist |
| | | 61G | Infectious Disease Officer |
| 61J | General Surgeon | 60J | Obstetrician & Gynechologist |
| | | 61K | Thoracic Surgeon |
| | | 61L | Plastic Surgeon |
| | | *61M | Orthopedic Surgeon |
| | | 61W | Peripheral Vascular Surgeon |
| | | *60K | Urologist |
| 61S | Radiologist | 61Q | Therapeutic Radiologist |
| | | 61R | Diagnostic Radiologist |
| 61U | Pathologist | 61Q | Therapeutic Radiologist |
| | | 61R | Diagnostic Radiologist |

* Used only under emergency conditions

2. ARMY NURSE CORPS

| PRIMARY SPECIALTY | | SUBSTITUTE SPECIALTY | |
|---|---|---|---|
| 66H | Medical-Surgical Nurse | 66B | Community Health Nurse |
| | | 66D | Pediatric Nurse |
| | | 66G | Obstetric & Gynecological Nurse |
| 66J | Clinical Nurse | ** | May be filled by any AMC, SSI, except the following: |
| | | 66E | OR Nurse |
| | | 66F | Nurse Anesthetist |
| | | 66A | Nurse Administrator |

# APPENDIX B

## Air Force Medical Substitutions List

Appendix B

AIR FORCE MEDICAL SUBSTITUTIONS LIST

| AFSC | | SUBSTITUTION FROM | SUBSTITUTE TO |
|---|---|---|---|
| 9116 | Bioenvironmental Engineer Staff | None | |
| 9124 | Bioenvironmental Engineer (Specialties A through G) | None | |
| 9136 | Medical Entomologist | None | |
| 9146 | Staff Biomedical Scientist | None | |
| 9156 | Biomedical Lab Officer (Specialties A through H) | None | |
| 9156B | Biomedical Lab Officer (Microbiologist) | 9936H | |
| 9166 | Aerospace Physiologist | None | |
| 9176 | Health Physicist | None | |
| 9186 | Clinical Psychologist | None | 9586 |
| 9196 | Clinical Social Worker | None | 9586 |
| 9216 | Dietitian | None | |
| 9226 | Occupational Therapist | None | |
| 9236 | Physical Therapist | None | |
| 9246 | Pharmacist | None | |
| 9256 | Optometrist | None | |
| 9266 | Biomedical Specialist | None | |
| 9266B | Audiologist | None | |
| 9266C | Speech | None | |
| 9266D | Other Specialties | None | |
| 9276 | Podiatrist | None | |
| 9286 | Physician Assistant | None | 9346, 9346A, 9366 9386 |
| 9316 | Staff Clinician | Any 93XX, 94XX, 95XX | |
| 9346 | Family Physician | 9366, 9386, 9356, 9286, 9756C | 9316, 9346A, 9366+ shreds,[1] 9376, 9396, 9556 |
| 9346A | Family Practice Specialist | 9346, 9366, 9386, 9356, 9286, 9756C | 9316 |
| 9356 | Aerospace Med. Physician | All 93XX, 94XX, 95XX with completion of AMP course | 9316, 9346, 9346A 9396 |
| 9356A | Aerospace Med. Specialist | | |
| 9356B | Preventive Medicine | | |
| 9356C | Occupational Medicine | | |
| 9356D | Family Practice Specialist | | |
| 9366 | Pediatrician (Subspecialties of Pediatrics) | 9236, 9756B, 9346 | 9316, 9346, 9346A, 9366 + shreds, 9386, 9396, 9536 |
| 9376 | Physical Medicine Physician | 9346 | 9316 |
| 9386 | Internist | 9346, 9366, 9356, 9286, 9756C | 9316, 9346, 9346A, 9586, 9386 + shreds, 9396, 9556 |

[1]Shreds are subspecialties

Appendix B

(continued)

| AFSC | SUBSTITUTION FROM | SUBSTITUTE TO |
|---|---|---|
| 9386 (Subspecialist of Internal Medicine) | 9386 | 9316, 9356 |
| 9396 Emergency Physician | 9346, 9366, 9386, 9356, 9286 | 9316 |
| 9416 Surgeon | 9496, 9426 (case dependent) | 9316, 9416A, 9416B, 9416C, 9416E, 9416G, 9426, 9446, 9486, 9496, 9586 |
| Subspecialties of Surgery | | |
| 9416A Thoracic | 9416 | 9316, 9416C |
| 9416B Colon and Rectal | 9416, 9426, 9496 | 9316 |
| 9416C Cardiac | 9416A, 9426, 9496 | 9316 |
| 9416D Pediatric | None | 9316, 9416G |
| 9416E Peripheral Vascular | 9416, 9486 | 9316 |
| 9416F Neurological | None | 9316, 9576 |
| 9416G Plastic | 9416, 9416D, 9346 (case dependent), 9446 | 9316 |
| 9426 Urologist | 9416 | 9316, 9416, 9416B |
| 9436 Opthamologist | 9446, 9836 (case dependent) | 9316, 9416G, 9446 |
| 9446 Otorhinolaryngologist | 9836, 9436, 9416 | 9316, 9416G, 9436 |
| 9486 Orthopedic Surgeon | 9416, 9276 | 9316, 9486A, 9486B, 9416E |
| 9486A Hand Surgeon | 9486 | 9316 |
| 9486B Pediatrics | 9486 | 9316 |
| 9496 Obstetrics/Gynochologist | 9346, 9416, 9776 | 9316 |
| 9496A Endocrinologist | 9496 | 9316 |
| 9496B Oncologist | 9496 | 9316 |
| 9496C Pathologist | 9496 | 9316 |
| 9496D Maternal Fetal | 9496 | 9316 |
| 9526 Pathologist | None | 9316, 9526F |
| 9526F Neuropathologist | 9526 | 9316 |
| 9536 Diagnostic Radiologist | 9386K | 9316, 9536B, 9536C, 9536E |
| 9536B Neuroradiologist | 9536 | 9316 |
| 9536C Nuclear Medicine | 9536 | 9316 |
| 9536E Special Procedures | 9536 | 9316 |
| 9556 Dermatologist | 9346, 9366, 9386 | 9316 |
| 9566 Anesthesiologist | 9746 | 9316 |
| 9576 Neurologist | 9586, 9416F | 9316 |
| 9586 Psychiatrist | 9346, 9356, 9386, 9416 9186, 9196 | 9316, 9576, 9586A |
| 9586A Child Psychiatrist | 9586 | 9316 |
| 9596 Radiotherapist | None | 9316 |
| 9716 Nursing Administrator | 9726, 9756, 9766 | 9756 |

Appendix B

(continued)

| AFSC | | SUBSTITUTION FROM | SUBSTITUTE TO |
|---|---|---|---|
| 9726 | Mental Health Nurse | 9756 | 9716, 9756 |
| 9736 | Operating Room Nurse | 9756 | |
| 9746 | Nurse Anesthetist | 98XX | 9566 |
| 9756 | Clinical Nurse | 9716, 9726, 9756A, 9776, 9786 | 9716, 9726, 9736, 9766 |
| 9756B | Pediatric Nurse | None | 9366 |
| 9756C | Primary Care Practitioner | None | 9346, 9346A, 9386, 9726, 9736 |
| 9766 | Flight Nurse | 9756 | 9716 |
| 9776 | Nurse - Midwife | None | 9496, 9756 |
| 9786 | Environmental Health Nurse | 9925 | 9756, 9925 |
| 9816 | Dental Staff Officer | all other dental | 9746, 9826, 9756*, 9286* |
| 9826 | Dental Officer, General | all other dental | 9746, 9816, J9826, Q9826, 9836, 9846, 9856, 9886, 9896, 9756*, 9286* |
| J9826 | Dental Officer, General (+1 yr. Gen. Dent. Res.) | 9826 | 9746, 9816, 9826, 9836, 9846, 9856, 9866, 9876, 9886, 9896, 9756*, 9286* |
| Q9826 | Dental Officer, General (+2 yrs. Gen. Dent. Res.) | 9826 | 9746, 9816, 9826, 9836, 9846, 9856, 9866, 9876, 9886, 9896, 9756*, 9286* |
| 9836 | Oral Surgeon | 9826, J/Q9826 (case dependent), 9846, 9886 | 9436, 9446, 9746, 9876, 9756*, 9816, 9826, 9846, 9886, 9286* |
| 9846 | Peridontist | 9826, J/Q9826, 9836, 9856, 9886 | 9746, 9816, 9826, 9836, 9876, 9886, 9756*, 9886* |
| 9856 | Prosthodontist | 9826, J/Q9826, 9866, 9886 | 9746, 9816, 9826, 9846, 9866, 9886, 9756*, 9286* |
| 9876 | Oral Pathologist | J/Q9826, 9836, 9846 | 9746, 9816, 9826, 9756*, 9286* |
| 9886 | Endodontist | 9826, J/Q9826, 9836, 9846, 9856, 9866 | 9746, 9816, 9826, 9836, 9846, 9856, 9866, 9756*, 9286* |
| 9896 | Pedodontist | 9826, J/Q9826, 9866 | 9746, 9816, 9826, 9756*, 9286* |

*98XX substitute for 9756 and 9286 at Second Echelon only.

Appendix B

(continued)

| AFSC | SUBSTITUTION FROM | SUBSTITUTE TO |
|---|---|---|
| 9916 Staff Veterinarian | None | 9925 |
| 9925 Veterinarian | 9916, 9936, 9946, 9956, 9786 (Public Health only) 9356 (Public Health only) | 9786 |
| 9936 Veterinary Scientist (Subspecialties B,C,D,E,H) | None | 9516B, 9925 |
| 9946 Veterinary Clinical Spec. (Subspecialties A,B,C,D,G) | None | 9925 |
| 9956 Veterinary Health Spec. (Subspecialties B,D,) | None | 9925 |
| 902X0 Medical Specialist | 902X1 | 914X1 |
| 902X1 Cardiopul. Lab Specialist | None | |
| 902X2 Surgical Svc. Specialist | None | |
| 903X0 Radiological Specialist | None | |
| 903X1 Nuclear Med. Specialist | None | |
| 905X0 Pharmaceutical Specialist | None | |
| 906X0 Med. Admin. Specialist | 902X0 | 902X0 |
| 907X0 Envir. Health Specialist | 908X0 | 566X0 |
| 908X0 Vet Specialist | None | 907X0 |
| 911X0 Aerosp. Physiological Specialist | None | |
| 912X5 Optometry Specialist | None | |
| 913X0 Phys. Therapy Specialist | 913X1 | 913X1 |
| 913X1 Occup. Therapy Specialist | 913X0, 914X0 | 913X0, 914X0 |
| 914X0 Mental Health Clin. Spec. | 913X1, 914X1 | 913X1, 914X1 |
| 914X1 Mental Health Unit Spec. | 914X0, 902X0 | 914X0 |
| 915X0 Medical Material Spec. | 645X0 | 645X0, 645X1 |
| 917X0 Phys. Asst. Trainee | None | |
| 918X0 Orthotic Specialist | 324X0 | |
| 925X0 Cytotechnologist | None | |
| 981X0 Dental Asst. Specialist | None | |
| 982X0 Dental Lab Specialist | None | |

*98XX substitute for 9756 and 9286 at Second Echelon only.

# APPENDIX C

## Net DOD Manpower Requirements Constraints By Available Facilities And Skill Substitutions

NET DOD MANPOWER REQUIREMENTS CONSTRAINED BY AVAILABLE FACILITIES AND SKILL SUBSTITUTION

| OCCUPATIONAL TITLE | M+20 | M+30 | M+40 | M+70 | M+100 | M+130 | M+160 |
|---|---|---|---|---|---|---|---|
| General Surgeon | 734 | 434 | 270 | 408 | 42 | 14 | 2 |
| Anesthesiologist | 148 | 21 | 11 | 10 | 10 | ø | ø |
| Internal Medicine | 134 | ø | ø | ø | ø | ø | ø |
| Thoracic Surgeon | 31 | 14 | ø | 9 | ø | ø | ø |
| Peripheral Vascular Surgeon | 5 | 3 | 2 | 2 | ø | ø | ø |
| Neurosurgeon | 56 | 21 | 19 | 7 | ø | ø | ø |
| Plastic Surgeon | 7 | 3 | ø | ø | 3 | ø | ø |
| Urologist | 29 | 3 | ø | ø | ø | ø | ø |
| ENT | 21 | ø | ø | 7 | 4 | ø | ø |
| Orthopedic Surgeon | 866 | 450 | 280 | 303 | 28 | ø | ø |
| Occupational Medicine | 5 | 1 | ø | ø | ø | ø | ø |
| Pulminary Disease Medicine | ø | ø | ø | 3 | 4 | ø | ø |
| Gastroentrologist | ø | 4 | 1 | 5 | 5 | ø | ø |
| Cardiologist | ø | ø | ø | 5 | 8 | ø | ø |
| Allergist/Clinical Immunologist | ø | 2 | 2 | 3 | 3 | ø | ø |

| OCCUPATIONAL TITLE | M+20 | M+30 | M+40 | M+70 | M+100 | M+130 | M+160 |
|---|---|---|---|---|---|---|---|
| Psychiatrist | ø | 8 | ø | ø | ø | ø | ø |
| Clinical Pharmacologist | 12 | 4 | ø | 1 | 1 | ø | ø |
| Clinical Nurse | 756 | 336 | 23 | 121 | 2 | ø | ø |
| Medical Surgical Nurse | 443 | 454 | 111 | 1520 | 3 | ø | ø |
| Nurse Anesthetist | 489 | ø | ø | 44 | 57 | ø | ø |
| Operating Room Nurse | 382 | 58 | 23 | 90 | 4 | 75 | ø |
| Mental Health Nurse | 86 | 92 | 71 | 142 | 58 | ø | ø |
| General Dental Officer | 127 | 34 | ø | ø | ø | ø | ø |
| Veterinary Lab Animal Officer | 7 | ø | ø | ø | ø | ø | ø |
| Veterinary Pathologist | 1 | ø | ø | ø | ø | ø | ø |
| Veterinary Microbiologist | 5 | ø | ø | ø | ø | ø | ø |
| Veterinary Comparative Officer | 16 | ø | ø | ø | ø | ø | ø |
| Occupational Therapist | ø | ø | ø | ø | 4 | ø | ø |

| OCCUPATIONAL TITLE | M+20 | M+30 | M+40 | M+70 | M+100 | M+130 | M+160 |
|---|---|---|---|---|---|---|---|
| Physical Therapist | ø | ø | ø | ø | 2 | ø | ø |
| Hospital Dietitian | 6 | ø | ø | 20 | ø | ø | ø |
| Nuclear Medical Science Officer | ø | ø | ø | 3 | ø | ø | ø |
| Entomologist | ø | ø | ø | 7 | ø | ø | ø |
| Physiologist | 1 | 2 | ø | ø | ø | ø | ø |
| Podiatrist | ø | 17 | ø | ø | ø | ø | ø |
| Psychologist | ø | ø | ø | ø | 6 | ø | ø |
| Physician Assistant | ø | ø | ø | ø | 31 | 1 | ø |
| Orthotic Specialist | 28 | 6 | 1 | ø | ø | ø | ø |
| Hospital Corpsman | 1951 | 1209 | 115 | 1316 | 722 | ø | ø |
| X-ray Technician | 386 | ø | ø | 168 | 108 | ø | ø |
| Biomedical Equipment Repair Technician | 83 | 5 | 16 | 106 | 25 | ø | ø |
| Pharmacy Technician | 257 | 47 | 15 | 163 | 127 | ø | ø |
| Operating Room Technician | 2035 | 42 | ø | 202 | 163 | ø | ø |

| OCCUPATIONAL TITLE | M+20 | M+30 | M+40 | M+70 | M+100 | M+130 | M+160 |
|---|---|---|---|---|---|---|---|
| Laboratory Technician | 877 | ø | ø | 461 | 261 | ø | ø |
| Optical Laboratory | ø | 9 | 9 | 56 | 14 | ø | ø |
| Patient Administration Specialist | ø | ø | ø | ø | 135 | ø | ø |
| Medical Supply Specialist | 169 | 65 | 174 | 95 | ø | ø | ø |
| Medical Specialist | 774 | 1140 | 1140 | 10,924 | 1417 | ø | ø |
| Dental Specialist | ø | ø | ø | 629 | 251 | ø | ø |
| Psychiatric Specialist | ø | 45 | 1 | 140 | 62 | ø | ø |
| Orthopedic Specialist | 228 | 53 | 11 | 52 | 35 | ø | ø |
| Physical Therapy Specialist | 76 | 37 | 1 | 53 | 33 | ø | ø |
| Occupational Therapy Specialist | ø | 90 | 4 | 26 | 21 | ø | ø |
| Respiratory Specialist | 396 | 42 | 10 | 29 | 29 | ø | ø |
| Hospital Food Service Specialist | 12 | ø | ø | ø | ø | ø | ø |
| Environmental Health Specialist | ø | ø | ø | ø | 7 | ø | ø |

# APPENDIX D

## Military Personnel Codes And Sample Data Formats

# Appendix D

## SAMPLE DATA FORMATS

TABLE 1. PEACETIME ASSIGNED PERSONNEL STRENGTHS--ACTIVE DUTY MILITARY AND CIVILIAN EMPLOYEES

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | ACTIVE DUTY | | | CIVILIAN EMPLOYEES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | ARMY | NAVY | AF | ARMY | NAVY | AF |
| PHYSICIANS | | | | | | | | | | |
| GENERAL PRACTICE | 6111 | 0108 | 9346 | 6A09 | | | | | | |
| MEDICAL SPECIALITY | | | | | | | | | | |
| Allergy | 60M | 1602 | 9386A | 6A02 | | | | | | |
| Cardiovascular Diseases | 6011 | 1603 | 9386C | 6A06 | | | | | | |
| Dermatology | 60L | 0111 | 9556 | 6A07 | | | | | | |
| Gastroenterology | 60G | 1605 | 9386G | 6A08 | | | | | | |
| Internal Medicine | 61F | 0101 | 9386 | 6A12 | | | | | | |
| Pediatrics | 60P | 0105 | 9366 | 6A21 | | | | | | |
| Pediatric Allergy | | 1604 | 9366A | 6A02 | | | | | | |
| Pediatric Cardiology | 60Q | 1615 | 9366B | 6A06 | | | | | | |
| Pulmonary Diseases | 60F | 1610 | 9386K | 6A26 | | | | | | |
| SURGICAL SPECIALITY | | | | | | | | | | |
| General Surgery | 61J | 0214 | 9416 | 6A30 | | | | | | |
| Neurological Surgery | 61Z | 0224 | 9416F | 6A31 | | | | | | |
| Obstrectics and Gynecology | 60J | 0229 | 9486 | 6A15 | | | | | | |
| Opthalmology | 60S | 0234 | 9436 | 6A17 | | | | | | |
| Orthopedic Surgery | 61M | 0244 | 9486 | 6A32 | | | | | | |
| Otolaryngology | 60T | 0249 | 9446 | 6A19 | | | | | | |
| Thoracic Surgery | 61K | 0264 | 9416A | 6A34 | | | | | | |
| Plastic Surgery | 61L | 0254 | 9416G | 6A33 | | | | | | |
| Colon and Rectal Surgery | | 1506 | 9416B | 6A24 | | | | | | |
| Urology | 60K | 0269 | 9426 | 6A36 | | | | | | |
| OTHER SPECIALITY | | | | | | | | | | |
| Aerospace Medicine | 61N | 0045 | 9356 | 6A01 | | | | | | |
| Anesthesiology | 60N | 0118 | 9566 | 6A04 | | | | | | |
| Child Psychiatry | 60U | 0115 | 9586 | 6A25 | | | | | | |
| Diagnostic Radiology | 61R | 0131 | 9536 | 6A27 | | | | | | |
| Forensic Pathology | | 1631 | | | | | | | | |
| Neurology | 60V | 0121 | 9576 | 6A13 | | | | | | |
| Occupational Medicine | 60D | 0166 | | 6A16 | | | | | | |
| Psychiatry | 60W | 0115 | 9586 | 6A25 | | | | | | |
| Pathology | 61U | 0158 | 9526 | 6A20 | | | | | | |
| Physical Medicine and Rehabilitation | 61P | 0125 | 9376 | 6A22 | | | | | | |
| General Preventive Medicine | 60C | 0160 | 9356B | 6A23 | | | | | | |
| Public Health | 60C | 0169 | | 6A23 | | | | | | |
| Radiology | 61S | 0131 | 9536 | 6A27 | | | | | | |
| Therapeutic Radiology | 61Q | 0135 | 9596 | 6A27 | | | | | | |
| TECHNICAL OCCUPATIONS | | | | | | | | | | |
| DENTAL ASSISTANT (Dental Specialist) | 91W | DT | 981X0 | 330 | | | | | | |
| LICENSED PRACTICAL NURSE (Hospital Corpsman) | 91C | HM | 90250 | 300 | | | | | | |
| PHYSICIAN'S ASSISTANT (Physician's Assistant) | 01IA | 0099 | 9286 | 611 | | | | | | |
| SURGICAL TECHNICIAN (Operating Room Technician) | 91D | HM8483 | 902X2 | 301 | | | | | | |
| RADIOLOGIC TECHNICIAN (X-Ray Technician) | 91P | HM8452 | 903X0 | 313 | | | | | | |

SOURCE

Defense Data Managment Center
Report for OASD(HA)

Processing Mode: Electronic

Media: Tape, disk, hard copy

Accessibility: Other Government Agencies

Classification: Unclassified

Proponent: ASD(MRA&L)

TABLE 1. PEACETIME ASSIGNED PERSONNEL STRENGTHS--ACTIVE DUTY MILITARY AND CIVILIAN EMPLOYEES, CONTINUED

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | ACTIVE DUTY | | | CIVILIAN EMPLOYEES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | ARMY | NAVY | AF | ARMY | NAVY | AF |
| TECHNICAL OCCUPATIONS (Continued) | | | | | | | | | | |
| MEDICAL RECORD TECHNICIAN (Patient Administration Specialist) | 71G | | 906X0 | 513 | | | | | | |
| MEDICAL LABORATORY TECHNICIAN (Laboratory Technician) | 92B | HM8501 HM8506 | 924X0 | 311 | | | | | | |
| PHARMACY TECHNICIAN (Pharmacy Technician) | 91Q | HM8482 | 905X0 | 312 | | | | | | |
| PHYSICAL THERAPY ASSISTANT (Physical Therapy Specialist) | 91J | HM8466 | 913X0 | 303 | | | | | | |
| ORTHOPEDIC ASSISTANT (Orthopedic Specialist) | 91H | HM8489 | 919X0 | 304 | | | | | | |
| PROFESSIONAL OCCUPATIONS | | | | | | | | | | |
| BIOLOGICAL SCIENTIST (Physiologist) | 68J | 0848 | 9166 | 5C | | | | | | |
| PSYCHOLOGIST (Psychologist) | 68S | 0851 | 9186 | 5E | | | | | | |
| DENTIST (General Dental Officer) | 63B | 0335 | 9826 | 6C | | | | | | |
| DIETITIAN (Hospital Dietitian) | 65C | 0876 | 9216 | 6H | | | | | | |
| NUCLEAR MEDICAL TECHNOLOGIST (Nuclear Medical Science Officer) | 60B | 0140 | 9386R | 6A28 | | | | | | |
| NURSE--PROFESSIONAL (General Nurse Officer) | | | | | | | | | | |
| Clinical Nurse | 66J | 0925 | 9756 | 6E | | | | | | |
| Medical-Surgical Nurse | 66H | 0925.1910 | | 6F | | | | | | |
| Nurse Anesthetist | 66F | 0952 | 9746 | 6F | | | | | | |
| OR Nurse | 66E | 0932 | 9736 | 6F | | | | | | |
| Mental Health Nurse | 66C | 0925.1930 | 9726 | 6F | | | | | | |
| OCCUPATIONAL THERAPIST (Occupational Therapist) | 65A | 0874 | 9226 | 6H | | | | | | |
| PHYSICAL THERAPIST (Physical Therapist) | 65B | 0873 | 9236 | 6H | | | | | | |
| PODIATRIST (Podiatrist) | 68L | 0892 | 9276 | 6H | | | | | | |
| RESPIRATORY THERAPIST (Respiratory Therapist) | 91V | HM8541 | 90251 | 300 | | | | | | |
| SERVICE OCCUPATIONS | | | | | | | | | | |
| DIETARY TECHNICIAN (Hospital Food Service Specialist) | 94F | | 622X1 | 800 | | | | | | |
| PSYCHIATRIC AIDE (Psychiatric Specialist) | 91F | HM8485 | 914X1 | 302 | | | | | | |
| PARAMEDIC EMT PERSONNEL (Medical Specialist) | 91B | HM8404 | 902X0 | 300 | | | | | | |
| OCCUPATIONAL THERAPY ASSISTANT (Occupational Therapy Specialist) | 91L | HM8466 | 913X1 | 303 | | | | | | |
| MAINTENANCE OCCUPATIONS | | | | | | | | | | |
| ELECTROMEDICAL EQUIPMENT REPAIR (Biomedical Equipment Repair Technician) | 35U | HM8478 | 918X0 | 198 | | | | | | |

TABLE 1. PEACETIME ASSIGNED PERSONNEL STRENGTHS--ACTIVE DUTY MILITARY AND CIVILIAN EMPLOYEES, CONTINUED

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | ACTIVE DUTY | | | CIVILIAN EMPLOYEES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | ARMY | NAVY | AF | ARMY | NAVY | AF |
| CLERICAL OCCUPATIONS | | | | | | | | | | |
| MEDICAL SHIPPING AND/OR RECEIVING CLERK (Medical Supply Specialist) | 76J | | 915X0 | 551 | | | | | | |
| OTHER OCCUPATIONS | | | | | | | | | | |
| ENVIRONMENTAL HEALTH SPECIALIST (Environmental Health Specialist) | 91S | HM8432 | 907X0 | 322 | | | | | | |
| ENTOMOLOGIST (Entomologist) | 68G | 0860 | 9136 | 5C | | | | | | |
| ORTHOTIC SPECIALIST (Orthotic Specialist) | 42C | HM8489 | 919X0 | 304 | | | | | | |
| VETERINARIAN (Veterinarian) | 64A | | 9925 | 6G | | | | | | |
| Veterinary Lab Animal Officer | 64C | | | 6G | | | | | | |
| Veterinary Pathologist | 64D | | | 6G | | | | | | |
| Veterinary Microbiologist | 64E | | | 6G | | | | | | |
| Veterinary Comparative Officer | 64F | | | 6G | | | | | | |
| OPTICAL LABORATORY SPECIALIST (Optical Laboratory Specialist) | 42E | HM8463 | | 311 | | | | | | |

NOTES:

1. Navy officer codes which begin with a 1 are subspecialty codes.
2. Blocks with no entries represent occupations for which there was no corresponding occupational title or code.
3. Air Force also has an enlisted physician assistant (917X0)

# Appendix D (Continued)

## SAMPLE DATA FORMATS

TABLE 2. PEACETIME RESERVE STRENGTHS

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | READY | | | STANDBY | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | ARMY | NAVY | AF | ARMY | NAVY | AF | ARMY | NAVY | AF |
| PHYSICIANS | | | | | | | | | | | | | |
| GENERAL PRACTICE | 6111 | 0108 | 9346 | 6A09 | | | | | | | | | |
| MEDICAL SPECIALITY | | | | | | | | | | | | | |
| Allergy | 60M | 1602 | 9386A | 6A02 | | | | | | | | | |
| Cardiovascular Diseases | 6011 | 1603 | 9386C | 6A06 | | | | | | | | | |
| Dermatology | 60L | 0111 | 9556 | 6A07 | | | | | | | | | |
| Gastroenterology | 60G | 1605 | 9386G | 6A08 | | | | | | | | | |
| Internal Medicine | 61F | 0101 | 9386 | 6A12 | | | | | | | | | |
| Pediatrics | 60P | 0105 | 9366 | 6A21 | | | | | | | | | |
| Pediatric Allergy | | 1604 | 9366A | 6A02 | | | | | | | | | |
| Pediatric Cardiology | 60Q | 1615 | 9366B | 6A06 | | | | | | | | | |
| Pulmonary Diseases | 60F | 1610 | 9386K | 6A26 | | | | | | | | | |
| SURGICAL SPECIALITY | | | | | | | | | | | | | |
| General Surgery | 61J | 0214 | 9416 | 6A30 | | | | | | | | | |
| Neurological Surgery | 61Z | 0224 | 9416F | 6A31 | | | | | | | | | |
| Obstrectics and Gynecology | 60J | 0229 | 9486 | 6A15 | | | | | | | | | |
| Opthalmology | 60S | 0234 | 9436 | 6A17 | | | | | | | | | |
| Orthopedic Surgery | 61M | 0244 | 9486 | 6A32 | | | | | | | | | |
| Otolaryngology | 60T | 0249 | 9446 | 6A19 | | | | | | | | | |
| Thoracic Surgery | 61K | 0264 | 9416A | 6A34 | | | | | | | | | |
| Plastic Surgery | 61L | 0254 | 9416G | 6A33 | | | | | | | | | |
| Colon and Rectal Surgery | | 1506 | 9416B | 6A24 | | | | | | | | | |
| Urology | 60K | 0269 | 9426 | 6A36 | | | | | | | | | |
| OTHER SPECIALITY | | | | | | | | | | | | | |
| Aerospace Medicine | 61N | 0045 | 9356 | 6A01 | | | | | | | | | |
| Anesthesiology | 60N | 0118 | 9566 | 6A04 | | | | | | | | | |
| Child Psychiatry | 60U | 0115 | 9586 | 6A25 | | | | | | | | | |
| Diagnostic Radiology | 61R | 0131 | 9536 | 6A27 | | | | | | | | | |
| Forensic Pathology | | 1631 | | | | | | | | | | | |
| Neurology | 60V | 0121 | 9576 | 6A13 | | | | | | | | | |
| Occupational Medicine | 60D | 0166 | | 6A16 | | | | | | | | | |
| Psychiatry | 60W | 0115 | 9586 | 6A25 | | | | | | | | | |
| Pathology | 61U | 0158 | 9526 | 6A20 | | | | | | | | | |
| Physical Medicine and Rehabilitation | 61P | 0125 | 9376 | 6A22 | | | | | | | | | |
| General Preventive Medicine | 60C | 0160 | 9356B | 6A23 | | | | | | | | | |
| Public Health | 60C | 0169 | | 6A23 | | | | | | | | | |
| Radiology | 61S | 0131 | 9536 | 6A27 | | | | | | | | | |
| Therapeutic Radiology | 61Q | 0135 | 9596 | 6A27 | | | | | | | | | |
| TECHNICAL OCCUPATIONS | | | | | | | | | | | | | |
| DENTAL ASSISTANT (Dental Specialist) | 91W | DT | 981X0 | 330 | | | | | | | | | |
| LICENSED PRACTICAL NURSE (Hospital Corpsman) | 91C | HM | 90250 | 300 | | | | | | | | | |
| PHYSICIAN'S ASSISTANT (Physician's Assistant) | 011A | 0099 | 9286 | 6H | | | | | | | | | |
| SURGICAL TECHNICIAN (Operating Room Technician) | 91D | HM8483 | 902X2 | 301 | | | | | | | | | |
| RADIOLOGIC TECHNICIAN (X Ray Technician) | 91P | HM8452 | 903X0 | 313 | | | | | | | | | |

SOURCE

Defense Data Managment Center Report for OASD(HA)
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Accessibility: Other Government Agencies
Classification: Unclassified
Proponent: ASD(MRA&L)

# Appendix D (Continued)

## SAMPLE DATA FORMATS

TABLE 2. PEACETIME RESERVE STRENGTHS, CONTINUED

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | READY | | | STANDBY | | | RETIRED | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | ARMY | NAVY | AF | ARMY | NAVY | AF | ARMY | NAVY | AF |
| TECHNICAL OCCUPATIONS (Continued) | | | | | | | | | | | | | |
| MEDICAL RECORD TECHNICIAN (Patient Administration Specialist) | 71G | | 906X0 | 513 | | | | | | | | | |
| MEDICAL LABORATORY TECHNICIAN (Laboratory Technician) | 92B | HM8501 HM8506 | 924X0 | 311 | | | | | | | | | |
| PHARMACY TECHNICIAN (Pharmacy Technician) | 91Q | HM8482 | 905X0 | 312 | | | | | | | | | |
| PHYSICAL THERAPY ASSISTANT (Physical Therapy Specialist) | 91J | HM8460 | 913X0 | 303 | | | | | | | | | |
| ORTHOPEDIC ASSISTANT (Orthopedic Specialist) | 91H | HM8489 | 919X0 | 304 | | | | | | | | | |
| PROFESSIONAL OCCUPATIONS | | | | | | | | | | | | | |
| BIOLOGICAL SCIENTIST (Physiologist) | 68J | 0848 | 9166 | 5C | | | | | | | | | |
| PSYCHOLOGIST (Psychologist) | 68S | 0851 | 9186 | 5E | | | | | | | | | |
| DENTIST (General Dental Officer) | 63B | 0335 | 9826 | 6C | | | | | | | | | |
| DIETITIAN (Hospital Dietitian) | 65C | 0876 | 9216 | 6H | | | | | | | | | |
| NUCLEAR MEDICAL TECHNOLOGIST (Nuclear Medical Science Officer) | 60B | 0140 | 9386R | 6A28 | | | | | | | | | |
| NURSE--PROFESSIONAL (General Nurse Officer) | | | | | | | | | | | | | |
| Clinical Nurse | 66J | 0925 | 9756 | 6E | | | | | | | | | |
| Medical-Surgical Nurse | 66H | 0925.1910 | | 6F | | | | | | | | | |
| Nurse Anesthetist | 66F | 0952 | 9746 | 6F | | | | | | | | | |
| OR Nurse | 66E | 0932 | 9736 | 6F | | | | | | | | | |
| Mental Health Nurse | 66C | 0925.1930 | 9726 | 6F | | | | | | | | | |
| OCCUPATIONAL THERAPIST (Occupational Therapist) | 65A | 0874 | 9226 | 6H | | | | | | | | | |
| PHYSICAL THERAPIST (Physical Therapist) | 65B | 0873 | 9236 | 6H | | | | | | | | | |
| PODIATRIST (Podiatrist) | 68L | 0892 | 9276 | 6H | | | | | | | | | |
| RESPIRATORY THERAPIST (Respiratory Therapist) | 91V | HM8541 | 90251 | 300 | | | | | | | | | |
| SERVICE OCCUPATIONS | | | | | | | | | | | | | |
| DIETARY TECHNICIAN (Hospital Food Service Specialist) | 94F | | 622X1 | 800 | | | | | | | | | |
| PSYCHIATRIC AIDE (Psychiatric Specialist) | 91F | HM8485 | 914X1 | 302 | | | | | | | | | |
| PARAMEDIC EMT PERSONNEL (Medical Specialist) | 91B | HM8404 | 902X0 | 300 | | | | | | | | | |
| OCCUPATIONAL THERAPY ASSISTANT (Occupational Therapy Specialist) | 91L | HM8466 | 913X1 | 303 | | | | | | | | | |
| MAINTENANCE OCCUPATIONS | | | | | | | | | | | | | |
| ELECTROMEDICAL EQUIPMENT REPAIR (Biomedical Equipment Repair Technician) | 35U | HM8478 | 918X0 | 198 | | | | | | | | | |

TABLE 2. PEACETIME RESERVE STRENGTHS, CONTINUED

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | READY | | | STANDBY | | | RETIRED | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | ARMY | NAVY | AF | ARMY | NAVY | AF | ARMY | NAVY | AF |
| CLERICAL OCCUPATIONS | | | | | | | | | | | | | |
| MEDICAL SHIPPING AND/OR RECEIVING CLERK (Medical Supply Specialist) | 76J | | 915X0 | 551 | | | | | | | | | |
| OTHER OCCUPATIONS | | | | | | | | | | | | | |
| ENVIRONMENTAL HEALTH SPECIALIST (Environmental Health Specialist) | 91S | HM8432 | 907X0 | 322 | | | | | | | | | |
| ENTOMOLOGIST (Entomologist) | 68G | 0860 | 9136 | 5C | | | | | | | | | |
| ORTHOTIC SPECIALIST (Orthotic Specialist) | 42C | HM8489 | 919X0 | 304 | | | | | | | | | |
| VETERINARIAN (Veterinarian) | 64A | | 9925 | 6G | | | | | | | | | |
| Veterinary Lab Animal Officer | 64C | | | 6G | | | | | | | | | |
| Veterinary Pathologist | 64D | | | 6G | | | | | | | | | |
| Veterinary Microbiologist | 64E | | | 6G | | | | | | | | | |
| Veterinary Comparative Officer | 64F | | | 6G | | | | | | | | | |
| OPTICAL LABORATORY SPECIALIST (Optical Laboratory) | 42E | HM8463 | | 311 | | | | | | | | | |

NOTES:

1. Navy officer codes which begin with a 1 are subspecialty codes.
2. Blocks with no entries represent occupations for which there was no corresponding occupational title or code.
3. Air Force also has an enlisted physician assistant (917X0)

# Appendix D (Continued)

## SAMPLE DATA FORMATS

TABLE 3. WARTIME MANPOWER REQUIREMENTS BY DAYS AFTER MOBILIZATION

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | DAYS AFTER MOBILIZATION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | M DAY | M+10 D DAY | M+20 | M+30 | M+40 | M+50 | M+60 | M+90 | M+ 120 | M+ 180 |
| PHYSICIANS | | | | | | | | | | | | | | |
| GENERAL PRACTICE | 6111 | 0108 | 9346 | 6A09 | | | | | | | | | | |
| MEDICAL SPECIALITY | | | | | | | | | | | | | | |
| Allergy | 60M | 1602 | 9386A | 6A02 | | | | | | | | | | |
| Cardiovascular Diseases | 6011 | 1603 | 9386C | 6A06 | | | | | | | | | | |
| Dermatology | 60L | 0111 | 9556 | 6A07 | | | | | | | | | | |
| Gastroenterology | 60G | 1605 | 9386G | 6A08 | | | | | | | | | | |
| Internal Medicine | 61F | 0101 | 9386 | 6A12 | | | | | | | | | | |
| Pediatrics | 60P | 0105 | 9366 | 6A21 | | | | | | | | | | |
| Pediatric Allergy | | 1604 | 9366A | 6A02 | | | | | | | | | | |
| Pediatric Cardiology | 60Q | 1615 | 9366B | 6A06 | | | | | | | | | | |
| Pulmonary Diseases | 60F | 1610 | 9386K | 6A26 | | | | | | | | | | |
| SURGICAL SPECIALITY | | | | | | | | | | | | | | |
| General Surgery | 61J | 0214 | 9416 | 6A30 | | | | | | | | | | |
| Neurological Surgery | 61Z | 0224 | 9416F | 6A31 | | | | | | | | | | |
| Obstrectics and Gynecology | 60J | 0229 | 9486 | 6A15 | | | | | | | | | | |
| Opthalmology | 60S | 0234 | 9436 | 6A17 | | | | | | | | | | |
| Orthopedic Surgery | 61M | 0244 | 9486 | 6A32 | | | | | | | | | | |
| Otolaryngology | 60T | 0249 | 9446 | 6A19 | | | | | | | | | | |
| Thoracic Surgery | 61K | 0264 | 9416A | 6A34 | | | | | | | | | | |
| Plastic Surgery | 61L | 0254 | 9416G | 6A33 | | | | | | | | | | |
| Colon and Rectal Surgery | | 1506 | 9416B | 6A24 | | | | | | | | | | |
| Urology | 60K | 0269 | 9426 | 6A36 | | | | | | | | | | |
| OTHER SPECIALITY | | | | | | | | | | | | | | |
| Aerospace Medicine | 61N | 0045 | 9356 | 6A01 | | | | | | | | | | |
| Anesthesiology | 60N | 0118 | 9566 | 6A04 | | | | | | | | | | |
| Child Psychiatry | 60U | 0115 | 9586 | 6A25 | | | | | | | | | | |
| Diagnostic Radiology | 61R | 0131 | 9536 | 6A27 | | | | | | | | | | |
| Forensic Pathology | | 1631 | | | | | | | | | | | | |
| Neurology | 60V | 0121 | 9576 | 6A13 | | | | | | | | | | |
| Occupational Medicine | 60D | 0166 | | 6A16 | | | | | | | | | | |
| Psychiatry | 60W | 0115 | 9586 | 6A25 | | | | | | | | | | |
| Pathology | 61U | 0158 | 9526 | 6A20 | | | | | | | | | | |
| Physical Medicine and Rehabilitation | 61P | 0125 | 9376 | 6A22 | | | | | | | | | | |
| General Preventive Medicine | 60C | 0160 | 9356B | 6A23 | | | | | | | | | | |
| Public Health | 60C | 0169 | | 6A23 | | | | | | | | | | |
| Radiology | 61S | 0131 | 9536 | 6A27 | | | | | | | | | | |
| Therapeutic Radiology | 61Q | 0135 | 9596 | 6A27 | | | | | | | | | | |
| TECHNICAL OCCUPATIONS | | | | | | | | | | | | | | |
| DENTAL ASSISTANT (Dental Specialist) | 91W | DT | 981X0 | 330 | | | | | | | | | | |
| LICENSED PRACTICAL NURSE (Hospital Corpsman) | 91C | HM | 90250 | 300 | | | | | | | | | | |
| PHYSICIAN'S ASSISTANT (Physician's Assistant) | 011A | 0099 | 9286 | 6H | | | | | | | | | | |
| SURGICAL TECHNICIAN (Operating Room Technician) | 91D | HM8483 | 902X2 | 301 | | | | | | | | | | |
| RADIOLOGIC TECHNICIAN (X-Ray Technician) | 91P | HM8452 | 903X0 | 313 | | | | | | | | | | |

SOURCE

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Accessibility: Other Government Agencies

Classification: Unclassified

Proponent: OASD(HA)

TABLE 3. WARTIME MANPOWER REQUIREMENTS BY DAYS AFTER MOBILIZATION, CONTINUED

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | DAYS AFTER MOBILIZATION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | M DAY | M+10 D DAY | M+20 | M+30 | M+40 | M+50 | M+60 | M+90 | M+ 120 | M+ 180 |
| TECHNICAL OCCUPATIONS (Continued) | | | | | | | | | | | | | | |
| MEDICAL RECORD TECHNICIAN (Patient Administration Specialist) | 71G | | 906X0 | 513 | | | | | | | | | | |
| MEDICAL LABORATORY TECHNICIAN (Laboratory Technician) | 92B | HM8501 HM8506 | 924X0 | 311 | | | | | | | | | | |
| PHARMACY TECHNICIAN (Pharmacy Technician) | 91Q | HM8482 | 965X0 | 312 | | | | | | | | | | |
| PHYSICAL THERAPY ASSISTANT (Physical Therapy Specialist) | 91J | HM8466 | 913X0 | 303 | | | | | | | | | | |
| ORTHOPEDIC ASSISTANT (Orthopedic Specialist) | 91H | HM8489 | 919X0 | 304 | | | | | | | | | | |
| PROFESSIONAL OCCUPATIONS | | | | | | | | | | | | | | |
| BIOLOGICAL SCIENTIST (Physiologist) | 68J | 0848 | 9166 | 5C | | | | | | | | | | |
| PSYCHOLOGIST (Psychologist) | 68S | 0851 | 9186 | 5E | | | | | | | | | | |
| DENTIST (General Dental Officer) | 63B | 0335 | 9826 | 6C | | | | | | | | | | |
| DIETITIAN (Hospital Dietitian) | 65C | 0876 | 9216 | 6H | | | | | | | | | | |
| NUCLEAR MEDICAL TECHNOLOGIST (Nuclear Medical Science Officer) | 60B | 0140 | 9386R | 6A28 | | | | | | | | | | |
| NURSE--PROFESSIONAL (General Nurse Officer) | | | | | | | | | | | | | | |
| Clinical Nurse | 66J | 0925 | 9756 | 6E | | | | | | | | | | |
| Medical-Surgical Nurse | 66H | 0925.1910 | | 6F | | | | | | | | | | |
| Nurse Anesthetist | 66F | 0952 | 9746 | 6F | | | | | | | | | | |
| OR Nurse | 66E | 0932 | 9736 | 6F | | | | | | | | | | |
| Mental Health Nurse | 66C | 0925.1930 | 9726 | 6F | | | | | | | | | | |
| OCCUPATIONAL THERAPIST (Occupational Therapist) | 65A | 0874 | 9226 | 6H | | | | | | | | | | |
| PHYSICAL THERAPIST (Physical Therapist) | 65B | 0873 | 9236 | 6H | | | | | | | | | | |
| PODIATRIST (Podiatrist) | 68L | 0892 | 9276 | 6H | | | | | | | | | | |
| RESPIRATORY THERAPIST (Respiratory Therapist) | 91V | HM8541 | 90251 | 300 | | | | | | | | | | |
| SERVICE OCCUPATIONS | | | | | | | | | | | | | | |
| DIETARY TECHNICIAN (Hospital Food Service Specialist) | 94F | | 622X1 | 300 | | | | | | | | | | |
| PSYCHIATRIC AIDE (Psychiatric Specialist) | 91F | HM8485 | 914X1 | 302 | | | | | | | | | | |
| PARAMEDIC EMT PERSONNEL (Medical Specialist) | 91B | HM8404 | 902X0 | 300 | | | | | | | | | | |
| OCCUPATIONAL THERAPY ASSISTANT (Occupational Therapy Specialist) | 91L | HM8466 | 913X1 | 303 | | | | | | | | | | |
| MAINTENANCE OCCUPATIONS | | | | | | | | | | | | | | |
| ELECTROMEDICAL EQUIPMENT REPAIR (Biomedical Equipment Repair Technician) | 35U | HM8478 | 918X0 | 198 | | | | | | | | | | |

SAMPLE DATA FORMATS

TABLE 3. WARTIME MANPOWER REQUIREMENTS BY DAYS AFTER MOBILIZATION, CONTINUED

| OCCUPATIONAL TITLE | OCCUPATIONAL CODE | | | | DAYS AFTER MOBILIZATION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARMY | NAVY | AF | DOD | M DAY | M+10 D DAY | M+20 | M+30 | M+40 | M+50 | M+60 | M+90 | M+ 120 | M+ 180 |
| CLERICAL OCCUPATIONS | | | | | | | | | | | | | | |
| MEDICAL SHIPPING AND/OR RECEIVING CLERK (Medical Supply Specialist) | 76J | | 915X0 | 551 | | | | | | | | | | |
| OTHER OCCUPATIONS | | | | | | | | | | | | | | |
| ENVIRONMENTAL HEALTH SPECIALIST (Environmental Health Specialist) | 91S | HM8432 | 907X0 | 322 | | | | | | | | | | |
| ENTOMOLOGIST (Entomologist) | 68G | 0860 | 9136 | 5C | | | | | | | | | | |
| ORTHOTIC SPECIALIST (Orthotic Specialist) | 42C | HM8489 | 919X0 | 304 | | | | | | | | | | |
| VETERINARIAN (Veterinarian) | 64A | | 9925 | 6G | | | | | | | | | | |
| Veterinary Lab Animal Officer | 64C | | | 6G | | | | | | | | | | |
| Veterinary Pathologist | 64D | | | 6G | | | | | | | | | | |
| Veterinary Microbiologist | 64E | | | 6G | | | | | | | | | | |
| Veterinary Comparative Officer | 64F | | | 6G | | | | | | | | | | |
| OPTICAL LABORATORY SPECIALIST (Optical Laboratory) | 42E | HM8463 | | 311 | | | | | | | | | | |

NOTES:

1. Navy officer codes which begin with a 1 are subspecialty codes.
2. Blocks with no entries represent occupations for which there was no corresponding occupational title or code.
3. Air Force also has an enlisted physician assistant (917X0)

# APPENDIX E

## Goal Programming Formulation

# A GOAL PROGRAMMING FORMULATION FOR EFFICIENTLY ALLOCATING HEALTH MANPOWER BETWEEN MILITARY AND CIVILIAN SECTORS IN WARTIME

## E.1 THE PROBLEM

In peacetime, the military sector employs active duty health manpower and provides medical assistance to family dependents as well, while maintaining a sizable trained reserve force in the civilian sector. The reserve component may not necessarily have identical military and civilian occupational titles; for instance, aerospace medicine is typically a secondary specialty for civilian general practitioners or specialists with additional Air Force training. This issue is particularly relevant for allied health manpower.

In wartime, reservists are called for active duty and there may be estimated health personnel shortages to be met with draftees. Medical care is provided by the military sector to this enlarged active duty force while the civilian sector must also supply care to family dependents and war casualties sent back to the continental U.S. (CONUS). Some 50,000 hospital beds have been assigned to war casualties by the Civilian-Military Contingency Hospital System (C/MCHS).

In March of 1983, the Defense Department had 10,119 and 19,083 physicians in active duty and the reserve, respectively, and an anticipated wartime shortage of 4,470. Given a total supply over 460,000 medical doctors in 1980, about 376,000 of which are dedicated to direct patient care activities, wartime military requirements are not expected to draw much more than 10 percent of the physicians available to the U.S. population. If, however, such requirements, are defined by medical specialty, analysis has shown that effects on the remaining civilian supply can be quite dramatic. For instance, there are only 810 general preventive medicine specialists, 394 dedicated to direct patient care, 73 in military active duty and 117 reservists, leaving just 204 civilian sector specialists to treat the general population in time of war or full mobilization. Due to an initially small total supply, military requirements will further reduce it by more than 50 percent.

The Defense Department also has an estimated wartime shortage of 35,137 non-physician health manpower among which 5,440 nurses, 15,395 combat medics (medical specialists), and 5,313 hospital corpsmen (comparable to a civilian LPN). The reserve force in this case is quite large, over 60,000 professionals, therefore subtracting for the civilian supply an estimated 96,828 health personnel in wartime. As with physicians, the pressure placed by wartime military requirements is unevenly distributed among professions, especially when reservists with similar job titles are added to the pool with estimated shortages. For instance, from a total supply of 680 occupational therapy assistants in 1980, 161 are active duty military and 113 reservists, respectively, with an estimated wartime shortage of 141. Consequently, only about 39 percent of the total supply of such therapists will be available to the civilian population in wartime.

Consequently, wartime military requirements must be analyzed by specialty to estimate relative shortages affecting the civilian population. Measures of need for care are not available for all occupational titles of interest. Radical increases in the population/provider ratios after meeting military needs may be used to indicate potential problem-specialties, possibly accentuated by a spatial (i.e., geographical) misallocation of the available health manpower, especially if the drafting system is purely random.

## E.2 DEFINITION OF RELEVANT INDICATORS

The first issue in defining relevant indicators to measure the relative pressure by wartime military requirements on the remaining supply of health manpower available to the civilian population, is the identification of comparable occupational titles. For simplicity and lack of better data, it will be assumed that similar civilian and military professional roles are performed. Also, total U.S. population will be used as a proxy for civilian population for lack of more specific information.

The following variables will be used in the problem formulation below:

- Total supply (TS): most current data on the total number of professionals exercising a particular professional specialty. If available, the total supply of professionals dedicated to patient care activities will be used.
- Military supply: most current data on the number of active duty military (MAD) and reservists (MR) by specialty.
- Wartime military shortage (WMS): worst case estimate available of shortages by specialty.
- Population/provider ratios: total and net ratios (TPPR and NPPR, respectively) will be computed, using the total and the net civilian supply of health manpower, by specialty.
- The specialty substitutability matrix: this issue has been considered by the military sector and should be of concern for wartime planning. For example, pediatric and adult cardiologists are specialties subject to very similar training. Dental surgeons may replace general dentists although the opposite is not necessarily true. A specialty substitutability matrix (SSM) may be defined by a body of health specialists, using a 0-1 index to indicate perfect, approximate or no substitutability possible between row and column specialty headings.
- Care settings: if data availability permits, the total demand for care by the civilian population and consequent need for care suppliers should be estimated for at least two settings--office visits and hospital admissions. Several health specialties with wartime military shortages are typically hospital-based and special consideration should be given to this setting. Also, current hospital employment data are more easily available.
- Geographic constraints: a panel of experts may define what percentage of the U.S. counties (PCC) is allowed to show relative shortages of health manpower by specialty, possibly definning a concept for relative shortage (RSC) as well. The shortage area concept used by DHHS as of November of 1980 defines only population per FTE primary care physicians, dentists, psychiatrists, podiatrists and livestock veterinarians which should not exceed 3,500:1, 5,000:1, 30,000:1, 28,000:1, and 10,000:1, unless unusually high need for care can be demonstrated. The measures for vision care and pharmacy services are defined in terms of the demand for services.
- Male draft: apparently this may not be an issue except for wartime specialties directly involved in combat activities, such as medical specialists (combat medics). Female draft might be indispensable to meet military requirements for some specialties such as nurses. Total supply by specialty should not be allowed to exceed the number of male professionals, if female draft legislation is not approved.

## E.3 PRELIMINARY FORMULATION OF THE PROBLEM

The problem described in Section 1 above can be formulated as an attempt to best allocate health manpower to meet given national objectives in wartime, taking into account constraints such as the available supply, and care demand requirements. A preliminary problem formulation is presented below.

Assume that three major wartime goals have been defined:

- wartime military shortages of health manpower must be met;
- the civilian population per provider must be kept within desirable ranges to meet the estimated demand;
- the hospital manpower in CONUS must meet the normal demand for care and the increase in patient load represented by war casualties.

Such goals can only be met respecting several constraints imposed by total health manpower availability, manpower requirements derived from the peacetime demand for care function, etc. Some of these constraints can be expressed as indicated below.

### E.3.1 Total Health Manpower Availability

The total number of professionals allocated to peacetime military active duty and reserve, as well as estimated wartime military shortages all components of wartime military active duty, cannot exceed the total supply of health manpower by specialty. The net supply of health manpower available to attend the wartime needs of the civilian population is computed as the difference between the total supply available and total military wartime needs, as represented by peacetime active duty, peacetime reserve and estimated wartime shortages).

### E.3.2 Civilian Demand For Care

For certain specialities, desired bounds have been defined for the ratio of population to providers. Such bounds must be met with the net civilian supply per specialty.

The peacetime civilian demand for care is typically defined for the physician's office and hospital settings. These demand functions may suffer a downward shift in wartime because normal maintenance and other types of voluntary care needs may decrease.

However, such effect might be difficult to estimate except as upper and lower bounds on the peacetime demand for care. For example, the wartime demand for a certain type of care will lie between the peacetime level and 80 percent of that level. In other words, a 20 percent reduction in the peacetime number of visits is anticipated in wartime. If such coefficients are unavailable from previous war experiences, the peacetime demand level may simply be used as an upper bound on wartime demand.

The manpower requirements derived from wartime civilian demand functions must be met with the net civilian supply available, by specialty and care setting. There may occur a wartime productivity increase so that fewer health professionals can supply the same level of care. If such estimates are available from previous wartime experiences, lower and upper bounds can be defined for civilian manpower requirements, the upper bound being represented by peacetime needs and the lower bound estimated as a fraction of the upper bound. Otherwise, just an upper bound can be placed on manpower needs derived from peacetime civilian demand for care.

Some manpower categories might be considered reasonably close substitutes under emergency. For example, a dental surgeon may perform the functions of a dentist although the reverse is not true without additional training. Pediatric and adult medical specialties undergo similar formal training. The Defense Department has defined a preliminary matrix dealing with the question of physician specialty substitutability within the military sector. An emergency substitutability matrix can perhaps be defined for the civilian sectors as well, taking into account formal training similarities and assigning values between 0 (no substitutes) and 1 (perfect substitutes) to row and column professional titles. These coefficients can then be used to impose joint manpower availability constraints for several specialties.

### E.3.3 Geographic Constraints

Net civilian shortages will probably result from war demands for certain types of medical specialists. At the same time, because the spatial distribution of health manpower is not homogenous throughout the U.S. Some counties may suffer a greater impact from a random draft by specialty. To avoid that, a constraint may limit the population per provider ratio at the county level not to exceed pre-defined desired levels. Alternatively, the county ratios may not be allowed to fall below a cut-off point based on the peacetime statistical frequency distribution.

## E.4 THE TECHNIQUE OF GOAL PROGRAMMING

The term goal programming was first proposed by Charnes and Cooper (1961) for mathematical programming formulations of the problems of coming "as close as possible" to a set of simultaneously unattainable goals. As Dyer (1977) points out, "this approach to multiple objective optimization did not receive significant attention until the mid 1960's However, during the past fifteen years [there has been] (....) a flood of professional articles and books" (p.1). Applications to planning issues arising in several fields such as advertsiing, manpower (Charnes et. al, 1972), production, health care (Lee, 1972) etc. have been proposed, including a computer-interactive formulation to an academic planning problem (Dyer, 1972 and Geoffrion, et. al., 1972). The most recent trend is to place goal programming in the broader context of piecewise linear programming applied to a separable objective function (see, for instance, Dyer, 1977).

A simple example supplied in Dyer (1977) is useful to describe the methodology. Suppose a manager has identified a problem that can be formulated as a traditional mathematical problem except that there are two objective functions, $f_1(x)$ and $f_2(x)$. The manager is then asked to specify some of his goals, the answer being that he would like $f_1$ to be at least as large as $b_1$, and $f_2$ to lie between two defined values $b_{2L}$ and $b_{2R}$. Then he is asked to assign weights of relative importance to deviations of f from b and of $f_2$ from both $b_{2L}$ and

$b_{2R}$. Then he is asked to assign weights of relative importance to deviations of $f_1$ from $b_1$ and of $f_2$ from both $b_{2L}$ and $b_{2R}$. After some thought he responds with weights $w_1$, $w_2$ and $w_3$.

The problem is then formulated in terms of postive and negative deviations from a certain goal i (noted as $Y_i^+$ and $Y_i^-$, respectively), as follows:

$$\text{Min} \quad W_1Y_1^- + W_2Y_2^- + W_3Y_3^+$$

subject to:

$$f_1(X) - Y_1^+ + Y_1^- = b_1$$

$$f_2(X) - Y_2^+ + Y_2^- = b_{2L}$$

$$f_3(X) - Y_3^+ + Y_3^- = b_{2R}$$

$$Y_i^+ , Y_i^- \geq 0 , i = 1, 2, 3$$

Dyer (1977) subsequently shows that this formulation is equivalent to a piecewise linear approximation to an additive separable nonlinear objective function. However, this conclusion is not particularly relevant to the formulation of the problem at hand, although it will greatly simplify a future search for a computer code to solve it.

A very interesting extension of this simple-minded example is presented in Geoffrion, Dyer and Feinberg (1972), proposing a man-machine interactive approach to multi-criterion optimization. The decision-maker would "resolve the conflicts inherent in the given multiple criteria, but [the procedure] never actually requires this preference function to be identified explicity. In other words, (...) [the implementation requires] only the necessary information from the decision-maker concerning his preferences over the criteria" (p. 357).

An application is provided concerning the allocation of faculty time among three principal departmental activities. The initially

defined tradeoff weights associated with each of the criteria can be revised at each step, after the graphic display of intermediary solution is reviewed by the decision-maker. He can also select the most desirable position in the display, thus starting a new iteration. The authors' experience is that "decision-makers can provide the required information without significant difficulty [and] (...) have used the model to aid the adminstration in investigating the impact of proposed changes in policies which would significantly affect the mix and number of required courses." (p. 365).

An interactive approach is especially relevant for an application of goal programming to a probabilistic situation where the very definition of the goals is tentative, such as with the problem under consideration. Such goals may result from consensus among relevant public agency representatives, the impact of different weighting schemes being substantial. Therefore, the involvement of policy-makers in the process of identifying an optimal strategy for allocating health manpower between sectors may improve the specification of national goals under emergency, obtain better solutions and illustrate the trade-offs involved.

## E.5 GOAL PROGRAMMING FORMULATION OF THE PROBLEM

The following symbols will be used in the mathematical formulation:

$TS_s, (TS_s^c)$ = total supply of health manpower category s (in county c), where $s = s_i + s_2$, $s_i$ and $s_2$ referring to office and hospital settings, respectively.*

$MAD_s, MR_s$ = active duty military and reservists of type s

$WMS_s$ = wartime military shortage in category s

$POP\ (POP^c)$ = total population (in country c)

$NCS_s\ (NCS_s^c)$ = net civilian supply of manpower type s (in county c)

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* If needed, s can be broken down into finer categories.

$NPPRs(NPPR_s^c)$ = net population provider type s ratio (in county c), defined as $POP_s/NCS_s$ ($POP_s^c/NCS_s^c$)

$LB_s$, $UB_s$ = desired lower and upper bounds on the net ratio of population provider types s

PC = proportion of the national population/provider ratio providing the lowest bound for county level ratios (a constant between 0 and 1)

WDD = wartime demand decrease factor (between 0 and 1), showing a downward shift on the demand for care function

$WPI_s$ = wartime productivity increase factor for specialty s, showing an improvement in the average productivity (visits or discharges) per provider (a constant between 0 and 1)

A preliminary goal programming formulation may be as follows:

$$\text{Min} \sum_s [W_{1s} Y_{1s}^+ + W_{2s} \sum_c Y_{2sc}^+ + W_{3s} \sum_c Y_{3sc}^- + W_{4s} \sum_c Y_{4sc}^- + W_{5s} Y_{5s}^+]$$

subject to:

$$WMS_s - \sum_c TS_s^c - MAD_s - MR_s - Y_{1s}^+ + Y_{1s}^- = 0 \text{ for all } s \quad (1)$$

$$NCS_s = \sum_c NCS_s^c = \sum_c TS_s^c - MAD_s - MR_s - WMS_s \text{ for all } s \quad (2)$$

$$TS_s = \sum_s TS_s^c \text{ for all } s \quad (3)$$

$$NPPR_s^c - Y_{2sc}^+ + Y_{2sc}^- = UB_s \text{ for all } s, c \quad (4)$$

$$NPPR_s^c - Y_{3sc}^+ + Y_{3sc}^- = LB_s \text{ for all } s, c \quad (5)$$

c + -

$$NPPR_s - Y_{4sc^-} + Y_{4sc} = PC * NPPR_s \text{ for all } s, c \quad (6)$$

$$NPPR_s^c = POP_s^c / NCS_s^c \quad (7)$$

$$(TS_s - MAD_s)(1\text{-}WDD) - Y_{5s}^+ + Y_{5s}^- = (1 + WPI_s)*NCS_s \text{ for all } s \quad (8)$$

All variables positive (9)

$$WDD_1,\ WPI_s,\ PC \in (0, 1) \text{ all } s \quad (10)$$

The objective function minimizes deviations from exactly meeting constraints. Constraint 1 states that estimated wartime military shortages cannot exceed the health manpower available, after the active duty and reserve military have been subtracted from the total supply of professionals types. Constraints 2 and 3 are simple equalities, defining the net civilian and total supply at the national level as the sum of county totals. Constraint 4 and 5 impose upper and lower bounds on the net ratio of population per provider type s ratio at the national level, respectively. Constraint 7 defines the population - provider ratio. Constraint 8 takes into account the wartime demand decrease and productivity increase factors to obtain an estimated net requirement for health manpower type s which should not exceed the net civilian supply. The derivation is as follows: the peacetime requirement for s $PCR_s$ is decreased by (1-WWD), because of a wartime demand downshift. On the other hand, the total peacetime productivity increases by (1 + WPIs) to become:

$$\frac{PCR_s^c}{TS_s^c - MAD_s^c} \quad (1 + WPI\ s)$$

Therefore:

$$\frac{PCR_s\ (1\text{-}WDD)}{\frac{PCR_s}{TS_s - MAD_s}\ (1 + WPI)} < NCS_s$$

Or:

$$\frac{(TS_s - MAD)\ (1 - WDD)}{1 + WPI} \quad < \quad NCS_s$$

Finally, constraints 9 and 10 define all variables as positive and WDD, $WPI_s$, PC to be in the interval between 0 and 1, respectively.

A coefficient $SSM_{sq}$ may be used to express the rate of substitutability between skill types s and q, based perhaps on training similarities. In this case, constraint type (1) may be jointly defined for groups of professions, allowing a certain percentage of skill $q \neq s$ to be added to TS, MAD, MR and WMS.

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# APPENDIX F

## Sample Collateral Data Formats

Appendix F
SAMPLE DATA FORMATS

TABLE 1. PEACE AND WARTIME TOTAL FORCE STRENGTH--WORLDWIDE

| PERSONNEL CATEGORY | PEACETIME | WARTIME | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M Day | M+10 D DAY | M+20 | M+30 | M+40 | M+50 | M+60 | M+90 | M+120 | M+180 |
| Officer | | | | | | | | | | | |
| Combat Troops | | | | | | | | | | | |
| Combat Support | | | | | | | | | | | |
| Combat Service Support | | | | | | | | | | | |
| Enlisted | | | | | | | | | | | |
| Combat Troops | | | | | | | | | | | |
| Combat Support | | | | | | | | | | | |
| Combat Service Support | | | | | | | | | | | |

SOURCE:

Wartime Manpower Authorization Posture Statement (WARMAPS)
Processing Mode: Electronic
Media: Tape, disk, hard copy
Accessibility: Highly restricted--by written request and "need to know" basis only
Classification: Top Secret
Proponent: ASD(MRA&L)

SAMPLE DATA FORMATS

TABLE 2. NON--THEATER BED REQUIREMENTS

ESTIMATED
OCCUPIED BEDS

n

0

| M DAY | M+10 D DAY | M+20 | M+30 | M+40 | M+50 | M+60 | M+90 | M+120 | M+180 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

SOURCE:

Report of the Wartime Medical Posture Study, OASD(MRA&L), 1980

Processing Mode: Manual

Media: Hard Copy

Assessibility: Other Government Agencies

Classification: Secret

Proponent: OASD(MRA&L)

Exhibit 10, (continued)
SAMPLE DATA FORMATS

TABLE 3. THEATER BED REQUIREMENTS