Systems Analysis
For a "New Generation" of Military Hospitals

(1)

Volume 1. Analysis of Military Health Care

Final Report

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SYSTEMS ANALYSIS
FOR A "NEW GENERATION" OF MILITARY HOSPITALS

VOLUME 1

ANALYSIS OF MILITARY HEALTH CARE

FINAL REPORT
TO THE ADVANCED RESEARCH PROJECTS AGENCY
OF THE DEPARTMENT OF DEFENSE

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SYSTEMS ANALYSIS

FOR A "NEW GENERATION" OF MILITARY HOSPITALS

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The Department of Defense set up a special project organization as shown on the following page, under the direction of Dr. Louis M. Rousselot, Assistant Secretary of Defense (Health and Manpower) and Dr. Donald MacArthur, Deputy Director, Defense Research and Engineering. Besides members of DOD, the group included representatives from the Department of Health, Education and Welfare and from the Veterans Administration.

OFFICE OF THE SECRETARY OF DEFENSE

Colonel Robert Joy, USA MC, was the Project Officer representing the Office of Defense Research and Engineering, who sponsored the study. Colonel Joy was a steady influence on all of our work; he read our working memoranda and reports reliably and critically, furnishing a valuable sounding board for the merit of our conclusions as they developed. Equally helpful in various ways were other members of the Secretary's Office:

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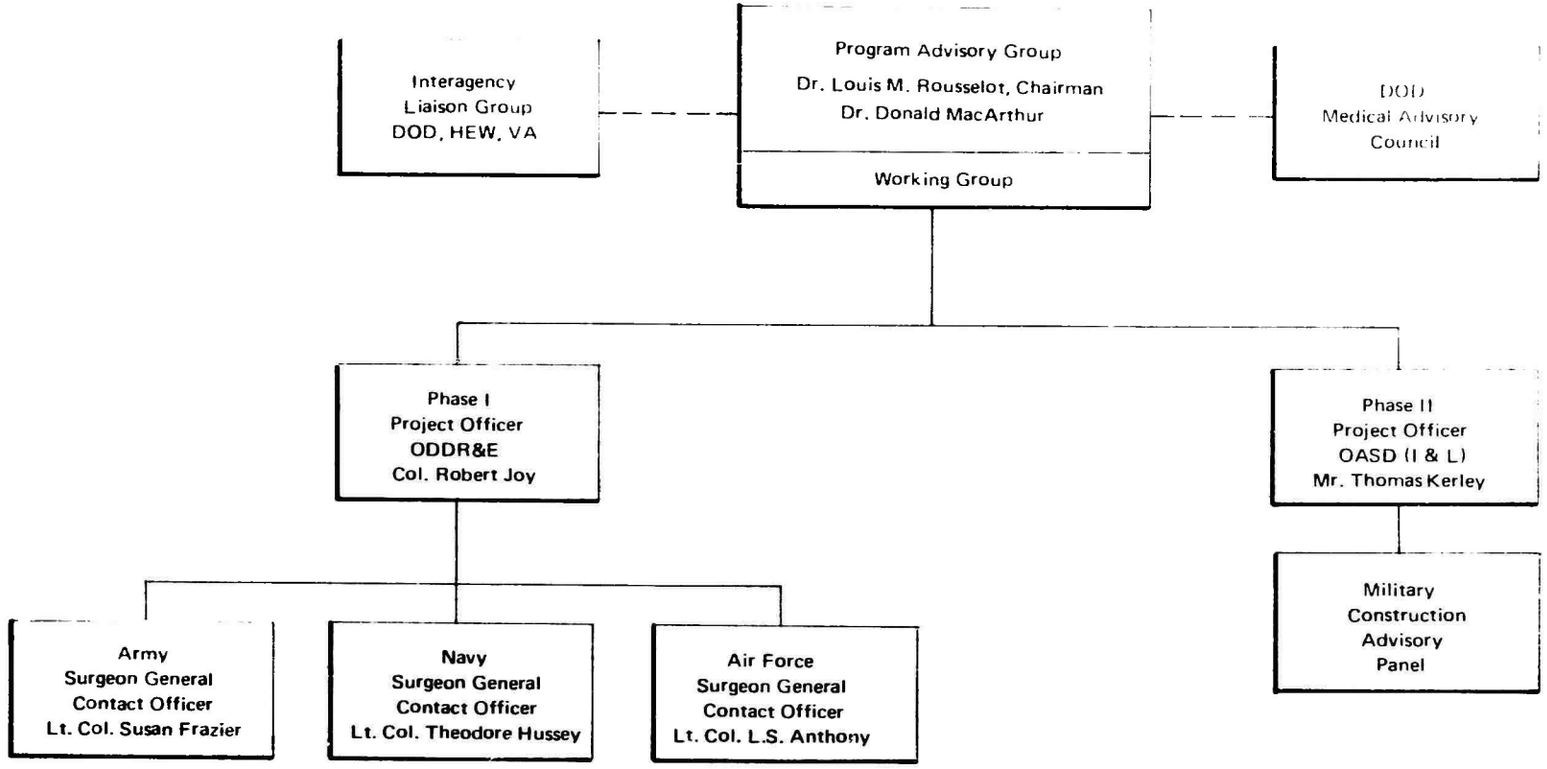
Lieutenant Commander John Hendren USN MSC, Assistant Project Officer
Colonel Clarence Edmonds USAF MSC
Mr. Thomas Kerley, Installations and Logistics
Mr. John Freeman, Comptroller
Mr. Patrick Gross, Systems Analysis
Mr. Garen Staglin, Systems Analysis



PROJECT ORGANIZATION WITHIN THE DEPARTMENT OF DEFENSE

CONTACT OFFICERS

Each service appointed an officer to act as our primary point of contact with that service. These three officers saw to our requests for visits to the military bases, for consultations with various officers throughout the Offices of the Surgeons General, and for numerous reports and regulations. In addition to being exceedingly helpful throughout the study in these respects, they were deeply interested in the success of our work, gave unstintingly of their time, and made many valuable suggestions.

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Navy - Lieutenant Commander Theodore Hussey, MSC

Air Force - Lieutenant Colonel Leonard Anthony, MSC

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HOSPITAL OFFICERS

During the first half of the study, members of our staff spent many days at military hospitals, gathering operating data and talking with members of the staffs to collect new concepts which we were developing. Nine military hospitals were designated for these purposes:

Walson Army Hospital, Fort Dix, New Jersey

Dewitt Army Hospital, Fort Belvoir, Virginia

Womack Army Hospital, Fort Bragg, North Carolina

Jacksonville Naval Hospital, Jacksonville, Florida

Beaufort Naval Hospital, Beaufort, South Carolina

Oak Knoll Naval Hospital, Oakland, California

USAF Hospital, March AFB, California

USAF Hospital, Andrews AFB, Maryland

USAF Hospital, Lackland AFB, Texas

The members of the staffs of these hospitals were unfailingly generous in taking time from their other duties to assist us in any way that we asked. We also had occasion to visit a number of other bases, including

Mayport Naval Base, Cecil Field, Camp Pendleton, Travis AFB, Norton AFB, and Hamilton AFB.

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Walson Army Hospital

Colonel David Eisner, Commander

Colonel Seth Linthicum, Executive Officer

Jacksonville Naval Hospital

Captain Charles Lewis, Commander

Captain John Young, Administrative Officer

March AFB Hospital

Colonel William Hernquist, Commander

Colonel Patrick Pomphrey, Administrator

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*Now Administrator, Montefiore Hospital

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Johan van Lengen
Bonnie Martz
Rosalie Sperling
Richard White

SRS CONSULTANTS, INC. AND CAMPBELL, ALDRICH AND NULTY, ARCHITECTS

William Smock, Subproject Director
John Ellis
Glenn Merithew
Joshua Shuchatowitz

*Now at Cleveland Clinic

MEDICAL AND HOSPITAL SERVICE CONSULTANTS

Margaret Arnstein, Dean, Yale School of Nursing, New Haven, Conn.

Dr. Byron Brogdon, University of New Mexico, Albuquerque, N.M.

Dr. Max Bulian, Harvard Medical School, Boston, Mass.

Dr. David Freiman, Harvard Medical School, Boston, Mass.

A. Richard Goolkasian, Peter Bent Brigham Hospital, Boston, Mass.

Gail Kuhn, Assistant Chief of Nursing, Montefiore Hospital, Bronx, N.Y.

Dr. Charles Lewis, Harvard Medical School, Boston, Mass.

Dr. Ernest Saward, Kaiser Foundation, Portland, Oregon

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Charles Campbell, Editor

J. Anthony Gunn, Editor

A. Norman Law, Cover Design

William Reehl, Editor

Paula Schwartz, Editorial Assistant

1.2. ORGANIZATION OF THE REPORT

This report is organized in nine volumes plus a summary. The summary, which is intended to stand alone, contains all the conclusions from the rest of the report but omits the detailed reasoning and analysis by which we reached those conclusions. Thus it serves as a summary of results and as a guide to subjects of particular interest to individual readers.

The nine volumes are titled as follows:

Volume 1. Analysis of Military Health Care
Volume 2. Reorganization of the Base-Level Military Health Care System
Volume 3. Acquisition of Fixed Health Care Facilities
Volume 4. Development of the New Generation
Volume 5. Appendices: Improvements to Provision of Medical Services
Volume 6. Appendices: Improvements to Facilities for Patient Care
Volume 7. Appendices: Improvements to Support Services
Volume 8. Appendix: Survey of Military Hospitals
Volume 9. Appendix: Building Systems in Military Hospitals

The first four volumes contain all the results of the study, assembled in a form which knits all the results together into a description of the "new generation" of military hospitals. The remaining five volumes are appendices, in which are derived the special results for particular subsystems of the base-level health care system.

Volume 1 lays the background for the study: its purpose and organization, a brief description of the present health care system, and the social and political background in which the health care system of the future is likely to operate. This last matter is at least as important as the more rigorous considerations concerning costs. This volume also sets forth the hypotheses which we evaluated and discusses our methodology in evaluating alternatives. It concludes with a summary of the functional cost analysis (also contained in Volume 8, Survey of Military Hospitals) which forms the basis for all subsequent analysis and comparison.

Volume 2 discusses reorganization of the base-level health care system to take advantage of the innovations we propose. We have used the

term "reorganization" because many of the changes--particularly those concerned with ambulatory care and light care--require changes in organization at least as much as they require changes in facilities or equipment. The same might be said of the introduction of computer systems, which is one of the matters discussed in connection with changes in hospital services. Here we discuss various kinds of automation and streamlining of the clinical laboratory, food service, patient monitoring, physical examination facilities, nursing care, pharmacy, and materials handling.

Volume 3 deals with the planning process by which health facilities are acquired. We have emphasized the process rather than actual design, because many designs are potentially acceptable; a choice must be made in the context of a particular base. (An illustrative application of the proposed design process to a hypothetical redesign of the hospital at March AFB is contained in Volume 6.) In the long run, innovations in the design process are likely to produce better facilities at many locations than are innovations in the designs themselves.

Volume 4 deals with the transition from the present health care system to the "new generation." It summarizes the features of the first hospital in the "new generation," the prototype hospital which will serve as a testing ground both for experimental verification of the merit of concepts proposed in this study and for concepts which need further development. In both connections it will be necessary to gather much data not now available in order to have a solid basis for analyzing operations in the prototype hospital; this matter is considered at some length. Finally, the needs for an R & D program both within and outside the prototype hospital are presented. In the course of the analyses reported in the appendices, various R & D needs are identified, and these are summarized here.

Volume 5, the first of the appendices, presents studies concerned with the improvement of medical services. These studies support the recommendations for reorganized health care presented in Volume 2. They pertain to ancillary personnel for primary medical care and for restorative dentistry, a few possible improvements in nursing services, multiphasic testing, elimination of obstetric services (by providing them

1.1. PURPOSE OF THE STUDY

The goal of this study has been to apply the techniques of systems analysis to the problem of designing the health care system for domestic military bases. The central element of this system is the military hospital, from which the study gets its name, "Systems Analysis for a 'New Generation' of Military Hospitals." It is a "new generation," because essentially no constraints were placed upon the study team except that whatever they conceived for the "new generation" had to be feasible, given the mission, the available military personnel, and the military requirements of the services. Thus, we were free to consider changes in patterns or procedures for care, in staffing and training, in organization, in planning and design of the buildings, and in the equipment utilized.

As in every study without external constraints, it was necessary to establish guidelines defining those matters which would be subjects of study.

- In the case of facilities or equipment, the study was to be confined primarily to items located on the base. With regard to organization, procedure, or staffing, it was confined primarily to matters within the authority of the hospital commander or post surgeon to administer, though not necessarily to establish regulations for; thus, we did not consider changes in selective service policy, assignments, lengths of tours, and the like.

- The study was to deal with care of active and retired personnel and their dependents. Thus, we excluded veterinary practice.

- The focus of the study was to be primarily on <u>how</u> health care is delivered rather than <u>what</u> health care is delivered, particularly when the choices lie outside the hospitals and

dispensaries. For example, distributing contraceptives, increasing sanitation measures, or undertaking inoculations could be considered subjects of study, since each potentially affects the cost of care. Whether such things are done, or how intensively they are done, were regarded as policy questions lying outside the scope of our study.

- We were to examine areas where there was more than one reasonable alternative. Thus, we excluded procedures where, for whatever reason, we could find no feasible alternative. A principal criterion was that alternatives had to look reasonable in the light of present technology or technology developable within, say, four or five years; accordingly, we excluded conceivable but highly advanced possibilities such as spoken inputs to computers.

- The study was to concentrate on areas where alternative improvements would have a significant impact on costs or care, not trivial matters like stamp machines or baby pictures.

The phrase "subjects of study" was chosen with some care; many factors which fall outside the guidelines affect health care delivery and cannot be ignored, but they were not regarded as subjects of study. Thus, for example, the fact that a great many physicians serve only two years demonstrably creates inefficiency. However, this was not a subject of our study in the sense of evaluating, say, the effect of lengthening tours of duty or raising doctors' pay. At the same time, the fact that many physicians serve only two years could not be disregarded, because it affects many practices.

The product of the study is a set of recommendations, applicable not just to one hospital but the whole generation of hospitals to be built in the 1970's and after. The results are cast in a form which makes clear their presumed merit in different circumstances and the limitations to their applicability.

exclusively through CHAMPUS), patient monitoring equipment, and the in-patient surveys which led to the concept of a light care facility.

Volume 6 contains appendices dealing with improvements to facilities for patient care. It presents without evaluation some novel practices used in European hospitals, which can be borne in mind in designing the prototype hospital. It also contains a study of the economic benefits associated with the use of patient rooms of various sizes. It describes a computer program called RELATE (RElationship LAyout TEchnique), which aids in exploring the possibilities in facility layout and helps in arriving at a good layout. This program is also compared with a number of other programs designed to do the same task. Finally, Volume 6 shows the results of applying the innovations to the design process, presented in Volume 3, to a hypothetical redesign of the March AFB Hospital.

Volume 7 deals with improvements to support services. These are the areas where technology has the most to offer. There are studies concerning automated materials handling systems, convenience foods, unit packaging and automation in the pharmacy, disposable linens, computer-linked communications and remote consultation using television, automation in the clinical laboratory, and other computer systems for purposes such as maintaining patient records, scheduling, and inventory control.

Volume 8 includes the results of our surveys of operation at three hospitals (Fort Dix, Jacksonville NAS, and March AFB). The data collected here are used throughout the analyses presented in earlier volumes to provide a realistic framework in which to evaluate our proposed innovations.

Volume 9 considers the applicability of an innovation in building design, called building systems, to military hospitals. It defines building systems, identifies the problems in current building design which building systems are said to alleviate, and evaluates a number of building systems, modules, and components with regard to their ability to solve current problems. It concludes with recommendations for a building system to be adopted for the prototype hospital, based largely on its being available for a design which is planned to begin very soon, and thus serves as back-up for the plans presented in Volume 4.

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1.3. THE PRESENT MILITARY HEALTH CARE SYSTEM

1.3.1. INTRODUCTION

This section provides some general observations on the present base-level health care system, partly to orient readers unfamiliar with military health care and partly to serve as a point of departure for our speculations about its future in the next section. Detailed descriptions and operating statistics for three particular military hospitals are presented in Volume 8.

Hospitals on military bases in the United States generally function as community hospitals for the local military community, including active-duty personnel, their dependents, and retirees. They may have other functions as well, such as serving as evacuation stations for injured personnel returning from overseas or providing physical examinations to cadets or National Guard members. The hospital is always the focal point of the health care system on the base, and its personnel generally have duties outside the hospital such as dispensary duty, preventive medicine, and public health for the base.

In many respects the similarities between these military hospitals and civilian community hospitals are more evident than the differences. They suffer from many of the same problems--a demand for outpatient services which has climbed drastically over the past decade, a shortage of trained personnel, and high costs. Nevertheless, by comparison military hospitals are on the whole well run with capable staffs, and improvements are not to be sought in simply transferring standard practices from civilian hospitals to military ones. Not only do military hospitals have many special characteristics, but they cope with their problems at least as well as most civilian hospitals.

1.3.2. THE BASE-LEVEL HEALTH CARE SYSTEM

The health care contingent on a military base is charged with providing complete medical and dental care for all active-duty personnel under its jurisdiction. With some exclusions, notably dental care, it is charged with providing similar services to dependents of active-duty personnel. It also provides care to retirees and their dependents, and,

although these services are intended to be provided only "when available", in practice the demand for services from retirees and their dependents is not easy to ignore. The workload from these patients is a substantial fraction of the total workload, especially at bases in attractive retirement locations such as Florida and California. No civilians except emergency cases and persons needing special examinations such as food handlers are treated in military hospitals.

Because good health is required for military service, the population served by military hospitals is comparatively young and healthy; thus, the mix of diseases and injuries presented is quite different from that in civilian practice. Bone injuries, skin diseases, and upper respiratory infections are much more common; terminal diseases are rare. Because part of the function of the health care system is simply certification, patients who would never be seen in civilian practice get into the system. Military personnel also encounter long delays in administrative matters, such as obtaining orders, causing many patients to remain in the hospitals long after they would have been discharged from a civilian institution.

Since the military population is young, the number of obstetrical cases is relatively high. Dependents appear to have a disproportionately high incidence of psychiatric problems, possibly because military life often enforces separation, but perhaps only because the service is free to the patients. Extended psychiatric treatment or psychotherapy is not provided, but minor problems of psychiatric origin are an important part of the workload.

Although we had expected a significant distortion of the workload from injuries in Vietnam, there was little evidence of this in the military hospitals we visited. Injured Vietnam veterans generally amounted to only a few percent of the inpatients. However, the Vietnam build-up had increased the overall workload at many of the hospitals enormously over the past five years. Dramatic fluctuations in the workload for reasons such as this are among the most important characteristics of the base-level health care system. Since wars can flare up, large units can be transferred, and missions can be changed, the workload at military hospitals is not predictable, at least not to the extent that it is in

more stable communities.

One safety valve for overloads is the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS); this program permits treatment at civilian hospitals for military dependents if the service is not available on the base, all but a modest part of the charges being paid by the government. The extent to which CHAMPUS is used depends as much on the attitude of local commands as it does on the actual needs.

In the Army and Air Force base-level hospitals are commanded by a Medical Corps officer, who is also responsible for all medically related activities on the base and is himself under the command of the post or base commander. In the Navy the hospital commander is under the command of the Bureau of Medicine, and dispensaries are commanded by officers under the command of the base.* Both systems are alleged by the officers who operate under them to create problems--Army and Air Force commanders sometimes feel that medical needs are given short shrift in comparison with the needs of the military mission, which is the prime concern of the base commander; Navy commanders complain of being separated from their parent command in Washington, having to depend on other commands for services, and not having authority over dispensaries which depend on them.

Most bases have dispensaries in addition to outpatient clinics at the hospitals. Dispensaries operate to a large extent as certification centers (certifying that a man is well enough to return to duty or sick enough to require referral to the hospital or an outpatient clinic), and they seldom provide definitive treatment except for minor ailments. Some, however, have beds, usually for patients with anticipated stays of three days or less. In the present concept of care, dispensaries are justified mainly on the need for convenient access by their patients; thus, they are usually found in troop areas, on the flight line, or close to the docks.

Dental care is provided to active-duty personnel in facilities under the command of a dental officer. At training bases, where the population

*In the Army, Class II hospitals, such as Walter Reed General Hospital, are commanded by a general directly under the command of the Surgeon General of the Army.

consists predominantly of new recruits, the need for dental care (mainly restorations of decayed teeth) usually outstrips the capacity to supply it. This is partly because of a shortage of facilities and dentists, but also because recruits are transferred after a few months' stay. Dental facilities, by and large, are exceptionally well-equipped.

Military hospitals and their satellite dispensaries are largely self-contained entities which function independently of the other activities on the base, providing medical services as required to the personnel in those activities. There are exceptions, of course, such as flight surgeons and physicians who specialize in submarine medicine; mental hygiene clinics are also run in close cooperation with commanders. However, the hospitals do depend on various base activities for services such as laundry, telephone services, ambulances and other vehicles, non-medical supplies, and maintenance of buildings and equipment.

Cost accounting plays a far different role from that in civilian hospitals. Since services are provided free to all patients,* there is no need for a patient billing system. Cost accounts are maintained, but they give an inaccurate and incomplete picture of true costs, since they are broken down in ways which make it difficult to ascertain the cost of care for particular kinds of patients, they omit the cost of "free" services from other base activities, and they omit military salaries. Under project PRIME, instituted by the Department of Defense in 1968 and intended to produce more accurate data on the costs of all military activities (not only hospitals), the hospitals began assembling costs including the omitted items. The Air Force went further than its sister services in carrying out this program, but the idea has since lost steam in all the services.

There are many problems with carrying out the intent of PRIME, but the basic difficulty is that officers in command have very few costs under their control: they do not control the pay of the military staffs, which are assigned from Washington; they have very limited control of civilian salaries,

*There are a few items billed, notably the nominal subsistence fee to officers, dependents, and civilians, but collecting such fees does not require a billing system in any way comparable to those in civilian hospitals.

because manning tables are developed elsewhere and civilians under Civil Service cannot be fired except for gross incompetence or dereliction; and they do not control most supply costs, since they must provide whatever services are needed by the patients who present themselves.

Thus, the commander has only slight control over minor costs. The latter can be reduced by curtailing attendance at professional meetings, postponing repairs or equipment purchases which are not absolutely necessary, or perhaps discouraging the prescription of expensive drugs. For this reason, costs, although they are developed and examined, do not play the central role they do in a civilian hospital.

1.3.3. STAFFING AND ORGANIZATION OF THE BASE-LEVEL HEALTH CARE SYSTEM

The staff of the base health care system comprises full-time physicians in the Medical Corps; administrators, technicians, therapists, dieticians and various service personnel in the Medical Service Corps or Medical Specialist Corps; nurses in the Nurse Corps; dental officers in the Dental Corps; a few military personnel providing technical support; and a wide variety of civilians including nurses, cooks, plant engineers, technicians, secretaries, and clerks. Occasionally, civilian physicians are retained for special services.

Although organizations differ somewhat among the military services and among hospitals, the differences are not important. The organizations of three hospitals are described in detail in Volume 8; briefly, the commander is always a physician, responsible for all activities within the hospital and, except for the Navy, for all health care activities on the base. Under his command are the chief of professional services and the administrator, as well as the chiefs of a variety of other activities, known by different names in different services, including the chief dental surgeon, the chief of veterinary activities, and the chief of preventive medicine activities. The administrator is the executive officer in Army and Air Force hospitals; the chief of professional services is the executive officer in Navy hospitals. Organization under these chiefs is similar to that in civilian hospitals, as it almost must be, since the military depends upon personnel trained in

civilian institutions for all its physicians and dentists and many of its other staff members.

Among the physicians there is a noticeable gap in age between the senior officers, most of whom began their military careers during the Second World War or the Korean conflict, and the junior officers, most of whom are serving two years under the Berry plan, or perhaps five or six years under other programs. Very few young physicians plan to make military service their careers, and this is one of the major problems faced by the Department of Defense and by hospital commanders. At the local level the result is a rapid turnover of medical personnel; new arrivals are usually only slightly acquainted with the military system (and, indeed, with medical practice, since many have only completed internship).

The rapid turnover of personnel is not confined to the medical staff; it is part of normal military life, arising from the necessity to rotate personnel between undesirable duty (like Vietnam) and desirable duty, and from the belief that military personnel, especially command officers, should have experience in a wide variety of assignments.

Professional jealousies, which play a remarkably significant role in civilian hospitals, seem far less in evidence in military hospitals, though it is hard for an outsider to detect such problems. However, the fact that military rank supersedes professional rank inevitably causes occasional problems, since highly trained but young physicians and surgeons find themselves under the direction of less skilled superiors. This has led many people to suggest that military rank be abolished in the Medical Corps.

The nursing staff consists of officers of the Nurse Corps, civilian nurses, occasionally student nurses (as at Fort Belvoir, where students come from the Walter Reed Army Institute of Nursing), and aides. In all of our observations the nursing staffs were highly competent and conscientious.

Corpsmen in domestic military hospitals and dispensaries perform a far less demanding role than that for which they have been trained and, in many cases, have practiced. Some, like the Navy or Air Force independent-duty corpsmen, have assumed complete responsibility for all medical needs of men aboard ships or at remote outposts, including even appendectomies.

On duty on domestic bases, their activities are confined to routine tasks such as taking temperatures and dispensing aspirin. We were deeply impressed by the sure-handedness and knowledge of these men when we saw them performing their duties at sick call. As we recommend in Volume 2, proper training and supervision could enable corpsmen to play a much more significant role in providing primary medical care, particularly if, as seems likely, physicians are not available for these functions.

One further observation is that understaffing is a nearly universal complaint. In some cases there were obvious shortages, but we would venture the opinion that the problem is more apparent than real. One cannot use civilian practice without adaptation as a guide, because military health care has special needs--for example, the turnover in personnel means that some people officially on board have not yet arrived, leaves are longer, and the motivation of overtime pay is often not authorized. After extended consideration, we concluded that, with some exceptions pointed out in this report, staffing tables and manpower surveys were as fair and as accurate as they could be.

1.3.4. EQUIPMENT IN MILITARY HOSPITALS

In comparison with their civilian counterparts, military hospitals are generally well equipped, since funds for capital equipment, while seldom available on the scale which planners would like, are not the enormous problem they are for many community hospitals. However, military hospitals have been uneven in taking advantage of technological advances. Hospitals on military bases have little need for the highly complex and expensive devices like large-scale computerized patient monitoring equipment. They have taken advantage of certain items now available (e.g., automated laboratory equipment, EKG monitors, and pacemakers), but in some respects they are not as progressive as the leading civilian hospitals.

In Volumes 5 and 7, we evaluate a number of the current technological innovations in dental practice, multiphasic testing, patient monitoring equipment, automated materials handling, convenience food service, unit packaging and automatic dispensing of drugs, laboratory automation, computer-based communication systems, automated patient record

systems, and other computer applications. Some of these should be adopted, some should be developed further, and others offer too little to military hospitals to justify them. In considering each of these innovations, we questioned the staff members of the military hospitals we visited for their reaction to the potential changes. Their responses ranged from enthusiastic acceptance through judicious skepticism to outright rejection. On the whole, they were receptive to change, and in any case we gave their doubts full consideration in reaching our conclusions.

1.3.5. MILITARY HEALTH CARE FACILITIES

Military hospitals tend to be conventional in design. Almost without exception, the hospitals we saw were the traditional "matchbox on a muffin"--that is, a one-story spread-out structure containing outpatient clinics, administration, and most services, surmounted by a nursing tower. There are two important reasons for this lack of innovation. One is the excessively long time it takes to plan, design, and build a military hospital. Although most of the hospitals we visited had been opened in the last decade, their planning commenced seven or eight years before they opened, so that they could be said to be obsolete in some respects even before they opened. The other reason is that the approval cycle is so long and involved that the "committee effect" takes over and discourages innovation. Nevertheless, the facilities planning agencies in the Offices of the Surgeon General and the Office of the Assistant Secretary (Installations and Logistics) are seriously interested in novel designs and novel building practices.

Military health facilities are designed within the scope of planning guidelines promulgated by the Department of Defense and the Bureau of the Budget. Guidelines are undoubtedly useful, but they tend to become out of date; unless a vigorous program of updating is maintained, they become an anachronistic straitjacket for designers. A good number of the hospital we saw (Walson Army Hospital, Dewitt Army Hospital, Womack Army Hospital, and Wilford Hall Hospital) were designed from an ingenious basic plan which supposedly allowed expansion of inpatient facilities by building, say, a "500-bed hospital on a 1,000-bed chassis." Unfortunately, growth

took place in the outpatient department instead of the inpatient wards, and none of the hospitals were able to expand as conveniently as anticipated.

These remarks are not intended to criticize the design, which was ingenious and forward-looking for its time, or the guidelines, but to criticize the concept. So many factors affect the required size of a hospital and the size of its internal departments that the matter cannot be settled once and for all. The growth of some departments and shrinkage of others is unpredictable. This has led us to emphasize flexibility in the design and the structure, and it is the reason that we have dwelt upon the planning process more than the plans.

Supporting this thought is another fact of military life: the people involved in the initial design are seldom present when the facility opens. This is almost invariably true of the hospital staff, as well as many of the other participants in design. For this reason, the need for good communication through the stages of planning, design, building, and operation is much more acute than in civilian institutions, where staff changes are less frequent.

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1.4. THE FUTURE OF MILITARY HEALTH CARE

1.4.1. INTRODUCTION

The Study for a New Generation of Military Hospitals is concerned with the health care systems which provide care to the community of active-duty personnel, their dependents, and retired personnel and their dependents, residing on or near military bases in the United States. It is conceived of as a ten-year program which will include conception and development of innovations, testing in a prototype hospital, and, ultimately, construction of a number of hospitals of the new generation. Thus the scope of direct interest to the study is the military-base health care system, and the period of direct interest to the study is the decade of the 1970's.

Despite these limitations, it is clearly of value to take a broader and longer view of military health care. The base health care system will function as a part of the total military system and a part of the total health care system of the nation. These systems provide the environment in which the base health care system operates. The new generation hospitals are expected to be built before the end of the 1970's, but the longer range future of the 1980's and 1990's is the time in which they will operate.

With these thoughts in mind, it has seemed worthwhile to try to delineate some outlines for the future. Such an exercise can serve at least three important purposes:

- It can break one's mind out of the mold of thinking about the present and lead to bolder innovations.
- Although the future is unknowable and good systems must be flexible enough to adapt to change, it can provide some guidance on the degree of change to be planned for.
- By providing a picture of what may lie in the future, it can suggest innovations to be made now and regarded as stepping stones to more distant goals.

The ideas presented here represent what Herman Kahn in The Year 2000 refers to as a "canonical projection," by which he means a description of

the future arrived at by extrapolating present discernible trends. He points out that while this is the most probable view of the future, it is actually not very likely; any of numerous developments could upset a canonical projection -- major war or severe depression are two of the most obvious. One need only imagine a canonical projection of 1970 made in 1940 to perceive the pitfalls in speculating about the year 2000 in 1970.

Fortunately, in speculating about military health care there are a number of redeeming features. For one, although there are exceptions, health care is not necessarily affected in an important way by important developments in other fields. For example, virtually no one in 1940 expected that men would walk on the moon in slightly over one generation, but the effects of this spectacular feat on community health care are slight; there are esoteric technological developments in medicine as a result of the space program, but few of them have much effect on routine hospital practice. Failure to anticipate the space program would not by itself cause one to err in anticipating developments in the practice of medicine.

A second redeeming feature is that in some instances virtually all conceivable eventualities, even though they may themselves be very different, lead to the same conclusion for military health care. For example, there are several different ways the military may get physicians: the draft laws may continue in force, an armed forces college of medicine may be established, or a foundation might be set up with somewhat the same role as RAND plays with regard to military research, selling physicians' services to the government. Regardless of what sources of physicians actually materialize, it seems clear that retention will remain a problem and that the armed forces must do everything possible to make military service attractive from a physician's point of view.

Finally, some contingencies represent real possibilities but do not require complete revision of plans. For example, dental caries may some day be totally eradicated, much as polio has been. The obvious consequence would be to reduce the work of dentists to a fraction of what it is now. Whatever one may think of the speculation, it is clear that the farthest one would wish to go at this time is to allow the possibility that dental facilities be convertible to some other function.

In speculating about the future one can be almost as bizarre as he wishes, provided he takes care to talk about a sufficiently distant future. While such conjecture may be interesting, it seldom has much practical value. Therefore, our speculations are ones which seem plausible for the latter half of the 1970's and the 1980's. Furthermore, they are confined to those matters which have a direct bearing on health care systems on a military base.

To discuss the future of military health care, we have found it convenient to divide speculations somewhat arbitrarily into three categories. The first is concerned with the military services themselves, since the kinds of manpower and missions which they will have strongly affect the kind of health care which must be provided. Our speculations in this direction are based upon laymen's opinions and have been arrived at without reference to classified war plans and contingency plans.

The second category concerns the delivery of health care in the United States. The military health care system uses many of the same personnel, the same equipment, the same procedures, and indeed faces many of the same problems as the civilian system. Therefore the military health care system tends to evolve along the same lines as the civilian system.

The third category concerns technological development. For better or worse, technology is regarded as the solution to many evident problems. In any case a great deal of effort is expended on technological developments, and they produce very rapid and dramatic change.

Finally, from these speculations we draw some broad conclusions concerning planning for the new generation of military hospitals.

1.4.2. EVOLUTION OF THE MILITARY SERVICES IN THE UNITED STATES

1.4.2.1. Size of Services

Having been badly burned in Vietnam and, to a somewhat lesser extent, in Korea, the United States is unlikely to undertake larger military commitments in the world in the next decade. At the same time, although there is

talk to the contrary, the country is unlikely to become so isolationist that the total number of active-duty personnel will be greatly reduced. Just as with weapons, the military must still stockpile people. Obviously, a number of contingencies could upset any prediction, but there is no evident reason to expect a drastic increase or decrease in the number of active-duty personnel or their dependents.

The total number of retired personnel obviously will increase, and in quite a predictable fashion. However, under current rules the details of this increase are not significant because military hospitals are programmed to allocate only 5% or 10% of their facilities (depending upon whether or not teaching is done) to retired personnel, regardless of the actual demand. In some locations the demand far exceeds this figure and in others it is less. Despite the predictable increase in numbers, the likely advent of national health insurance or something like it (discussed below) makes it unlikely that the military health care system will be called upon to care for more retirees.

1.4.2.2. Characteristics of the Population Served

The current social climate does not favor the military, and it is hard to conceive a dramatic change in this attitude. Several consequences flow from this circumstance. For one, the draft is likely to be modified further, tending to create even more a military consisting of a cadre of professionals with a large number of young recruits. Traditional military virtues are likely to undergo still further erosion, encouraging the concept of a non-ranked medical service; in fact, a civilian medical service supporting the military, as discussed below, is not inconceivable.

Since a substantial portion of the military force is not concerned with actual military operations but with development, logistics, training, and other support services, and since the technology surrounding all these matters grows continually more complicated, there is every reason to expect a highly educated military. In fact, the level of education of all beneficiaries of the system is likely to be higher. Consistent with this are

rising expectations with regard to the quality of health care. The military will be expected at least to keep step with civilian practice and, in view of the need to make service attractive, will find it desirable to stay in the forefront of medical practice.

Military medicine is likely to display still more the separation that is already partially in evidence. On the one hand, there could be a corps of physicians, presently typified by specialists in flight medicine, submarine medicine, or space medicine, who serve the particular medical needs of specialized active-duty personnel. This could include battlefield injuries as well. On the other hand, a group could serve the needs of the remainder of the military force, both in the U.S. and in stable overseas stations, whose medical needs are quite similar to those of the civilian population. The former group would certainly have to be directly under line commanders, responsive to the specific needs of the fighting forces, but the latter group would not necessarily have to be.

1.4.2.3. Medical Manpower

Obtaining medical manpower will certainly continue to be a problem. Already the operation of the draft laws with respect to doctors are regarded as unfair, and few "fair" alternatives seem to be around. Given the disparity between pay scales for physicians in the military and in civilian life, it is hard to see the end of the problem of retention. One possibility is a military college of medicine, but even if such a school were politically acceptable, it could hardly be expected to fulfill all the medical needs of the services.

Another possibility is a medical foundation that would sell physicians' services to the military in the U.S. and stable overseas bases in somewhat the same manner as RAND provides scientific services to the Air Force. (This is essentially the way that physicians are organized to sell services to the Kaiser insurance plans.) Whatever solution eventuates, it will be necessary to make the practice of medicine for the military services an attractive career. Doing this requires changes of the most sweeping kind, but two conclusions to be drawn now are that facilities and equipment should be

first-rate and that organization should be modified to eliminate the tedious elements of military medical practice, such as unrelieved dispensary duty.

Other medical manpower is less of a problem, since their training is less demanding and not so prolonged; for these the military has the choice of training its own personnel. Here lies an important opportunity: by organizing medical care so that nurses and paramedical personnel have more responsibility and more opportunities for professional advancement, it is possible to reduce the need for physicians and to give those that remain a more satisfying practice. The military services have already taken steps in this direction. The forces which will impel such a reorganization exist both in and out of the military service and will almost certainly grow stronger. We return to this matter below.

1.4.3. EVOLUTION OF MEDICAL PRACTICE AS RELATED TO MILITARY COMMUNITY HOSPITALS

1.4.3.1. Medical Personnel

With a strongly rising demand and increasing population, there is no end in sight to the shortage of doctors and nurses. It can be argued that the shortage is due to misallocation of resources (for example, economic conditions which overconcentrate doctors in the suburbs), but the effect is the same as a shortage and it is hard to see the end of either. This is a nationwide shortage which the military shares. It is likely that the services will be perceived more and more vividly as competing with other needs for medical personnel, and therefore their shortage is likely to be aggravated.

Under these circumstances the use of paramedical personnel should become more common. And with experience it is likely to become more acceptable, both to patients and to the medical profession. To be sure, there are problems concerned with training, with assignment of responsibility, with legal restrictions, and with acceptance, and these will slow down the process. But the outcome seems inevitable. Greater use of paramedical personnel will require and will probably get the cooperation

of medical schools. Doctors will get some training as managers, a skill which heretofore has been almost totally neglected in their training and their profession.

Advancing technology and medical knowledge continually increase specialization; for a field to be known well, it must be kept narrow. Coordinating the activities of many specialists will require broad knowledge and managerial skill. This role is likely to develop more commonly for physicians. Supervising paramedical personnel or nurses as well as specialized physicians then is a natural role, and this trend coincides with the need for more widespread use of paramedical personnel.

1.4.3.2. Medical Practice

It is apparent that there will be a gradual trend to further automation of routine processes, spurred by rising labor costs, contributions to accuracy and discipline, and, in the case of computers, by the need for more accurate data on operations. The fact that many automatable processes cannot be justified solely on the basis of cost-saving will probably not prove to be an important deterrent to their adoption. Automated procedures also can be justified on the basis of increased accuracy, continuous availability, or systematization of haphazard procedures. On these bases such devices as computers, automated laboratory equipment, automatic prescription dispensers, and similar laboratory equipment are likely to be regarded as the norm in medical practice. Nevertheless, current costs for such systems are high and current performance is not uniformly good so that introduction of such equipment will be gradual.

A force demanding flexibility is the foreseeable use of drugs to treat disorders not currently treated that way. Knowledge of psychotropic drugs will greatly increase, and their use will become more common. Besides their use for manifest disorders, such as depression and anxiety, there is also the possibility of treating disorder-prone patients before the disease is evident. There is currently some reason to believe that this may be possible for hypertension and atherosclerosis. If possibilities of this sort materialize, then medical screening will assume undeniable importance. Currently, the value of screening well patients is not proved, but consider-

ations such as these mean that it will become so. For this reason, and because it is likely that immunizations will become more effective, there is likely to be increasing emphasis on well-patient care.

One could compile a long list of possible improvements in medical treatment. As one example, there is some expectation that bone fractures can be made to heal faster through electrical stimulation. Whether this particular development comes to pass is not the point; there will be developments which shorten the hospital stay. However, it does not seem warranted to reach the conclusion that hospitals of the future can therefore be smaller. Instead, what is likely to happen is that treatments of other injuries and disorders will become possible. Thus there is no compelling reason for believing that hospitals must be either markedly larger or markedly smaller because of advances in treatment. There is reason for believing they must be adaptable.

1.4.3.3. Medical and Fiscal Organization

Looking ahead, one cannot escape the feeling that the United States will adopt some form of national health insurance, perhaps many forms, probably within a few years. Regardless of the details of such a scheme, a number of consequences can easily be traced. It will weaken the justification for providing health care to dependents and retirees. Whether it will remove responsibility for providing such care from military hospitals is problematical. Given the difficulties of obtaining and keeping physicians, it is likely that dependent health care will gradually be shifted out of military hospitals. This social evolution will take long enough -- at least a decade -- so that military hospitals will still have to be built and staffed to provide dependent care. But the need to reassess this possibility and provide means for graceful reduction of services will be there.

National health insurance will strongly reinforce the trend to combine health services in a region. Military hospitals are part of the medical resources in a region, and the integration of such facilities with civilian facilities seems plausible where care of dependents and retirees is concerned. It seems far less plausible and will probably be resisted

where active-duty personnel are concerned, on the grounds that military medicine has special needs, including the need to move with the fighting force.

As a part of the intention to organize the delivery of health care, considerably more data on operations will be demanded and made available through a computer-operated management information system. Such systems will at first be local, confined to one hospital and its satellites, but in time they will assemble information from hospitals in a region. However, there are enough problems with such systems so that it is hard to foresee widespread use of full-scale computerized management information systems for a decade or more.

National health insurance obviously carries with it more federal and state intervention and monitoring of medical practice. High costs will continue to be a public concern with the consequence that alternatives to hospitals -- ambulatory care facilities and light care facilities -- will grow. This pattern is one which the military services would find it natural to adopt now.

1.4.4. EVOLUTION OF APPLICABLE TECHNOLOGY

1.4.4.1. Computer Applications

The use of computers in fiscal operations is already strongly entrenched in civilian hospitals. They are less used for these purposes in military hospitals because fiscal operations are less important there. Computer applications in medical operations are just now beginning to bear fruit, and these applications will gradually grow in number and in scope. Applications which can clearly be visualized are the following:

- Medical communications
- Medical records
- Computer-aided diagnosis
- Medical history collection
- EKG, EEG, and pulmonary function analysis
- Interface to laboratory analysis equipment
- Reporting exams

Multiphasic test recording
Physiological monitoring
Control of pharmacy issue
Accounting and billing
Property ledger
Admissions and scheduling, census reporting

However, many of these applications are experimental and their efficacy or savings remain to be proven. While there are pressures, alluded to above, for statistical data on hospital operations, there are still problems and a large central computer performing effectively all the functions mentioned above is still a goal and not a reality. Acceptance of computers by the medical staff is slight, largely because insufficient attention has been paid in the past to real needs, which include very rapid response and high reliability. Widespread utilization of computers in medical care will come gradually, eventually becoming the norm, but this evolution will require time, five or ten years or more.

One can also speculate about more exotic uses of computers, such as process control of physiological functions. Very likely some developments not yet foreseen will occur, but for the requirements of the health care system of a military base the list above seems ample.

1.4.4.2. Systems Building

The techniques of systems building -- modular planning, modular design, prefabrication, factory building, dimensional coordination -- will gain wider acceptance. The impediments to more widespread use -- union opposition, inapplicable building codes, anachronistic traditions, unfamiliarity -- will gradually be surmounted. Because systems building is in many respects experimental, widespread use will not come suddenly, but the economic pressures in this direction are strong.

Buildings may come to be regarded as less permanent than heretofore. One concept in this direction, which is feasible and will certainly be exploited, though it may not become the norm, is the loft structure or buildings with interstitial space. In this concept, hospitals consist of large open lofts into which modular rooms of appropriate kinds can be inserted. Every other floor contains mechanical space and the deep trusses necessary for long spans. Essentially it is the need for adaptability, mentioned several times above, which makes use of these concepts likely.

1.4.4.3. Equipment

Automated equipment is likely to be more common, its adoption being spurred by reliability, accuracy, and regularity as much as by economy. This applies particularly to trash disposal. In fact, since convenience and the need for sterility will promote the use of disposables, it appears probable that automatic trash collection systems will become standard, much as air conditioning has become standard.

Automation of laboratory procedures is certain to continue, although it appears that, as physiological functions are better understood, requirements will continually run ahead of achievements. X-rays (or conceivably some equivalents for diagnosis) will become more automatic and require less skill of the technician. Recording on full-size plates will probably be replaced by microfiche or tape recordings, which lend themselves to image enhancement.

The use of television data links eliminates the need for physical proximity between doctor and patient. This possibility will be exploited, certainly for consultation with specialists, and perhaps for more routine diagnosis.

1.4.5. CONCLUSIONS

As we remarked in the Introduction (Section 1.4.1), the speculations made here represent a canonical projection -- that is, they provide a picture of the future based upon trends discernible today. There are good reasons for not believing it is a very accurate picture. In the first

place, it is extremely easy to err in one's perception of trends; and in the second, almost any number of contingencies could introduce new forces. Nevertheless it is possible to draw some conclusions from these speculations because, regardless of the details of the future, certain broad outlines stand out clearly:

- There will be considerably more use of paramedical personnel. The Department of Defense is in an exceptionally good position to undertake an expanded program for training and using paramedical personnel, adapting the military-base health care system to use them effectively. The shortage of physicians and other medical personnel, which the military will feel especially acutely, makes this necessary. This shortage is widely recognized and the time is right.
- It is essential that structures be adaptable and that operations be self-reviewing and self-renewing. Advances in technology make this evident. This view is only reinforced by speculations about reduction of dependent care or community cooperation.
- More automation will become the norm in medical care but only gradually. The forces leading to automation are stronger than economic ones. Machines and people are not totally interchangeable, and when machines are superior in reliability, accuracy, or regularity, they are likely to be regarded as preferable even though they may be somewhat more expensive.

1.5. SYSTEMS ANALYSIS

1.5.1. INTRODUCTION

Systems analysis means various things to various people. It attempts to deal explicitly and quantitatively with all issues that are important in making a choice or creating a design. The variety arises partly because analysts differ in abilities and perceptions, but primarily because different systems to be analyzed have different properties, and the approach that is suitable for one is not suitable for another.

The approach which seems most suitable for analysis of the base-level health care system and the one that we have employed in this study is cost-benefit analysis. This methodology is described in the paragraphs that follow.

1.5.2. ROLE OF COST-BENEFIT ANALYSIS

The problem which we undertook to answer for the Department of Defense is this: Given the present state of (and presently discernible changes in) technology, in the sociology of health care, in medical practice, and in politics, how can efficiency be improved by changes in the way that base-level military health care systems are planned, constructed, staffed, equipped, and operated? Obviously this is an exceedingly complex problem. Our goal was to provide a set of recommendations for specific courses of action.

The role of cost-benefit analysis in a study of this kind is to provide a background of data and logical reasoning to support recommendations. Thus, it serves simply as an aid to rational decision-making. It is akin to mathematical reasoning, in that it makes the reasoning explicit so that a critic can examine the assumptions and logic to convince himself, but it is far less precise.

In the course of analysis, numerous rather arbitrary choices must be made to answer such questions as the following:

- What is to be regarded as the system and what is to be regarded as its environment?

- What costs are to be included and on what basis (discounting, inflating)?

- Which elements should be regarded as costs and which as benefits?

- What are suitable criteria for a choice among alternatives?

Because of the arbitrary nature of such decisions, cost-benefit analysis is not a cut-and-dried procedure. In addition, data to support all of the analysis may be incomplete or of doubtful applicability, and sometimes the results of analysis do not point clearly in one direction or the other. For these reasons, we do not have the same degree of confidence in all our conclusions. Therefore, we have grouped them into several categories:

- Concepts which seem fully justified with important savings and benefits;

- Concepts with only modest savings or benefits that may not be fully realizable in practice;

- Concepts which appeared attractive but which are demonstrably inferior to present practices;

- Concepts which appeared promising but which, we later decided, would probably be unworkable, unrealistic, or unimportant (at least for now); and

- Concepts insufficiently developed for us to be certain of their merit but with enough promise to warrant further R&D.

1.5.3. REASONS FOR COST-BENEFIT ANALYSIS

When one must make a rational choice among alternatives, there must obviously be a criterion for the choice. If the choice is to be reviewed

by others, the criterion must be made explicit. Ideally, a certain set of factors will be generally recognized as relevant and important to the choice, and all these factors will be included in the criterion.

Once in a while this ideal state of affairs occurs, at least in principle. One example is a business organized for profit. It is often possible to reduce all of the factors bearing on a business decision to dollars. Since the business is organized for profit, the businessman's criterion is dollars realized from alternative courses of action, and the preferable choice is the one producing the highest return. We have admittedly ignored a number of problems which arise in such analyses (for example, how soon must the profit be realized? How can risk and other uncertainties be reduced to dollars?) but the point is that analyzing the choice in terms of dollars seems plausible and more or less feasible. Since money exists as a medium of exchange, dollars provide the broadest base for putting factors in a choice on a commensurate basis. This is one reason that cost plays a central role in many decisions in governmental affairs. Another important reason why costs are central is that controlling the flow of money is the primary means by which a bureaucracy is controlled.

In many cases, however, some of the factors relevant to a choice are incommensurate. This problem clearly arises in choices among weapon systems. Presumably, the value of a weapon system is reflected in some measure of lethality, invulnerability, deterrence or something of the sort. Regardless of how one selects the proper measure and evaluates it, it is seldom expressible in dollars.

This state of affairs led to the development of cost-effectiveness analysis, in which all relevant and important factors fall into two classes: costs (e.g., for development, procurement, training, and operation) and effectiveness (e.g., lethality). The cost-effectiveness approach, however, opens the door to all sorts of complexities, and choices are never so simple as they were for the money-centered businessman. For suppose System A is both more expensive and more effective than System B; is it preferred? There is no answer to this question as it stands. Sometimes the choice is made on the basis of which system has the highest

ratio between effectiveness and cost. Within limits, this function of two incommensurate factors provides a unique and plausible criterion. There is, however, nothing special about this function as a criterion except its simplicity--one could equally well choose, for example, to maximize the ratio of the square of effectiveness to the square root of the cost. Selections can also be made by picking the most effective system below a given cost, or by picking the cheapest system above a given effectiveness. Thus, there is no reason, once we have admitted the incommensurate factor called effectiveness, to expect that rote analysis will provide a unique choice (even if we believe all the analysis).

Although defense planners have sometimes sought to base their decisions solely upon the simple criterion of which system provides the most effectiveness for a dollar, rational discussions always recognize that there are more costs than those measurable in dollars and more elements to effectiveness than lethality. For example, one of the costs not reckoned in dollars which led to the decision to pursue missiles as instruments of strategic retaliation in preference to bombers was the fact that bombers required forward bases on the soil of precarious allies; a shift in political power could make it necessary to close a base, regardless of fiscal cost or requirements of effectiveness. Vulnerability to political events might be considered a negative element in effectiveness; but if we choose to lump all factors, save dollar cost, into one element called effectiveness, how can we rationally combine political invulnerability with lethality? For that matter, how does one combine invulnerability to enemy attack with lethality?

These examples illustrate that choices in some complex situations must be based on more than just dollar cost and some other single property called effectiveness. If the additional factors are not considered, the picture is incomplete; it is a simplified version useful only as an aid, not a guide, to rational decision-making.

To be realistic, we must attach both benefits and penalties to each alternative. Some of the penalties can be reckoned in dollars and denoted as costs. Some of the benefits might also be expressed in dollars, in

which case they could be described as profits, deducted from costs, or presented simply as unadorned dollar benefits, whichever point of view seems most rational. But the factors that cannot be reckoned in dollars are likely to be incommensurate with each other.

Thus, rational decision-making is perhaps best served by displaying the relevant factors, be they described as benefits or profits, penalties or costs, and basing the decision on the whole array. We may then encounter the dilemma of one alternative being preferable to another with regard to some factors but inferior with regard to others. The solution lies in the relative importance of the different factors; one obvious approach is to weight the factors in such a way that they can be combined to produce a preference score. There is nothing inherently wrong with this procedure, but in practice it is utterly unconvincing. The arbitrariness of the weighting factors, added to that of all the other choices made in the analysis, undermine the credulity of the logic. About the only time it is accepted is when all the arbitrariness is hidden in a computer program.

There are other reasons for not pretending to eliminate judgment from the decision-making process in this way. One is that some important factors are not easily or convincingly quantifiable. This is certainly true of "quality of care," "patient acceptability," and "attractiveness." Experts or consumers are sometimes polled in order to assign numerical values to such factors; however, this is not true quantification, and the use of such procedures should not be hidden in a composite preference score. Moreover, quantification seldom clarifies what bearing a given factor may have on the desirability of an alternative.

If the factors are not combined into a single preference score, the dilemma remains. When presented with the same array of factors, different people might choose different alternatives, presumably because they weight factors differently. This is why honest men can disagree. The extent of disagreement can be regarded as a reflection of the risk that the conclusion may be wrong.

The procedure of arraying all of the factors deemed to be relevant and important in making a choice among alternatives is what we mean by

cost-benefit analysis.* It is generally desirable to quantify all of the factors but this is not always possible. The array of factors which must be included in any rational analysis of a matter as complex as health care must comprise both quantifiable and nonquantifiable factors.

1.5.4. DEFINITION OF A SYSTEM

Systems are usually defined as an aggregation of men and machines (or occasionally as one or the other) put together to carry out a mission or perform a function. When one undertakes a cost-benefit analysis, he must define the extent of the system he intends to study.

Every system is itself a subsystem of some larger system (the base health care system, for example, is a subsystem of the base or of the entire military health care system), and every system is composed of many subsystems (the base health care system includes a nursing subsystem, a food service subsystem, and so on). How one chooses to define the boundaries of systems and subsystems is largely an arbitrary choice; we outlined in Section 1.1 the boundaries of the base health care system using the guidelines previously stated. Section 1.4, "The Future of Military Health Care," described the environment of the "new generation" of military hospitals. Such matters, which bear on the functioning of the base health care system but which are not "subjects of study," must be taken into account in evaluating hypothesized changes to the system.

The boundaries of the subsystems of the base health care system depend upon the scope and nature of the hypothesized changes. By and large, each of the changes which we identified as potentially beneficial were confined to some subsystem of the base health care system as it is conventionally analyzed and managed--laboratory, pharmacy, food service, nursing services, etc. Thus, it was possible to evaluate many of the hypotheses in the context of just one or two subsystems. This simplification was fortunate, because the difficulty of carrying out evaluations is considerable.

*This is not the only sense in which the term cost-benefit analysis is used.

In confining attention to one subsystem at a time, one runs the risk of suboptimizing--that is, doing the best possible within the confines of one subsystem but failing to find a still better alternative evident only by changing other subsystems as well. For example, unit packaging of drugs for inpatients is of marginal benefit and might legitimately be rejected; however, since it facilitates automated dispensing, which is of more significant advantage for outpatient prescriptions, the concept of unit packaging becomes distinctly promising. Had we confined our attention to inpatient prescriptions, we could have overlooked this advantage.

The ultimate goal is to synthesize all hypothesized changes which prove desirable into a complete health care system, all of whose elements are mutually supporting. Doing this explicitly and systematically is an ambition usually more honored than achieved; we cannot assert that we have done it perfectly. Nevertheless, as this study proceeded, the hypotheses which were finally shown to be desirable were gradually adapted one to another so that the description of the "new generation" of military hospitals is self-consistent and takes advantage of the best features of each innovation.

1.5.5. HYPOTHESES FOR POTENTIAL IMPROVEMENTS

In the first half of this study, after we had become familiar with practices, requirements and constraints in the present health care systems on military bases, we developed a working list of hypotheses for potential improvements to the system. Some of these hypotheses were derived from practices being used or experimented with in other places, both in the United States and abroad. Others were original, at least in their details, with the project staff. The question for each was whether it could be used effectively to increase efficiency or improve the quality of care. Almost every idea underwent modification as the concept matured and was adapted to the constraints imposed by the environment of the military health care system and the requirements imposed by other parts of the system.

The hypotheses with which we dealt in this study and which are evaluated in this report are as follows:

- Because many patients in military hospitals are not very sick by civilian standards, savings and other benefits can be gained by building light care facilities in conjunction with acute care facilities.

- To alleviate the shortage of physicians, ambulatory care can be reorganized in a way which makes use of more nonphysicians (corpsmen and nurses with special training) without loss of quality.

- In a similar fashion, specially trained dental assistants can be used more extensively to alleviate the shortage of dentists.

- Clinical laboratory tests can be automated somewhat more than they are now to reduce the cost of making determinations. In the chemistry laboratory it is possible to provide results within a minute or two after a sample is drawn, even at dispensaries remote from the laboratory.

- Automated materials handling systems can produce savings by reducing the manpower required to move materials in a hospital.

- Vacuum trash and linen collection systems can save personnel and are more convenient than present methods.

- Convenience foods are cheaper than meals prepared in the hospital, offer adequate variety, and are quite palatable.

- The costs of linen service can be reduced by using disposable linens.

- Unit packaging and automated dispensing of drugs can save nurses' time, reduce errors in administering drugs, and allow quicker filling of prescriptions.

- Multiphasic testing facilities can reduce the cost of making physical examinations.

- Closed circuit television can be used for remote consultation or remote diagnosis to improve the quality of care and increase convenience to patients.

- The staff of a military hospital can be motivated to be more cost conscious than they are now and thereby reduce operating costs.

- An automated management information system is feasible and can be used to keep track of the operating efficiency of all departments in a hospital, thus providing a real-time measure of performance.

- An automated hospital information system can be installed to process all orders and to record all results and actions.

- Inpatient records can be kept in a computer file and portions retrieved as necessary by the medical and nursing staff to improve the quality of care.

- Computer-controlled patient monitoring systems can be used to reduce the staff required in intensive care units and to reduce morbidity and mortality.

- Computers offer a more reliable and cheaper means for inventory control, scheduling, and certain aids to practice such as diagnosis and psychiatric support.

- Obstetrical services, as an example of a service not required by military needs, can be eliminated from military hospitals and provided through CHAMPUS in order to reduce costs.

- The novel methods of design and construction called building systems can be adopted or adapted to the needs of military hospitals.

- The process by which military hospitals are planned, designed, and built can be speeded up, made more rational, and result in buildings more responsive to the needs of the users through planning units, form diagrams, and multitrack scheduling.

- Layouts of hospitals can be made more rational and efficient by enlisting the aid of a computer to develop and evaluate them.

- There is an economically optimum room size determined by a balance between the efficiency of large rooms and the reduction in problems of mixing patients (e.g., men and women) with small rooms.

1.5.6. EVALUATION OF HYPOTHESES

Having developed a set of hypothetical alternatives to present practices in military hospitals, we undertook to evaluate them using cost-benefit analysis, as described in Sections 1.5.2 and 1.5.3. Here we faced a problem discussed in those sections, namely, the need in the course of analysis to take account of the real-world constraints on our novel concepts. Rather than evaluate the potential improvements in the context of a hypothetical military base, where practical limitations are more easily overlooked, we elected to evaluate them by determining their effect if they were applied at each of the three military bases we studied in detail--Fort Dix, Jacksonville NAS, and March AFB.

By examining the concepts individually and collectively at each of these three bases, we have spanned the three services and the range of sizes from 200 beds at March AFB to 900 beds at Fort Dix. Thus, any differences in the merits of our concepts attributable to peculiarities of the services or differences of size have probably been uncovered.

There are differences--for example, reorganization of ambulatory care is simpler at a recruit-training base like Fort Dix than at an Air Force base like March; light care has a marked effect at large hospitals like those at Fort Dix and Jacksonville but is only marginally feasible at March AFB.

Our extended study of these three bases, recorded in Volume 8, furnished the specific operating data necessary to carry out the analyses. The functional cost analysis, discussed in the next section (Section 1.6), furnished the basic elements of cost necessary for each of the cost-benefit analyses. Because our evaluations have been made in the context of a real, quantified environment (in the system sense) we regard them as realistic.

It will also be seen throughout this report that we have tried to take into account all relevant and important factors in carrying out cost-benefit analyses of our hypothesized improvements, considering not only quantifiable costs and savings but nonquantifiable penalties and benefits as well.

1.5.7. COMBINING CAPITAL AND OPERATING COSTS

Besides the problem of dealing with disparate criteria of choice in cost-benefit analysis, another problem arises in the case of costs. Most systems entail two kinds of costs--(1) capital costs at the time the system is originally set up and (2) subsequent operating costs. Frequently, one alternative may be more expensive to buy in the first place but cheaper to operate thereafter. To decide what alternative is best, we need a rational way of combining capital and operating expenses.

There are two possibilities. One is to amortize capital expenditures and add them to operating expenses. This is straightforward and easy to follow if operating expenses are the same year after year, and if the depreciation of capital equipment is "straight-line," (i.e., constant during each year for the lifetime of the equipment). Putting all expenses in terms of operating expenses is attractive for analysis of military health care, because operating expenses dominate capital expenses. For example, it will be seen in Section 1.6 that one year's

operating budget at military hospitals comes close to the original capital investment.

The other possibility is to discount future expenses to obtain their "present value." All future expenses for the lifetime of the equipment can then be added to capital expenses to obtain total system cost. In some cases this method is useful, though most people find it easier to grasp the concept of amortization.

In the next two subsections we shall describe both amortization and discounting. In our analysis we have presented the former method for making comparisons. Obviously, both methods, properly applied, must provide the same conclusion.

1.5.7.1. Amortization of Capital Expenditures

To combine capital expenses, which occur just once at the beginning of operation, with operating expenses, which are incurred throughout the life of each subsystem, it is useful to treat capital expenses as if they were spread out over the equipment life. The idea is that equipment which required a capital expense depreciates in value through its lifetime and, at the end of its life, will have to be replaced. It is well known that buildings and equipment depreciate exponentially--that is, their value diminishes most rapidly in the early years and more slowly thereafter. However, we are not usually interested in their actual value in any particular year but rather in their cost when they have to be replaced. For this reason, it is simpler and equally satisfactory to imagine that their value depreciates at a uniform rate from their purchase cost at the beginning to zero at the end of useful life. This makes the amount to be added to operating expenses constant in each year.

Obviously, the lifetime chosen for plant and equipment can affect the amortized cost considerably. (This is one of the somewhat arbitrary choices hidden in systems analysis.) One can deal with this problem by making a "parametric analysis"--that is, presenting results for a variety of different lifetimes which span the range of reasonable assumptions. However, doing so explicitly proliferates the number of variables a decision-maker must cope with in deciding which alternative to

pick. In our analysis we have used different lifetimes appropriate to different parts of the system (for example, 10 years for equipment like carts and conveyors, 25 years for buildings), but we have not explicitly redone the analysis for other lifetimes. Nonetheless, it is important to examine the figures to see what would happen if different lifetimes had been chosen. It turns out in virtually every case that the conclusions would be unchanged. In any event, the numbers used are made explicit, so that the reader can explore other suppositions if he wishes.

1.5.7.2. DISCOUNTING FUTURE EXPENSES

In order to combine operating expenses, it will sometimes be convenient to consider all expenses as if they were occurring at the time of original purchase. To do this we consider the "present value" of future expenses.

The idea is that operating expenses to be incurred some time in the future could be covered by setting aside at the beginning some smaller amount of money which would appreciate through interest to the amount required. For example, if an element of a system will cost $1000 per year in operating expenses, we could put aside now for, say, the fifth year, $621, which, if invested at 10% per year (compounded), would amount to $1000 when we need it during the fifth year. Thus, the "present value" of an expenditure of $1000 five years hence is $621.

In most cases operating expenses can be considered the same year after year. In this case we can make use of a simple formula. The present value P of all future operating expenses is the sum

$$P = A + A \frac{1}{1 + r} + A \frac{1}{(1 + r)^2} + \ldots + A \frac{1}{(1 + r)^{n-1}}$$

where A is the annual operating expense, r is the interest rate, and n is the lifetime of the equipment. For example, to operate for three years we would need A for the first year, and we would put aside an amount $A/(1 + r)$ for the second year and an amount $A/(1 + r)^2$ for the third year. The present value of the operating expenses would be the sum of these three amounts.

It should be carefully noted that discounting is intended to take account of the fact that money can be invested at interest. It is not a reflection of the fact that the future is uncertain. It can be made to reflect inflation by inflating the annual expenditures at some rate s.

$$P = A + A\,\frac{1+s}{1+r} + A\left(\frac{1+s}{1+r}\right)^2 + \ldots + A\left(\frac{1+s}{1+r}\right)^{n-1}$$

It will become apparent that large changes in P can be introduced by small changes in r or s if the lifetime n of the equipment is long.

There are various niceties that could be introduced, such as the fact that the annual operating expense does not all have to be available at the beginning of the year, as we have implied by the expressions above. However, the future is uncertain enough, and the choices of r and s are arbitrary enough, so that one feels no compunction about omitting these details.

A few formulas follow, from which a table of present values has been computed.

$$P = A \sum_{i=0}^{n-1} \left(\frac{1+s}{1+r}\right)^i \qquad r \geq s$$

$$= A\,\frac{1 - \left(\frac{1+s}{1+r}\right)^n}{1 - \left(\frac{1+s}{1+r}\right)}$$

$$P = nA \text{ when } r = s$$

TABLE 1.5.1
MULTIPLIERS FOR PRESENT VALUES

n	s = 0 r = 0.04	s = 0 r = 0.07	s = 0 r = 0.10	s = 0.04 r = 0.07	s = 0.04 r = 0.10	s = 0.07 r = 0.10
1	1.00	1.00	1.00	1.00	1.00	1.00
2	1.97	1.94	1.91	1.98	1.95	1.98
3	2.89	2.81	2.74	2.93	2.84	2.93
4	3.78	3.63	3.49	3.85	3.69	3.85
5	4.64	4.40	4.18	4.74	4.49	4.75
6	5.46	5.11	4.80	5.61	5.25	5.62
7	6.26	5.78	5.36	6.46	5.96	6.47
8	7.02	6.40	5.88	7.28	6.64	7.30
9	7.75	6.98	6.34	8.08	7.28	8.10
10	8.46	7.53	6.77	8.86	7.38	8.88
11	9.13	8.04	7.15	9.62	8.46	9.64
12	9.78	8.51	7.50	10.35	9.00	10.38
13	10.41	8.96	7.82	11.06	9.51	11.10
14	11.01	9.37	8.11	11.76	9.99	11.80
15	11.59	9.76	8.38	12.43	10.45	12.48
16	12.14	10.13	8.62	13.09	10.88	13.15
17	12.68	10.46	8.83	13.72	11.29	13.79
18	13.19	10.78	9.03	14.34	11.67	14.42
19	13.69	11.08	9.21	14.94	12.04	15.03
20	14.16	11.35	9.37	15.53	12.38	15.62
21	14.62	11.61	9.52	16.09	12.71	16.20
22	15.06	11.85	9.66	16.65	13.01	16.76
23	15.48	12.08	9.78	17.18	13.31	17.30
24	15.89	12.29	9.89	17.70	13.58	17.84
25	16.28	12.49	9.99	18.21	13.84	18.35

1.6. FUNCTIONAL COST ANALYSIS

In Tables 1.6.1, 1.6.2, and 1.6.3 we present the results of analyzing operating costs for the health care activities at Fort Dix, Jacksonville NAS, and March AFB. The simplicity of these tables belies the difficulty of obtaining data on costs. Available records are internally inconsistent with regard to both staffing and costs, and a great deal of effort went into reconciling differences. Military salaries are either omitted from accounting records (at Fort Dix and Jacksonville) or aggregated in ways which did not suit our functional breakdown (at March AFB). We returned to staff allocations in order to estimate the proper cost allocations for military personnel. Some "free" services, such as laundry service from the Quartermaster Laundry, are not reckoned at all, either by the hospital or the provider of the services. In these cases we estimated the cost by estimating the proportion of the provider's workload produced by the hospital and taking that fraction of the provider's total budget.

The data assembled in these tables provided a basis for estimating the impact of the various potential innovations at each of the three hospitals. It also served as a guide to the functions that are most costly and therefore most worthy of attention.

We discourage comparisons among the tables. Although we have tried to make them comparable, we have not always been able to achieve this goal because of the way that available figures are aggregated and the different definitions used. In addition, there are differences in workload and services provided, to which some differences in cost can be traced. Therefore, it can be misleading to attribute higher or lower costs for a function at one hospital to inefficiency or efficiency compared with another hospital.

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TABLE 1.6

FUNCTIONAL COST D
WALSON ARMY HOSP
FY 1969

	Medicine[b]	Surgery[c]	Obstetrics and Gynecology[d]	Dispensary[e]	Clinics[f]	Dental[g]	Laboratory[h]	Radiology	Ph
Staff Totals	229	133	32	47	200	167	87	39	
Dentists						58			
						750,000			
Physicians	10	12	3	7	61		3	5	
	150,000	180,000	45,000	105,000	915,000		45,000	75,000	
Registered Nurses	60	23	12		9				
	600,000	230,000	120,000		90,000				
Other Nursing	159	98	17	34	130				
	1,248,816	874,291	150,000	238,000	1,140,848				
Other Professionals						109	79	28	
						590,866	474,565	199,898	1
Nonprofessionals				6			5	6	
				30,000			25,000	30,000	
	1,998,816	1,284,291	315,000	373,000	2,145,848	1,340,866	544,565	304,898	1
Linen									
Provisions									
Drugs									5
Medical Supply	48,011	120,178			184,058	82,591	184,317	94,659	
General Supply	27,701	66,609			39,345	48,438	8,676	179	
Services	1,597	845			4,587	2,814	1,145		
Housekeeping[o]	71,938	58,465	27,138	30,270	59,710	17,173	10,644	6,492	
Maintenance[p]	34,308	27,882	12,942	14,436	28,476	8,190	5,076	3,096	
Utilities[q]	42,728	34,725	16,118	17,979	35,465	10,200	6,322	3,856	
Minor Equipment	4,237	7,858			3,330	1,487	6,417	10,278	
Totals	2,229,336	1,600,853	371,198	435,685	2,500,819	1,511,759	767,162	423,458	6
Percent of Total	14.94	10.73	2.49	2.92	16.76	10.13	5.14	2.84	

See following page for explanatory notes.

TABLE 1.6.1

FUNCTIONAL COST DISTRIBUTION[a]
WALSON ARMY HOSPITAL, FT. DIX
FY 1969

ory[h]	Radiology	Pharmacy	Food Services[i]	Administration[j]	Records[k]	Sterile	Linens	Other Supply & Support	Totals	Percent Of Total
87	39	10	148	150	18	11	12	85	1,368	
									58	
									750,000	5.03
3	5			1					102	
000	75,000			30,000					1,545,000	10.35
						1			105	
						10,000			1,050,000	7.04
									438	
									3,651,955	24.47
79	28	9	16	35	4	10	1	13	304	
565	199,898	105,184	160,000	320,000	28,000	57,364	6,000	104,000	2,045,877	13.71
5	6	1	132	114	14		11	72	361	
000	30,000	5,000	1,019,742	806,114	84,000		54,792	430,590	2,485,238	16.65
565	304,898	110,184	1,179,742	1,156,114	112,000	67,364	60,792	534,590	11,528,070	77.25
							84,111		84,111	0.56
			536,653						536,653	3.60
		525,037							525,037	3.52
317	94,659			13,883		57,953		31,315	816,965	5.47
876	179	150	49,211	18,709	2,646		35,369	65,553	362,586	2.43
145		50	355	39,073[m]			176,000[n]	5,721	232,187	1.56
44	6,492	3,246	24,533	31,893	1,623	3,246	1,623	29,440	377,434	2.53
76	3,096	1,548	11,700	15,210	774	1,548	774	14,040	180,000	1.21
22	3,856	1,928	14,572	18,943	964	1,928	964	17,486	224,178	1.50
17	10,278	980	14,173	1,439		870		4,144	55,213	0.37
52	423,458	643,123	1,830,939	1,295,264	118,007	132,909	359,633	702,289	14,922,434[r]	
								4.70		100.00
4	2.84	4.31	12.27	8.68	0.79	0.89	2.41	4.70		100.00

Annotations for Functional Cost Distribution at Walson Army Hospital
(Table 1.6.1)

[a]Basic cost data were obtained from special compilations of accounting information prepared by the Management Services Office at our request. Also, the Supply and Services Division supplied estimates of the costs of various services provided without charge to the hospital by other post organizations, such as Engineering, Transportation, and Quartermaster. Personnel distributions were derived from manning lists obtained from the Personnel Division, supplemented by interviews with specific departments on staff utilization. The numbers shown represent full-time equivalents.

Tabular entries for costs of various categories of personnel were estimated on the basis of approximate averages, distributed in such a way as to make the subtotals consistent with available accounting figures. For example, staff physicians were assigned an average annual compensation of $15,000, registered nurses $10,000, and clerks $5,000. Other personnel cost entries absorbed the necessary remainders of the appropriate subtotals.

Thus, the personnel cost allocations that are shown are to be regarded as reasonable approximations rather than as precise accounting figures, since the latter were not directly obtainable on a functional assignment basis. It should be noted that the total costs and their breakdowns represent dollars disbursed or transferred, plus estimates of the costs of certain "free" services, such as laundry and utilities. Also, military labor has been factored in from separate accounting records, since these are not directly included in the hospital budget. Labor costs do not include fringe benefits not directly chargeable to hospital or base accounts, such as military retirement, tax advantages, PX and commissary privileges, etc.

[b]Includes all inpatient wards other than those in the next two columns.

[c]Includes operating rooms, recovery rooms, and surgical inpatient wards.

[d]Includes obstetrics, gynecology, and nursery wards.

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[e]Covers services to active-duty outpatients at nine dispensaries.

[f]All general therapy and specialized clinics, other than dispensaries and dental clinics.

[g]Includes in-hospital dental service, plus separate post dental clinics.

[h]Includes clinical laboratories, pathology, and blood-donor center.

[i]Includes dietitians and kitchen personnel.

[j]Includes general administrative functions plus public health and veterinary services.

[k]Includes direct services involved in inpatient and outpatient record rooms.

[l]Supply and other support functions are provided by one organizational division. Available cost accounts do not provide a means for separating these two functional components.

[m]Includes travel costs.

[n]Estimated cost of laundry service provided by Quartermaster without charge.

[o]Contractual housekeeping costs allocated in proportion to the areas utilized by various functional groups.

[p]Part of maintenance service is provided by the post without charge; total cost is an estimated value, and is allocated in proportion to area.

[q]Most utilities are provided by the post without charge; total cost is an estimated value, and is allocated in proportion to area.

[r]Gross total operating costs for FY 1969, including direct expenditures, plus military pay and estimated costs of free services provided by the post.

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TABLE 1.6.2

FUNCTIONAL COST DISTRIBUTI
JACKSONVILLE NAVAL HOSPIT
FY 1969

	Medicine[b]	Surgery[c]	Obstetrics and Gynecology[d]	Dispensary[e]	Clinics[f]	Dental[g]	Laboratory[h]	Radiology	Pharmacy	F
Staff Totals	137	61	73	0	92	9	25	10	63	
Dentists						2				
						30,000				
Physicians	17	7	3		42		3	2		
	255,000	102,000	42,000		582,000		45,000	30,000		
Registered Nurses	41	18	28		8					
	328,000	180,000	224,000		80,000					
Other Nursing	77	36	42		42					
	370,455	277,729	256,451		261,506					
Other Professionals						7	22	8	11	
						37,580	151,889	56,025	94,528	
Nonprofessionals	2									
	10,000									
	963,455	559,729	522,451		923,506	67,580	196,889	86,025	94,528	
Linen										
Provisions										
Drugs									318,060	
Medical Supplies	19,086	49,643	6,946		38,607	1,965	65,340	43,820		
General Supplies										
Services	8,455	2,166			1,707		4,722		58	
Housekeeping[o]	33,109	30,572	11,571		28,066	825	3,302	4,953	1,651	
Maintenance[p]	46,460	42,899	16,237		39,381	1,158	4,633	6,950	2,317	
Utilities[q]	89,762	82,883	31,371		76,086	2,238	8,951	13,427	4,476	
Minor Equipment	2,139	7,633	444		5,693	402	2,860	998	52	
Totals	1,162,466	775,525	589,020	0	1,113,046	74,168	286,697	156,173	421,142	
Percent of Total	17.22	11.48	8.72	0	16.48	1.10	4.25	2.31	6.24	

See following page for explanatory notes.

TABLE 1.6.2

NAL COST DISTRIBUTION[g]
IVILLE NAVAL HOSPITAL
FY 1969

ogy	Pharmacy	Food Service[i]	Administration[j]	Records[k]	Sterile	Linens	Other Supply	Other Support[l]		Totals	Percent of Total
10	63	11	43	27	4	10	17	38		620	
										2	
										30,000	0.44
2			1							75	
00			30,000							1,086,000	16.08
										95	
										812,000	12.02
										197	
										1,166,141	17.27
8	11	3	8	2	4		7			72	
25	94,528	30,000	100,000	20,000	23,176		70,000			583,198	8.64
		60	34	25		10	10	38		179	
		378,228	283,483	201,629		50,599	60,162	290,116		1,274,217	18.87
25	94,528	408,228	413,483	221,629	23,176	50,599	130,162	290,116 (·131,661 housekeeping)		4,951,556	73.3 (·1.95
						15,312				15,312	0.2
		154,394								154,394	2.29
	318,060									318,060	4.71
0					78,473					303,880	4.50
		33,832	27,782	6,169		6,868	34,641	26,705		135,997	2.01
	58	17	44,251[m]		133	7,421[n]	23	84,456		153,409	2.27
3	1,651	11,571	17,334	825	2,476	825	5,778		(including labor of 131,161)	152,858	2.26
0	2,317	16,237	24,324	1,158	3,475	1,158	8,108			214,495	3.18
7	4,476	31,371	46,994	2,238	6,713	2,238	15,665			414,413	6.14
3	52	2,531	7,965	2,558	441	1,424	32,017	3,507		70,664	1.04
3	421,142	658,181	582,133	234,577	114,887	85,845	226,394	273,123		6,753,377[r]	100.00
	6.24	9.75	8.62	3.47	1.70	1.27	3.35	4.04			

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Annotations for Functional Cost Distribution at Jacksonville Naval Hospital (Table 1.6.2)

[a]Basic cost data were obtained from documents provided by the Fiscal Office, primarily quarterly computer printouts of accounting records. Personnel distributions were derived from staff assignment sheets for nursing personnel and from other manning records of the Personnel Office, supplemented by interviews with specific departments on staff utilization. The numbers shown represent full-time equivalents. Tabular entries for cost of various categories of personnel were estimated on the basis of approximate averages, distributed in such a way as to make the subtotals consistent with available accounting figures. For example, regular staff physicians and dentists were assigned an average annual compensation of $15,000, residents and interns $12,000, registered nurses $8,000 or $10,000, and clerks $5,000. Other personnel cost entries absorbed the necessary remainders of the appropriate subtotals.

[b]Includes all inpatient wards other than those in the next two columns.

[c]Includes operating rooms, recovery rooms, and surgical inpatient wards.

[d]Includes Obstetrics, Gynecology, and Nursery wards.

[e]Dispensary services are operated and paid for by separate commands.

[f]General Therapy and specialized clinics operated in and by the hospital.

[g]Includes only in-hospital dental services to patients and staff.

[h]Includes clinical laboratories, Pathology, and Blood Bank.

[i]Includes dietitians and kitchen personnel.

[j]Includes general administrative functions, fiscal, personnel, data processing.

[k]Includes handling of inpatient and outpatient records and compilation of reports and statistics, plus admission and discharge processing.

[l]Includes engineering services, custodial, minor construction, equipment repair.

[m]Includes travel costs.

[n]Purchased dry cleaning services (hospital operates its own laundry).

[o]Allocated in proportion to area.

[p]Allocated in proportion to area.

[q]Allocated in proportion to area.

[r]Gross total operating expenditure for FY 1969.

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TABLE 1.6.

FUNCTIONAL COST DIS
MARCH AFB HOS
FY 1969

	Medicine[b]	Surgery[c]	Obstetrics and Gynecology[d]	Flight Surgeon[e]	Clinics[f]	Dental[g]	Laboratory[h]	Radiology	Ph
Staff Totals	90	73	31	9	99	57	22	14	
Dentists						13			
						195,000			
Physicians	8	4	2	3	30		3	2	
	135,000	60,000	30,000	45,000	483,633		45,000	30,000	
Registered Nurses	28	24	14		8				
	280,000	240,000	140,000		80,000				
Other Nursing	51	43	15	5	55				
	360,000	305,632	105,000	37,959	506,023				
Other Professionals	2	2			5	43	19	11	
	20,000	20,000			40,000	327,118	213,923	57,941	
Nonprofessionals	1			1	1	1		1	
	5,000			5,000	5,000	5,000		5,000	
	800,000	625,632	275,000	87,959	1,114,656	527,118	258,923	92,941	
Linen									
Provisions									
Drugs									
Medical Supplies						35,492	66,091	51,229	
General Supplies									
Services									
Housekeeping[o]	16,093	10,200	8,000	3,200	12,800	6,200	3,200	2,400	
Maintenance[p]	11,365	7,200	5,625	2,250	9,000	4,370	2,250	1,690	
Utilities[q]	7,134	4,500	3,520	1,410	5,630	2,735	1,410	1,055	
Minor Equipment									
Totals	834,592	647,532	292,145	94,819	1,142,086	575,915	331,874	149,315	
Percent of Total	14.06	10.91	4.92	1.60	19.24	9.70	5.59	2.52	

See following page for explanatory notes

B

TABLE 1.6.3

ONAL COST DISTRIBUTION[a]
ARCH AFB HOSPITAL
FY 1969

Radiology	Pharmacy	Food Service[i]	Administration[j]	Records[k]	Central Sterile	Linens	Other Supply	Other Support[l]	Totals	Percent of Total
14	9	44	69	15	3	3	14	4	556	
									13	
									195,000	3.29
2			1						53	
30,000			30,000						858,633	14.47
									74	
									740,000	12.47
									169	
									1,314,614	22.15
11	9	3	23	2	3		3	1	126	
57,941	74,133	30,000	230,000	15,000	20,000		30,000	10,000	1,088,115	18.33
1		41	45	13		3	11	3	121	
5,000		253,596	212,409	65,000		13,000	55,111	24,000	648,116	10.92
92,941	74,133	283,596	472,409	80,000	20,000	13,000	85,111	34,000	4,844,478	81.63
						7,890			7,890	0.13
		137,000							137,000	2.31
	310,541								310,541	5.23
1,229					84,897				237,709	4.01
							34,552		34,552	0.58
			26,155[m]			78,073[n]		49,149	153,377	2.58
2,400	800	6,400	10,400	800	1,600	800	2,400	1,600	86,893	1.46
1,690	565	4,500	7,320	565	1,125	565	1,690	1,125	61,205	1.03
1,055	350	2,815	4,580	350	700	350	1,050	700	38,289	0.65
								23,034	23,034	0.39
9,315	386,389	434,311	520,864	81,715	108,322	100,678	124,803	109,608[r]	5,934,968	100.00
2.52	6.51	7.32	8.78	1.38	1.82	1.70	2.10	1.85		

Annotations for Functional Cost Distribution at March AFB Hospital
(Table 1.6.3)

[a]Basic cost data were obtained from documents provided by the Business Office, including annual "Hospital Management Summary Cost Analysis and Financial Management" and quarterly computer printouts of accounting records. Personnel distributions were derived from authorized manning tables and from Form 201, Base Medical Staffing Report, supplemented by interviews with specific departments on staff utilization. The numbers shown represent full-time equivalents.

Tabular entries for costs of various categories of personnel were estimated on the basis of approximate averages, distributed in such a way as to make the subtotals consistent with available accounting figures. For example, except where constraints dictated otherwise, staff physicians and dentists were assigned an average annual compensation of $15,000, registered nurses $10,000, and clerks $5,000. Other personnel cost entries absorbed the necessary remainders of the appropriate subtotals.

Thus, the personnel cost allocations that are shown are to be regarded as reasonable approximations rather than as precise accounting figures, since the latter were not directly available on a functional assignment basis. It should be noted that the total costs and their breakdowns represent dollars disbursed or transferred and do not include fringe benefits that are not chargeable to hospital accounts, such as military retirement, tax advantages, PX and commissary privileges, etc.

[b]Includes all inpatient wards other than those in the next two columns.

[c]Includes operating rooms, recovery rooms, and surgical inpatient wards.

[d]Includes obstetrics, gynecology, and nursery wards.

[e]Covers separate Flight Medicine Office.

[f]All general therapy and specialized clinics other than dental.

[g]Includes Base Dental Clinic, Base Dental Lab, and Area Dental Lab.

[h]Includes Clinical Laboratories and Histopathology.

[i]Includes dietitians and kitchen personnel.

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[j]Includes general administrative functions plus public health and veterinary activities.

[k]Includes direct services involved in inpatient and outpatient record rooms.

[l]Includes plant management and equipment maintenance.

[m]Includes travel costs.

[n]Purchased laundry and dry cleaning services.

[o]Contractual housekeeping costs allocated in proportion to the areas utilized by various functional groups.

[p]Allocated in proportion to area.

[q]Allocated in proportion to area.

[r]Gross total operating expenditure for FY 1969.