Systems Analysis
For a "New Generation" of Military Hospitals

Volume 5. Appendices: Improvements to Provision of Medical Services

Final Report

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Arthur D. Little, Inc.

SYSTEMS ANALYSIS
FOR A "NEW GENERATION" OF MILITARY HOSPITALS

VOLUME 5
APPENDICES: IMPROVEMENTS TO PROVISION OF MEDICAL SERVICES

FINAL REPORT
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SYSTEMS ANALYSIS

FOR A "NEW GENERATION" OF MILITARY HOSPITALS

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PREFACE TO VOLUME 5

This volume contains several studies concerned with improvement of medical services, subsidiary to the recommendations contained in Volume 2 on reorganization of the base health care systems. The first two studies are concerned with the same matter - use of less highly trained personnel - in two different aspects of health care, medical and dental. The next study discusses possible improvements in nursing services. For a variety of reasons, we believe that major improvements in the efficiency of nursing care are almost impossible to achieve, but even minor improvements may permit a significant saving because nursing care represents such a large fraction of total costs.

The next section investigates multiphasic testing, which holds the promise of improving health care and reducing morbidity and mortality. We conclude that, at least for the time being, multiphasic testing costs too much and offers too little to be worthwhile on a military base. We have also considered the possibility of reducing the cost of providing health care by eliminating certain services from military hospitals and purchasing them through CHAMPUS. Obstetrics is a natural example, which we examine in the next section, concluding that for hospitals where the birth rate exceeds about 500 per year it is more economical for the military to provide the service.

Patient monitoring equipment is frequently spoken of these days as a revolutionary development in medical care. While the assertion has some substance, much of the equipment is technology in search of a problem. We examine some of the computer-aided patient monitoring systems. In the final section some of the data analysis and results which lie behind our recommendations for a light care unit are presented.

5.1. USE OF ANCILLARY PERSONNEL IN PRIMARY CARE

The material presented in this section serves as background to the recommendations presented in Section 2.4.

5.1.1. ADVANTAGES OF GREATER CORPSMAN RESPONSIBILITY

Primary ambulatory care in the military setting can be provided at less cost without significant diminution of quality of care by more extensive use of corpsmen with greater responsibility under limited physician supervision. Most of the system savings come in fewer referrals to specialty clinics, lower utilization of ancillary facilities, and some decrease in hospital admissions, as elaborated later in this section. In addition, less physician time will be required to perform the same functions, and there is some reason to expect that both physician and corpsman will gain greater satisfaction from their work. (The latter advantage will become increasingly important as the physician shortage impacts DOD.)

5.1.1.1. Model for Primary Care

Many different modalities are used to provide primary health care to active-duty personnel, depending on service, location, and type of personnel being served. Considering only army troop dispensaries, there are major differences in the division of labor and responsibilities assumed by corpsmen versus physicians. These differences (in the degree of screening and responsibility for treatment and disposition assumed by corpsmen) apparently depend on local factors, including the policies of the commanding officers of the base, the hospital, and the brigade. For example, a 1967 study of 12 army bases indicated that the percentage of troops at sick call that were seen by a physician varied from 100% (at Fort Ord, which had instituted such a policy on a test basis) to as low as 27% (at Fort Polk).* These differences may, of course, have been partly due to differences in disease and severity of illness of troops at sick call at the various bases on the subject day; however, if we assume that the sick call patients were reasonably homogeneous from base to base (which has been our observed experience), we can draw some interesting conclusions from the data developed by the study (Table 5.1.1).

*"Primary Medical Care of Recruits", Col. Milton C. Devolites, MSC (Informal Report).

TABLE 5.1.1

STATISTICAL SUMMARY OF DISPENSARY OPERATIONS
(ONE-DAY STUDY, 14 JUNE 1967)

	Dix	Knox	Benning	Bragg	Campbell	Gordon	Jackson	Bliss	Polk	Wood	Ord	Lewis	Total or Average
Patient on sick call	445	597	355	254	141	495	506	545	653	696	572	589	5848
Number seen by medical officer	286	242	135	180	102	176	304	290	177	503	572	382	3349
Percent of line 1	64	41	38	71	72	36	60	53	27	72	100	65	59%
Number referred to hospital clinics	46	60	55	59	24	92	138	32	93	118	149	76	942
Percent on line 1	10	10	16	22	17	19	27	6	14	17	26	13	16%
Admissions to hospital	46	2	3	5	6	5	20	11	22	15	9	34	178
Percent of line 1	10.3	.3	.9	2.0	4.3	1.0	4.0	2.0	3.4	2.2	6.0	1.5	3.0%
Number of MD's at sick call	10	8	6	5	4	7	7	9	9	9	38	14	126
Number of physicians assigned	112*	80	94	64	59	64	63	19	46	60	90	29	780
Average doctor time/patient (minutes)	5.9	6.5	8.0	4.5	6.0	11.5	3.9	7.9	7.4	2.8	4.6	8.2	6.4
Corpsmen/MD at sick call	4	5	6	8	5	3	4	8	7	5	3	6	5
Army strength provided dispensary care	23,000	45,000	50,000	51,000	25,000	37,000	20,000	28,000	22,000	23,000	40,000	26,000	390,000
Number on sick call/1000 troops	19	13	7	5	6	13	25	20	30	30	14	23	17
Number referred to hospital/ 1000 troops	2.0	1.3	1.1	1.2	1.0	2.5	6.9	1.1	4.2	5.1	3.8	2.9	2.5
Number admitted to hospital/ 1000 troops	2.00	0.04	0.06	0.10	0.24	0.14	1.00	0.02	1.00	0.65	0.85	0.35	0.54
Number referred directly to hospital clinics	19	21	53	51	21	42	62	0	36	90	149	30	574
Number given clinic appointments another day	27	39	2	8	3	50	76	32	57	28	-	76	398
Number of dispensaries	8	8	4	5	3	5	6	10	8	9	5	13	84
Dispensaries in temporary buildings	2	5	4	5	3	3	4	4	8	6	3	8	55

*Ft Dix also provides outpatient care to 20,000 dependents of AF personnel at McGuire AFB

Source: "Primary Medical Care of Recruits," Col. Milton C. Devolites, MSC (Informal Report)

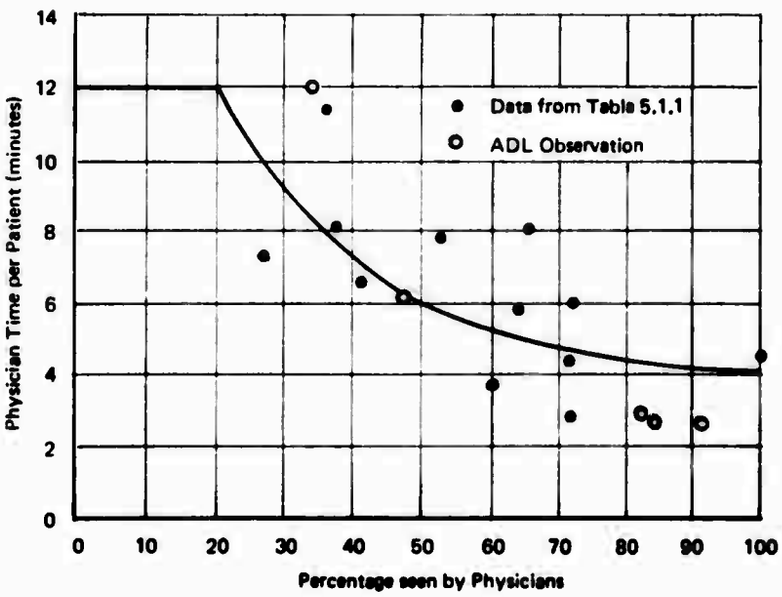

FIGURE 5.1.1 EFFECT OF PATIENT VOLUME ON PHYSICIAN TIME PER PATIENT

A plot of the average number of minutes spent by the physician per dispensary visit as a function of the percent of patients seen (Figure 5.1.1) suggests that the average time per patient decreases as the physician sees a larger fraction of the total patients at sick call. We have included in this plot our own observations during a survey of patient records at several bases; these points show the same trend as Col. Devolites' data.

The data are consistent with the following model of primary care, within this environment. (The model was actually developed before these data were obtained but is consistent with them.) We postulate two types of patients:

- Those with comparatively minor and immediately evident symptoms, most of which can be diagnosed and disposed of by a trained corpsman. It is our observation that probably about 80% of all presenting patients at sick call fall within this category.

- The more seriously ill or those who may require further diagnosis before a definitive treatment can be selected. Included in this group are a significant number who must see the physician not because of their illness, but because of the limitations

or degree to which a corpsman may prescribe treatment or certify excuses from duty.

Physicians personally see most of the patients in the second category and a fraction of those in the first category, depending on local policy.

The available published data, together with our own observations, appear to be consistent with the following estimates: on the average a corpsman takes approximately four minutes to screen patients at sick call; for some of these he can arrive at a disposition immediately. The physician spends an additional two minutes with each screened first-type patient that he sees and normally instructs him to return to barracks with light duty or with minor medication. However, the physician may spend twelve minutes with a patient with a more complex ailment; thus, if he sees a larger fraction of the total patients, the average time spent with each one will be shorter. We estimate that in the case of the first type of patient, the physician would have to spend three to four minutes per patient, if he were not screened by a corpsman who obtains the preliminary history and primary observations.

Out of 100 patients, for example, assuming that at least 20% should be seen by the physician, this model suggests that 400 physician minutes would be required if the physician sees 100% of the patients, 320 minutes if he sees 60% of the patients, and 270 minutes if he sees 25% of the patients. Accordingly, considerable savings in physician time are possible through having the corpsman assume a greater responsibility for patient diagnosis and disposition. The total cost of the staff time required (physician plus corpsman) will then be much less dependent on the percent of patients seen by the physicians. As shown in Table 5.1.2, the cost of total staff time is 20% less if the number of patients seen by the physician is reduced from 100% to 25%.

5.1.1.2. Number of Referrals, Diagnostics, and Hospitalizations

In discussions with physicians and corpsmen involved with dispensary operations, we have come to the preliminary (subjective) conclusion that in many instances corpsmen are much more efficient than physicians in

TABLE 5.1.2

STAFF COST VERSUS DEGREE OF SCREENING

Percent Seen by MD	Average MD Time per Visit(min.)	Total MD Time per 100 patients(min.)	Corpsman Time per 100 patients(min.)	Direct Staff Cost per 100 patients*
25%	10.5	270	400	$58
60%	5.3	320	400	$64
100%	4.0	400	400	$74

* Based on $3.65 per hour for corpsmen and $7.50 per hour for physicians.

giving primary care in the dispensary. This is due in large measure to the following:

(1) The corpsman becomes adept at diagnosing and treating the kinds of illnesses which are typical of young active-duty personnel, such as upper respiratory infections and orthopedic problems.

(2) The physician at sick call is typically young and inexperienced in mass occupational medicine, because of his recent academic background and training. He is, therefore, more likely to refer to a specialty clinic and to request diagnostics that might not be indicated to a more experienced physician.

(3) Physicians readily admit that they become bored with this type of medicine; also, corpsmen are often unhappy and complain that their experience and talents are not appropriately recognized and utilized.

It is unfortunate that there have been few definitive or even suggestive studies, adequately controlled or otherwise, that shed light on these observations and issues.

A study was made at Fort Ord in 1968 to test the impact of instituting a specialty or "group practice" clinic instead of the more conventional dispensary operation.* In this test, the physician staff at the dispensary was increased by a factor of four, and virtually all patients were seen by a physician. As a result, there were twice as many referrals to specialty clinics and to professional ancillary services such as X-ray and laboratory than in the more conventional type of dispensary. At the same time, although the numbers were small, hospitalizations appeared to increase by 15% after the new system was instituted.

*BCT Dispensary Comparison Study, U.S. Army Hospital, Fort Ord, California, MA-69-14, Col. R. E. Clausen, MC, et al., (10 July 1969).

A more controlled study* was subsequently carried out at Fort Ord during 1969. It compared the results of corpsmen screening to primary screening and disposition by physicians, both under more conventional conditions. Data on four to five thousand controlled visits were collected. Although the results have not been completely analyzed, a preliminary conclusion was reached that corpsmen had no higher a "miss" rate than did physicians, as evidence by the fact that the hospital admission rate on the second visit was no higher for corpsmen than for physicians. The study also concluded that corpsmen made fewer referrals to specialty clinics and requested fewer laboratory tests and X-rays. This may be in part because corpsmen were allowed less latitude than physicians for referrals or requests. The experimenters, however, did believe that it was due at least in part to the confidence and experience of seasoned corpsmen in contrast to young doctors.

Col. Devolites' study (referred to earlier) suggests that the percentage of patients that are referred to specialty clinics increases with the percentage that are seen by physicians. The pattern of points in Figure 5.1.2 indicates that the number of referrals increases from about 10%, when the physician sees 40% of the patients, to double that percentage when the physician sees 70% of the patients. If the populations are relatively homogeneous, one could conclude that physicians tend to refer to a greater extent than do corpsmen. Another possible explanation, however, is that the patients are either more ill or have more complicated diagnoses in those instances when a physician sees a higher percentage of them. There is also some indication (Figure 5.1.3) that the rate of hospital admissions is somewhat higher when a larger percent of the patients are seen by a physician. In both Figures 5.1.2 and 5.1.3 the conclusion to be drawn from the evidence is equivocal because there is uncertainty about the comparability of patients at different locations. We have not made further use of these observations in computing savings to accrue from using corpsmen more extensively.

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*Col. Canby and Capt. Miller, Fort Ord, California (Private communication).

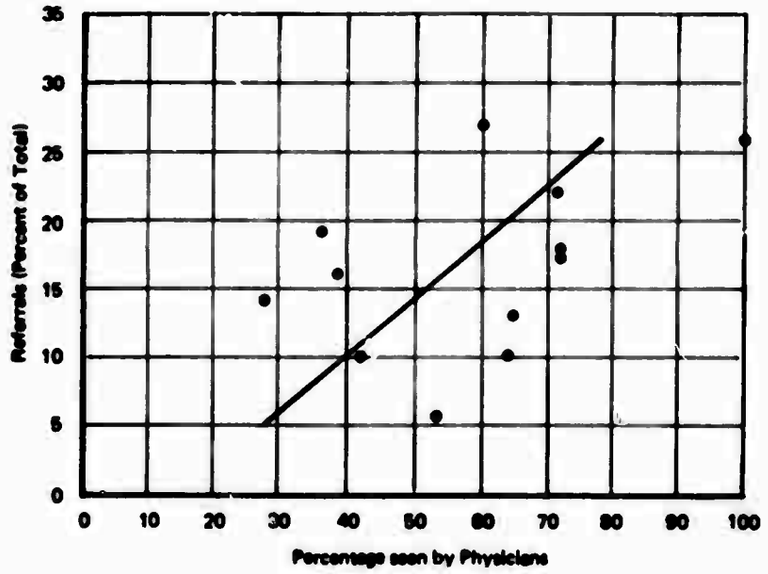

FIGURE 5.1.2 CLINIC REFERRALS VERSUS PERCENTAGE SEEN BY PHYSICIANS

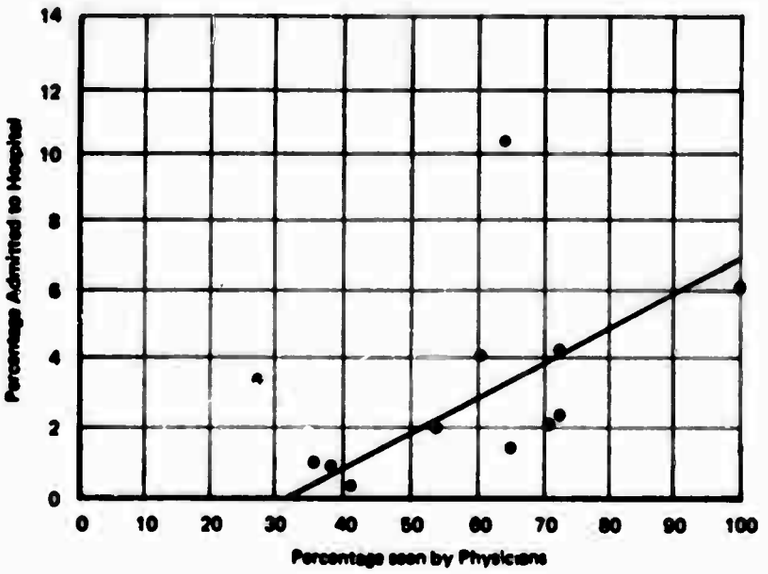

FIGURE 5.1.3 HOSPITAL ADMISSIONS VERSUS PERCENTAGE SEEN BY PHYSICIANS

5.1.2. SURVEY OF AMBULATORY CARE

We have reviewed about 750 outpatient records of male active-duty personnel at a variety of DOD bases representing different modalities for provision of primary ambulatory screening and care. There is considerable variability in records, in the amount of information recorded, and in type of population at risk at each location, making the results indicative and suggestive rather than precise. Very briefly, the following conclusions were drawn (the survey and conclusions are discussed subsequently at greater length):

- Where physicians provide the primary screening, between 50% and 90% more X-rays per visit are ordered.

- Similarly, about three times the number of laboratory tests per visit are ordered where physicians provide primary screening.

Whether these differences should be attributed to greater caution on the part of physicians or to greater ignorance of the need for tests on the part of corpsmen is problematical. Corpsmen may also have had less latitude to order tests and X-rays. In addition, the following observations are useful process statistics:

- About 20% of visits results in clinic referrals, independently of location.

- At training locations, about 8% of visits result in X-ray, primarily of extremities.

- At Army bases, where the personnel are short-term trainees and corpsmen provide primary screening, about 20% of visits are repeat visits. At Air Force bases, where personnel are permanently based and physicians provide all primary screening and care, only 7% are repeat visits.

- About 5% of visits result in hospital or dispensary admissions at training bases. The number is smaller at Air Force locations.

- The number of presenting diagnoses is small in most of the samples recorded. Upper respiratory infections and orthopedic complaints account for over half of the visits at training bases.

- Disposition and treatment is fairly uniform across locations. About two thirds of patients are returned to duty, with or without medication.

5.1.2.1. Introduction

The methods for providing triage (screening) and primary ambulatory care on military bases vary widely, depending on the type of staff and facilities available at the point of contact. Table 5.1.3 lists nine such modalities, which differ according to whether diagnostic facilities (lab and X-ray) are available, whether beds are available, and the type of personnel involved (corpsmen and physicians). The examples of each modality are drawn from our visits to different bases.

The models can be grouped into three major groups, depending on the personnel involved:

- In the first group, corpsmen provide the primary screening. MD's are available by referral to the base hospital.

- In the second group, corpsmen provide the primary screening, and physicians are available to see patients who are not disposed of by the corpsmen; this is the typical modality on Army training bases. A subdivision of this group can be made, depending on whether diagnostic facilities are available.

- In the third group, physicians see all patients, providing both initial screening and disposition.

TABLE 5.1.3

MODES OF PRIMARY AMBULATORY CARE

	Mode	Diagnostic Facilities	Beds Available	Examples
1.	Independent Corpsman MD not available	No	No	Destroyers based at Mayport Corpsmen in Field Air Force medics in remote stations
2.	Corpsman, MD available by referral	No	No	Fort Dix, P.M.
3.	Corpsman, MD available by referral	Yes	No	Fort Bragg, P.M.
4.	Corpsman screening MD backup	No	No	Fort Dix, A.M.
5.	Corpsman screening MD backup	Yes	No	Fort Bragg, P.M.
6.	Corpsman screening MD backup	Yes	Yes	Parris Island
7.	MD screen	No	No	Fort Ord experiment
8.	MD screen	Yes	Yes	Norton flight surgeon Mayport
9.	MD in quasi-group	Yes	Yes	Norton

We have focused on the handling and treatment of active-duty personnel, since this is where the largest variety of modalities occurs and because it appears to be the area most amenable to innovation and change. The charts show that patients may be returned to barracks at a variety of points in the system, depending on the disposition at each point and the facilities available at the primary screening location.

To obtain information and data on the various models of ambulatory care, any differences in cost of health care, and disposition of patients, we carried out an in-situ survey of the patient records at six bases (Norton, March, Mayport, Parris Island, Dix, and Bragg) and observed the operations in the dispensaries and outpatient clinics. This section describes the survey design and the results.

5.1.2.2. Survey Procedure

The survey procedure consisted of sending teams to several DOD base hospitals and dispensaries and collecting information from patient records. For each medical record in the sample, data were recorded for all visits in 1969 and 1970, including location of visit, type of clinic, and (where appropriate) diagnosis, disposition, and use of diagnostic facilities such as X-ray or laboratory. For any associated hospital admission, we obtained the inpatient record and recorded the entering diagnosis, length of stay, and any diagnostics and laboratory tests ordered. (As indicated below, however, it was not possible in all instances to follow through the inpatient records.) The information was coded onto survey forms, which were later coded for computer analysis, keypunched, and analyzed by means of tabulation routines. While the teams were at the dispensary locations, they also attempted to obtain information on such variables as the mean time per patient visit for corpsmen and physicians, total number of visits per day, and time required per X-ray (where appropriate).

The number of records coded in each instance is summarized in Table 5.1.4. Some 1150 records in total were examined, of which approximately 750 referred to male active-duty patients.

A brief summary of the survey procedure at each of the bases follows. Because of different conditions at each base, it was necessary to modify the survey procedure somewhat in each instance.

TABLE 5.1.4

SUMMARY OF PATIENT RECORD SURVEY

Location	Number of Records	Active Duty Records
Fort Dix	146	146
Fort Bragg	190	190
Parris Island	214	214
Mayport Destroyers	100	100*
Mayport Dispensary	200	-
March Hospital	104	29
March Flight Surgeon	21	20
Norton Dispensary	93	17
Norton Referrals	61	23
Norton Flight Surgeon	22	20
	1,151	759

* 76 records showed activity in 1969

5.1.2.2.1. Fort Dix

There are four dispensaries at Fort Dix that provide primary care to recruits. Medical officers are available in the dispensary for the a.m. sick call visits. Sick call begins at 6:30 a.m. with a corpsman taking temperatures, collecting sick slips, and signing the patient into the log book. The corpsman may return patients to active duty, or may prescribe certain medications. In the a.m. sick call, those patients not disposed of by the screening corpsman are seen by one of the attending medical officers. In the afternoon, when physicians are not available in the dispensary, the patient must be referred to the Emergency Room at the Walson Army Hospital if he is not disposed of by the corpsman.

The dispensaries do not have ancillary services such as laboratory or X-ray facilities, but throat swabs are taken in the dispensaries. Orders for throat cultures, however, are not entered into the medical record. The dispensaries generally have small pharmacies.

The survey sample included all medical records containing a 2-4 February 1970 visit at Dispensary 2, supplemented by as many medical records as could be found in the other three dispensaries with an afternoon sick call entry. Of the 146 records examined, about two thirds were from Dispensary 2 and one third from the other three dispensaries.

5.1.2.2.2. Fort Bragg

There are over 20 dispensaries and aid stations at Fort Bragg, serving a total of 30,000 troops. The 82nd Airborne Division, which has 13,000 to 15,000 men, is served by three dispensaries. The North and South Dispensaries have pharmacies and minimally equipped laboratories. The Central Dispensary is the only dispensary with an X-ray unit and a laboratory, and serves the 82nd Airborne Division (approximately 13,000 to 15,000 men). The Central Dispensary also provides X-rays for the North and South Dispensaries plus off-hour physician care.

Primary care provided at Fort Bragg is very similar to that at Fort Dix, in that patients are first screened by corpsmen; those not disposed of are then seen by a physician. Four physicians are generally available in the morning and one or two in the afternoon. Corpsmen are available to screen

patients at the Central Dispensary 24 hours a day, seven days a week.

The survey sample consisted of 200 outpatient records. Of these, approximately 150 were taken from the files of the Central Dispensary, and approximately 15 from each of the first, second, and third battalion files. The records were hand-picked by a corpsman; the sample provided a good alphabetic distribution of outpatient records.

In coding from the records, the following problems were encountered:

- If a patient is screened by a corpsman but is not seen by a physician, there is generally no entry in the outpatient record, according to practice at Fort Bragg.

- Some outpatient files were apparently incomplete, in that diagnostics appeared to be grossly underestimated and many files did not contain a Form 600, which describes the visit.

- There is some difficulty in interpreting the treatment and diagnoses because of physician's script or incompleteness of visit description.

- Inpatient records follow-up was not accurate: of 29 known inpatients, only 24 inpatient records could be located.

5.1.2.2.3. Parris Island

There are five dispensaries at Parris Island, each having a specified patient load and treatment facilities:

(1) Main Depot Dispensary - takes care of permanent personnel, with the exception of drill instructors and some retired officers. The depot contains a small ward for inpatient care of noncritical nature, such as observation, rest, and medications. This dispensary distributes all the medicine on Parris to the various dispensaries.

(2) Women's Dispensary - provides medical care for female marines.

(3) West End Dispensary - sees all recruits and drill instructors on a regular basis, and all emergencies between the hours of 4:30 and 6:30 p.m. Doctors are available on a 24-hour basis. Ward bed facilities are available for recruits, for non-acute illnesses, mild medical observation, and care. The West End Dispensary has a 100-mm X-ray machine with table for X-ray exams. The small pharmacy dispenses fairly simple medications. Minor surgery is done in the Surgical Clinic; there is also a Podiatry Clinic.

(4) East End Dispensary - provides the preliminary and exit physicals. Facilities include a 17-mm upright chest X-ray. Compiled medical records are kept here.

(5) Rifle Range Dispensary - provides sick call services for recruits who are doing their two-week duty on the rifle range and medical care for patients in the medical platoon. The neuropsychiatric screening unit is also here.

The sample consisted of approximately 225 patient records obtained from the East End Dispensary. About 180 represented records of recruits who had a typical eight weeks' training experience at Parris Island, and the remainder were medical records of recruits who had extended brig time or sustained illnesses.

5.1.2.2.4. Mayport

The Mayport Dispensary is an outpatient clinic located 30 miles from the Naval Air Station at Jacksonville. It serves a total population which ranges from 35,000 to 50,000, depending upon the number of ships visiting the home port. The dispensary contains X-ray and laboratory facilities, and has several infirmary beds for patients requiring observation.

Primary health care on a destroyer is provided by an independent duty corpsman who has some rarely used laboratory equipment; no other diagnostic

or X-ray facilities are available. For cases requiring the attention of a physician, or medical facilities, the patient is referred to a shore-based station such as Mayport or, in extreme cases, may be transferred to a larger ship which does have such facilities.

The sample at Mayport was composed of three elements: 100 files of military dependents selected at random from the outpatient records; 100 files of military dependents who, in the course of their treatment at Mayport, were also referred to Jacksonville Naval Hospital for consultation; and 100 files of active military personnel assigned to five destroyers currently visiting the port of Mayport (20 records from each of the five destroyers). Of this last group, only 76 of the hundred records had visits recorded in 1969 and, therefore, provided any information useful for this survey.

The validity of the data in the Mayport records is limited, because many of the records are in poor condition, handwriting is sometimes illegible, and comments are sketchy. The number of visits on the destroyer records is greatly understated, since record-keeping is more informal; apparently, only the visits of the sicker patients are recorded. As noted above, 25% of the destroyer records had no evidence of sick call visits during 1969.

Records for diagnostic services, including X-ray, were not reliable; in many cases an X-ray is mentioned in the physician's comments, but there is no order for that service in the file. It is not possible to know how many lab services were not recorded. Finally, the inpatient record system is clumsy, so the number of inpatient admissions counted is probably less than actual.

5.1.2.2.5. Norton Air Force Base

Norton has a well-equipped dispensary and twelve infirmary beds for patients requiring observation or light treatment. Patients requiring services not available at Norton, or acute bed care, are referred to March Air Force Base Hospital or a local community hospital.

In addition, there is a Flight Surgeon's facility across the street from the dispensary, which provides physicals and primary ambulatory care to flying personnel and their families. This facility uses the X-ray and laboratory services of the Dispensary.

Patients in all instances are seen by a physician; there is no screening and disposition by a corpsman as may occur for active-duty personnel at other bases.

The sample from Norton consisted of 93 records from the Dispensary and 22 records from the Flight Surgeon. Of the former, 18 were of active-duty personnel. This sample was supplemented by an additional 61 records (including 23 active-duty) of patients who had been referred from Norton to March AFB Hospital. All records were chosen according to a predetermined randomizing rule.

5.1.2.2.6. March Air Force Base

The main hospital facility at March provides primary ambulatory services to nonflying personnel, dependents, and retirees. In addition, there is a Flight Surgeon's facility, which provides physicals and ambulatory care for flying personnel and has X-ray and minimal laboratory equipment.

The provision of care is similar to that at Norton, in that all patients are seen by a physician.

We examined 104 outpatient records at March, of which 24 were for active-duty personnel, and an additional 21 were obtained from the Flight Surgeon's office. Records were randomly selected.

5.1.2.2.7. Problems of Comparison

It is apparent from the above description that the comparison of results was necessarily limited, primarily because of the following factors:

(1) Many records were incomplete, especially with regard to utilization of lab and even X-ray services.

(2) Not all visits were recorded, especially those where a patient may have been seen by a corpsman and not by a physician.

(3) Handwriting on many of the records was difficult to decipher.

(4) Policies as to which data are recorded in the record apparently vary by location.

(5) In some instances it was not possible to follow through the inpatient records.

(6) Since several teams were involved in recording the data at each of the locations, there were some potential inconsistencies in coding.

These problems, of course, are typical of those in health services "research." Ideally, one should have a high degree of replicability, validity, and comparability. As we have indicated, because of the lack of comparability of the data examined in the several different ambulatory care systems, we could see no point in choosing larger samples. In effect, our results must be considered as suggestive and indicative, rather than providing precise comparisons of modalities and outcomes. The only way to achieve a truly valid and precise comparison of the outcome of the different modalities of treatment would be to carry out a (very large) prospective study under carefully controlled conditions. As indicated in Section 5.1.1., there have been few attempts at such studies. Such a study would, of course, have been outside the time and other constraints of our project.

5.1.2.3. Analysis

In view of the problem of comparability mentioned above, and also the fact that we are primarily concerned with differences in modalities and provision of primary health care, the analysis below focuses on male active-duty personnel. Provision of primary health care to dependents and retirees is quite similar at each of the different locations surveyed (each patient is seen by a physician), so we should expect no major differences in that area.

Even for active-duty personnel, the population at risk differs among the different locations. At Fort Dix, Fort Bragg, and Parris Island, the patients seen in the dispensaries are primarily recruits, typically undergoing eight-week training periods. In the case of destroyers, most of the

patients are personnel permanently assigned to the destroyer. The active-duty personnel seen at the Air Force bases include a much higher proportion of officers, and the average age is higher. Thus, the active-duty population is not comparable in all respects.

5.1.2.3.1. Process Statistics

Table 5.1.5 summarizes some of the "process statistics" for the records of the male active-duty patients in the survey. The 760 records with activity resulted in some 2400 visits, or about three visits per patient on the average. The time periods involved for the various locations are, of course, different in that trainees are at the bases for generally six to eight weeks, whereas the Air Force locations, having a higher proportion of permanently assigned personnel, have patient records covering a longer period. For the destroyer records, about 60% of the visits were dispensary visits on the ship and about 40%, visits at a shore-based facility (Mayport dispensary). As indicated above, however, we believe that the number of ship-based dispensary visits is understated. At Fort Dix, Fort Bragg, and Parris Island about 80% of the visits were in dispensaries and about 20% in hospital clinics.

About 21% of visits to dispensaries at Fort Bragg and Parris Island represented second, third, or more visits in a particular episode. (A further visit in an episode is defined as another visit within two days of the original visit, and with the same diagnosis.) The corresponding figure for Fort Dix is 34%; this higher figure is related to the fact that a higher fraction of patients who come to dispensaries in the afternoon at Fort Dix must be sent to the hospital for disposition, since the corpsman must otherwise return patients to duty. At the Air Force locations only 7% of the first visits in an episode resulted in further visits.

5.1.2.3.2. Ancillary Facilities

Table 5.1.6 shows the number of ancillary facilities used in connection with the patient visits. Overall, about 10% of visits involved X-rays. The pattern of usage varied somewhat among locations. At the training locations in which patients were seen by corpsmen and physicians, X-rays were ordered on approximately 8% of the visits. At the Air Force locations, where all patients are seen by physicians, 12% of visits involved X-rays, or about a

50% higher rate. Similarly, only about 7% of visits at the training bases had associated laboratory tests, whereas such tests were ordered for approximately one third of the visits at the Air Force locations. As noted below, about 30% of the visits to the Flight Surgeons' offices were for routine physicals; if this is taken into account, the number of sick call visits with orders for X-rays, laboratory, and clinic visits was 40% higher than the percentages indicated. Although all laboratory tests, such as for throat swabs, may not have been entered into the records, it appears that physicians have a greater tendency to utilize ancillary facilities such as X-ray and laboratory than do corpsmen. About 20% of visits were in hospital-based clinics, regardless of location, generally indicating that the primary screener felt that the patient required more specialized consultation.

Table 5.1.7 provides some detail on the X-ray examinations for personnel of destroyers and training bases. At the training bases about 85% of the X-rays were of extremities, usually in connection with suspected fractures and the like, and another 10% were chest X-rays. The pattern was reversed for visits arising from destroyer referrals, in that 60% were for chest X-rays and 30% for extremities. At Air Force bases, about 50% of the X-rays were for chest X-rays and the remainder was divided between X-rays for extremities and more complicated X-ray procedures.

5.1.2.3.3. Admissions

Table 5.1.8 shows the number of hospital admissions that resulted from the visits. At the training bases about 5% of visits resulted in either hospital admissions or (in the case of Parris Island) dispensary ward admissions. Although the numbers in the samples are small, a much smaller percent appears to have been obtained at the Air Force locations. We are not sure, however, whether all admissions have been counted, and the populations are, of course, not the same; in general, trainees have no place to go other than the hospital, whereas permanently assigned personnel living with their families could be sent home instead of to the hospital. At all locations approximately two thirds of the admissions were on the first visit in the episode, uniformly across all facilities.

5.1.2.3.4. Diagnoses

Table 5.1.9 shows the distribution of visits for several of the major diagnoses. Overall, upper respiratory infections accounted for 18% of visits (but 38% of visits at Fort Dix). Similarly, orthopedic-type complaints accounted for 24% of visits overall, although these were mainly restricted to the destroyer-based patients and to the training bases, where they accounted for about one third of the diagnoses. Thus, upper respiratory infection and orthopedic complaints accounted for over half of the visits at the training bases. Visits because of injuries accounted for about 8% of the total and dermatological complaints another 8%. Annual physicals accounted for about 30% of the visits to the Flight Surgeons' offices at the Air Force bases.

5.1.2.3.5. Disposition and Treatment

Table 5.1.10 shows the percent of visits that were disposed by returning the patient to duty, generally with medication; to quarters or light duty; or referred to specialized clinics. Overall, about two thirds of patients could be returned to duty with or without medication at all locations.

Table 5.1.11 shows the distribution of treatments that were noted in the patient records. Overall, about 20% of the visits had treatments indicated. Of these, about 31% were for orthopedic treatments, primarily bandages, representing 6% of total visits. Another 6% of treatments were associated with minor surgery. Treatments prescribed outside the clinic or dispensary, such as foot soaking, averaged 28%.

5.1.2.3.6. Fort Dix Analysis

We noted that two systems are in effect at the Fort Dix dispensaries. During the morning sick call, physicians are available in the dispensary to see patients that the corpsman cannot dispose of himself; the only disposition the corpsmen are permitted to make is "return to duty", with or without medication. In the afternoon the dispensary is staffed only by corpsmen, who must refer to the hospital (generally the emergency room) patients who cannot be returned to duty. We have, therefore, carried out a special analysis of these two modalities.

Table 5.1.12 A. shows that,in general, the presenting diagnoses are very similar in the morning and in the afternoon. As might be expected, the disposition of patients is considerably different (Table 5.1.12 B.). In the morning, about 68% of the patients were returned to duty, whereas in the afternoon only 48% of patients were immediately returned to duty; 51% were referred to the hospital emergency room or other hospital clinics. If we analyze the dispensary visits only (Table 5.1.12 C.) the percent of patients actually disposed of by corpsmen is 49% in the afternoon, compared with 27% in the morning. It appears that when physicians are not immediately available, corpsmen assume greater responsibility in terms of patient disposition, handling almost twice the percentage on their own.

It is, of course, difficult to compare quality of care under the two systems. One measure that can be considered is how soon an ultimate hospital admission is made. For example, if corpsmen were to return to duty a higher fraction of patients who ultimately are hospitalized during their episode than do physicians, one might argue that quality of care is lower, since the patients' conditions may be aggravated by the longer time period before admission. Table 5.1.13 shows the number of admissions by day of episode, as a function of whether the first visit occurred in the morning or afternoon. Statistically, the number of hospitalizations per episode was the same in the morning as the afternoon. Two of the thirteen admissions from morning episodes were made after the first day of the episode. All six admissions from afternoon episodes were made on the first day of the episode. This suggests that the corpsmen did a good job of screening and did refer all patients who required hospitalization during their episode.

Another possible measure of the quality of care is the number of visits or length of comparable episodes; it may be that if the proper disposition or treatment is not made on the first visit of an episode, the episode may be unduly prolonged as a result. We have therefore attempted to compare the episodes in which the first visit to the dispensary was in the morning, with those in which the first visit was in the afternoon. Tables 5.1.14-A and -B show the distribution of visits by episode for "A.M. Episodes" and "P.M. Episodes" for Upper Respiratory Infections, Orothopedic, and Other. There were 190 such morning episodes in the sample, of which 55 were handled by corpsmen. Similarly, there were 73 episodes in the arternoon, of which

28 were handled by corpsmen and 45 were referred to the emergency room of the hospital. For purposes of this analysis, referral to the emergency room is considered part of the first visit, similar to the corpsman's referring the patient to the physician in the dispensary in the morning.

Table 5.1.15 compares three sets of statistics for morning episodes and afternoon episodes: the percent of episodes by diagnosis; the average number of visits in the episode; and percent of episodes that required at least one additional visit. The distribution of episodes by diagnosis is quite similar in the morning and afternoon: about 45% were for URI complaints, 25% for Orthopedic complaints, and about 30% for Other. Corpsmen handled about 30% more of the first visits on their own in the afternoon compared with the morning. The second part of Table 5.1.15 shows the average visits per episode. The distributions are very similar between morning and afternoon visits, and between visits handled by the corpsmen and visits handled by the physician (or emergency room). On the average each episode consisted of 1.4 visits; orthopedic complaints required somewhat more visits than did URI or "other" complaints. The third part of Table 5.1.15 suggests that episodes originating in the afternoon had a somewhat higher percentage of at least one additional visit; the differences are, however, not statistically significant due to the small number of cases involved in each instance.

To summarize this part of the analysis, it would appear that length of episode is the same whether the patient was handled by a corpsman or a physician, and whether the episode was initiated in the morning or afternoon.

5.1.2.4. Discussion

As we have indicated earlier, our survey and analysis were not carried out under ideally controlled conditions. Furthermore, the populations at risk are not strictly comparable among the various locations. Nevertheless, most of the conclusions are consistent with those that have been obtained in a few previous studies; it appears that where corpsmen assume greater responsibility for screening and disposition of patients, quality of care is no different than when physicians provide this aspect of health care. It also appears that physicians order more X-rays and lab procedures than do corpsmen.

Although it is admitted that these results are suggested or indicated rather than proven in any sense, there is more than sufficient evidence to lead us to the conclusion that an increased degree of responsibility for corpsmen will lead to significant savings, without any impairment in the quality of care. This result is particularly significant in the light of the increasing pressure on physicians nationally, and the growing national trend toward the enhanced use of paramedical personnel.

This work makes clear that it would be extremely valuable to carry out large-scale controlled prospective surveys, which would provide more definitive and quantitative results. Such surveys might be best carried out within the military environment, where controls can be more effectively implemented. The findings would have widespread importance, not only for the military health system but for the private health care system as well.

TABLE 5.1.5

PROCESS STATISTICS FOR ACTIVE-DUTY VISITS

Location	Screening Staff	X-ray	Lab	Beds	No. of Records	Total No. of Visits	Dispensary Visits No.	Dispensary Visits Percent	No. of First Visits (Episodes)	Add'l Visits	Percent Add'l Visits
Destroyers	Corpsman	No	No	No	76	257	157	61	224	56	25
Fort Dix	Corpsman and MD	No	No	No	146	406	314	77	303	103	34
Fort Bragg	Corpsman and MD	Yes	Yes	No	190	623	479	77	538	85	16
Parris Island	Corpsman and MD	Yes	Yes	Yes	214	557	442	79	441	116	26
March Flight Surgeon	MD	Yes	Yes	No	20	58	53	91	55	3	5
Norton Flight Surgeon	MD	Yes	Yes	No	20	66	42	64	61	5	8
March Hospital	MD	Yes	Yes	Yes	29	159	-	-	149	10	7
Norton Dispensary	MD	Yes	Yes	Yes	40	241	-	-	225	16	7
TOTAL					735	2,367	1,487		1,996	394	20

TABLE 5.1.6

USE OF ANCILLARY FACILITIES

Location	Total No. of Visits	X-rays		Laboratory		Clinic Visits	
		Number	Percent	Number	Percent	Number	Percent
Destroyers	257	53	21	36	14	100	39
Fort Dix	406	15	4	20	5	92	23
Fort Bragg	623	42	7	57	9	144	23
Parris Island	557	65	12	28	5	115	21
March Flight Surgeon	58	8	14	16	28	5	9
Norton Flight Surgeon	66	11	17	29	44	24	36
March Hospital	159	11	7	40	28	34	21
Norton Dispensary	241	33	14	97	40	63	18
TOTAL	2,367	238	10	323	14	557	23

TABLE 5.1.7

RADIOLOGY EXAMINATIONS

Location	Chest		Extremities		Other		Total
	Number	Percent	Number	Percent	Number	Percent	Number
Destroyers	32	60	16	30	5	9	53
Fort Dix	1	7	14	93	0	0	15
Fort Bragg	6	14	32	76	4	10	42
Parris Island	7	11	57	88	1	2	65
March Flight Surgeon	8	100	0	0	0	0	8
Norton Flight Surgeon	10	91	1	9	0	0	11
March Hospital	4	36	6	55	1	9	11
Norton Dispensary	16	49	11	33	6	18	33
TOTAL	84	35	137	58	17	7	238

TABLE 5.1.8

ADMISSION RATES

Location	Total No. of Visits	Admissions Number	Admissions Percent	Number Admissions First Visit	Percent	Average Days per Admission
Destroyers	257	8	3	5	63	14
Fort Dix	406	19	5	12	63	2
Fort Bragg	623	28	4.5	19	68	2
Parris Island	557	9 hospital 17 ward	5	6	67	15 5
March Flight Surgeon	58	0	0	-	-	NA
Norton Flight Surgeon	66	1	1	1	100	NA
March Hospital	159	2	1	1	50	NA
Norton Dispensary	241	4	2	4	100	NA
	2,367	71	4	48	68	

TABLE 5.1.9

VISITS BY TYPE OF DIAGNOSIS

Location	Total Visits	Upper Respiratory Infection		Orthopedic		Injuries		Dermatology		Physicals	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Destroyers	257	31	12	62	24	19	7	9	4	0	0
Fort Dix	406	154	38	132	33	6	1	29	7	0	0
Fort Bragg	623	106	17	105	17	72	12	85	14	0	0
Parris Island	557	88	16	279	50	32	6	46	8	0	0
March Flight Surgeon	58	9	16	1	2	0	0	1	2	14	24
Norton Flight Surgeon	66	5	7	0	0	8	12	1	1	22	33
March Hospital	159	28	17	1	1	27	16	13	8	4	2
Norton Dispensary	241	14	6	2	1	25	10	15	6	6	2
TOTAL	2,367	435	18	582	24	189	8	189	8	46	2

TABLE 5.1.10

VISITS BY TYPE OF DISPOSITION

Location	Return to Duty	Light Duty or Quarters	Clinic Referrals	Other
Destroyers	65%	8%	25%	2%
Fort Dix	65%	11%	19%	5%
Fort Bragg	72%	11%	13%	4%
Parris Island	61%	27%	8%	4%
March Flight Surgeon	96%	0%	0%	4%
Norton Flight Surgeon	79%	4%	1%	16%
March Hospital	69%	2%	3%	26%
Norton Dispensary	68%	0%	2%	30%

TABLE 5.1.11

DISTRIBUTION OF TREATMENTS BY VISITS

Location	Number of Visits	Treatments Number	Treatments Percent	Orthopedic	Observation	Minor Surgery	Therapy Outside Clinic
Destroyers	257	68	26%	16%	40%	7%	18%
Fort Dix	406	44	11%	59%	0	5%	7%
Fort Bragg	623	152	24%	33%	26%	9%	18%
Parris Island	557	104	19%	45%	2%	3%	48%
March Flight Surgeon	58	2	3%	0	0	0	100%
Norton Flight Surgeon	66	7	11%	29%	0	14%	57%
March Hospital	159	30	19%	20%	0	7%	50%
Norton Dispensary	241	56	23%	26%	0	0	21%
TOTAL	2,367	463	20%	31%	15%	6%	28%

TABLE 5.1.12

VISITS TO FORT DIX DISPENSARY

A. DIAGNOSIS BY VISITS

	Upper Respiratory Infection	Orthopedic	Other
A.M.	37%	33%	30%
P.M.	41%	31%	28%

B. DISPOSITION OF PATIENTS

	Number of Visits	Returned to Duty	Quarters or Light Duty	Clinic Referral	Admissions
A.M.	327	68%	14%	12%	6%
P.M.	75	48%	1%	51%	0%

C. DISPOSITION OF PATIENTS - DISPENSARY VISITS

	Number of Visits	Number Disposed of by Corpsmen	Percent Disposed by Corpsmen
A.M.	239	75	27
P.M.	75	37	49

TABLE 5.1.13

FORT DIX DISPENSARY –

ADMISSIONS BY DAY OF EPISODE

Day of Episode	First Visit A.M.	First Visit P.M.	Total	Percent
1	11	6	17	90
2	0	0	0	0
3	1	0	1	5
4	1	0	1	5
Total Admissions	13	6	19	100
Total Episodes	190	73	263	
Admissions per Episode	7%	8%	7%	

TABLE 5.1.14-A

DISTRIBUTION OF FORT DIX DISPENSARY VISITS BY EPISODE

A. MORNING

No. of Visits in Episode	Upper Respiratory Infection: First Visit Disposed by Corps-men	Upper Respiratory Infection: First Visit Disposed by MD	Upper Respiratory Infection: Total	Orthopedic: First Visit Disposed by Corps-men	Orthopedic: First Visit Disposed by MD	Orthopedic: Total	Other: First Visit Disposed by Corps-men	Other: First Visit Disposed by MD	Other: Total	First Visit Disposed by Other	Total Corps-men	Total MD	Totals
AT LEAST 1	34	55	89	13	32	45	8	46	54	2	55	133	190
2	4	6	10	3	17	20	3	11	14	1	10	34	45
3	1	2	3	2	4	6	1	3	4		4	9	13
4				1	2	3	1	1	2		2	3	5
5				1	1	2	1		1		2	1	3
6				1	1	2					1	1	2
7				1		1					1		1
TOTAL	39	63	102	22	57	79	14	61	75	3	75	181	259

TABLE 5.1.14-B

DISTRIBUTION OF FORT DIX DISPENSARY VISITS BY EPISODE

B. AFTERNOON

No. of Visits in Episode	Upper Respiratory Infection: First Visit Disposed by Corps-men	Upper Respiratory Infection: First Visit Disposed by ER	Upper Respiratory Infection: Total	Orthopedic: First Visit Disposed by Corps-men	Orthopedic: First Visit Disposed by ER	Orthopedic: Total	Other: First Visit Disposed by Corps-men	Other: First Visit Disposed by ER	Other: Total	First Visit Disposed by Other	Total Corps-men	Total ER	Totals
AT LEAST 1	10	17	27	9	16	25	9	12	21		28	45	73
2	3	3	6	4	5	9	3	4	7		10	12	22
3	1		1	2	1	3					3	1	4
4				1		1					1		1
TOTAL VISITS	14	20	34	16	22	38	12	16	28	-	42	58	100

TABLE 5.1.15
EPISODE STATISTICS--FORT DIX

	Upper Resp. Infection			Orthopedic			Other					
	First Visit Disposed of by											
	Corpsmen	MD	Total	Corpsmen	MD	Total	Corpsmen	MD	Total	Total Corpsmen	Total MD	Total
A. PERCENT OF EPISODES												
A.M.	18%	29%	47%	7%	17%	24%	4%	24%	28%	29%	70%	99%
P.M.	14	23	37	12	22	34	12	16	29	38	62	100
B. AVERAGE VISITS PER EPISODE												
A.M.	1.1	1.1	1.1	1.7	1.8	1.8	1.7	1.3	1.4	1.4	1.4	1.4
P.M.	1.4	1.2	1.3	1.8	1.4	1.5	1.3	1.3	1.3	1.5	1.3	1.4
C. PERCENT OF EPISODES WITH ADDITIONAL VISITS												
A.M.	12%	11%	11%	23%	53%	44%	37%	24%	26%	18%	26%	24%
P.M.	30	18	22	44	31	36	33	33	33	36	27	30

5.1.3. PHYSICIAN REVIEW OF PATIENT RECORDS

To analyze the content of dispensary practice in the different locations, Dr. Charles Lewis reviewed 669 records involving 2156 visits during a two-month period at the different bases (Table 5.1.16). At Fort Dix, Fort Bragg, and Parris Island, the average number of visits per record ranged from 2.6 to 3.3 per man over a training period of two months. Between two-thirds and three-fourths of all active-duty military personnel on these bases are seen in dispensaries sometime during their two-month assignment. The records from Mayport, representing men stationed on five destroyers, show the medical contacts of these personnel over a period of twelve months when referred to the dispensary at Mayport, which serves as a backup facility to the corpsmen on the destroyers. The records from March and Norton Air Force bases also represent 12 months' experience.

There was little variation (from 62% to 74%) in the portion of visits that represented single encounters for medical complaints or problems. That is, approximately 70% of visits at all bases did not result in a revisit to the physician. This is indicative of the types of diseases and problems being dealt with.

Table 5.1.16 also presents another measure of the utilization of ambulatory care: the percentage of active-duty patients who accounted for half of all visits. This figure averaged about 25% and was remarkably similar at all locations. It is also consistent with the experience of several civilian health insurance plans, suggesting that in all health care systems a minority of patients account for a majority of the visits.

At present almost all patients are seen by physicians (Table 5.1.17). Handicapped by the problems of retrospective medical abstract record reviews, we first attempted to identify those visits in which the patient obviously needed to see the patient. The criteria for this classification included, for example, all those with infections or ill-defined symptoms or complaints that suggested some form of organic disease. In addition to that number, 10% of the remainder, or those who could have been seen by nonphysicians, were added. For example, at Fort Dix, 9% of all visits were believed to

require the direct attention of the physician; 10% of the remaining 91% that could have been managed by nonphysicians were assumed to require some kind of consultation. Therefore, a total of 18% is indicated in Table 5.1.17. The percentage of patients that should be seen by physicians thus ranges from a low of 16% at Fort Bragg to a high of 31% at March-Norton.

About 10% of the visits at Fort Dix resulted in referrals; the majority of these could have been eliminated with the recommended ambulatory care facility proposed for training bases. Similarly, 8% of the visits at Parris Island were for referrals, and most of these would have been eliminated.

Table 5.1.18 provides information on the distribution of "diagnoses" made in the 2156 contacts. The variations reflect the nature of admissions and types of personnel served. In short-term training installations, approximately 70% to 80% of all visits are for musculoskeletal, respiratory, or dermatological problems; these ailments are responsible for 50% to 60% of visits on permanent bases. Within this triad, the distribution of complaints is quite similar, except for an increased number of respiratory tract infections at Fort Dix (to be expected on the basis of the characteristics of that population) and the frequency of musculoskeletel problems at Parris Island (also predictable because of the training). About 8% of visits were for ill-defined or neuropsychiatric problems. These data were used in determining the number and type of ambulatory care specialists required on training bases (Section 2.4).

5.1.4. DISPENSARY PROCESS STATISTICS

This section presents some relevant statistics on process rates and patient contact times, with particular emphasis on sick call. The estimates are based on observations made at the different dispensaries that we visited and data collected during our survey of outpatient records (Section 5.1.2).

In particular, we compare visits at a Fort Dix dispensary with those at Parris Island West End Dispensary. The dispensaries at Fort Dix have a pharmacy and minor lab facilities; physicians are available only during the morning sick call, until about 10:30 a.m.. Each dispensary at Fort Dix serves about 3000 to 4000 troops and is staffed with four to five corpsmen.

The Parris Island West End Dispensary serves approximately 7000 troops, has X-ray and lab facilities (which are referred to from the other dispensaries), and podiatry and surgical clinics (which are also referred to from other dispensaries). The surgical clinic handles minor orthopedic, surgical, and dermatological problems. Physicians are available all day. The dispensary also has an infirmary ward, which is not relevant to our current analysis. Staffing is approximately 20 personnel. The Parris Island Dispensary thus is, in effect, very close to our prototype ambulatory care center in services provided, but without the recommended staff organization.

5.1.4.1. Process Statistics

Table 5.1.19 shows process statistics for the Fort Dix Dispensary #2 (one-day sample) and Parris Island West End Dispensary (two-day sample). Virtually all patients at the Fort Dix Dispensary (95%) are seen during the morning sick call period, compared with 50% at Parris Island. Of the remaining 50% of the visits at the Parris Island Dispensary, 30% were to the Podiatry Clinic, and another 20% were sick call visits during the remainder of the day. In both instances 15% of patients were disposed of by corpsmen; about 85% of patients were also seen by a physician. Corpsman time per patient averaged about two minutes at Fort Dix Dispensary, with one corpsman screening, and five to six minutes at the Parris Island Dispensary, which had two or three corpsmen screening at sick call. Physician time averaged four minutes per patient seen during sick call at Fort Dix and about three minutes per patient at the Parris Island Dispensary sick call. Total average patient contact time was about six minutes at Fort Dix and seven to eight minutes at Parris Island, for corpsman plus physician time, per patient at sick call.

5.1.4.2. Prototype Dispensary

We expect the prototype ambulatory care center to operate in approximately the manner described below. (Details will differ somewhat from location to location, particular service, the nature of the base, kind of

military personnel being served, and the distribution of problems). The prototype care center will serve about 8000 troops, who will generate about 250 visits per day.

Table 5.1.20 compares process statistics for the proposed center with those for present Fort Dix dispensaries. Of the estimated 250 visits per day, between 50% to 60%, or 125 to 150, will be at morning sick call, which is normally compressed within a three-hour period (Table 5.1.19). The remainder of the visits will be for treatment of complaints such as orthopedic and podiatry ailments (about 20% to 30%, or 50 to 75, visits per day) and sick call visits during the rest of the day (about 20%). Currently, the average time taken by corpsmen to screen and dispose of patients at sick call is three to four minutes (Table 5.1.2). Physicians average three to four minutes per patient when they see a large portion (85%) of sick call patients and about six minutes otherwise. We consequently estimate that the average corpsman service time per patient seen will be four to five minutes.*

Thus, if corpsmen handle the majority of screening, certification, and disposition of patients, the average load per screening corpsman at sick call is 12 to 15 patients per hour. Each screening corpsman will therefore handle a total peak sick call load of 35 to 45 patients within a three-hour peak period, so four of them will be able to handle adequately the estimated peak sick-call load of 125 to 150 patients. In addition to the primary screening and disposition, some patients will, of course, be sent for treatment to the treatment rooms, for X-ray or lab tests, to the pharmacy for medication, or referred to the ambulatory care center physician.

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*These results are in agreement with a report entitled "An Evaluation of the Efficiency and Effectiveness of the Sick Call System and Facilities at Fort Benning, Georgia" by Robert A. Hille, LTC MSC. The study was based on general statistics at Fort Benning for the period 1966-1967 and particularly 13 April to 3 May 1968. Hille determined that patients seen by a corpsman had an average service time of 5.8 minutes. Patients seen by a physician had a service time of 6.5 minutes, which compares with 6.4 minutes reported for all training centers by Col. Devolites ("in Primary Medical Care of Recruits," an informal report). Considering only the basic trainees, these had a mean service time of 4.9 minutes with the corpsman and 4 minutes with the physician. A total of 26.7% of men on sick call were referred to the hospital; this included 10.7% referred to specialty clinics, 3.2% referred to lab, 9.4% to X-ray, and 3.4% to the hospital.

5.1.5. BRIEF REVIEW OF LITERATURE ON UTILIZATION OF PHYSICIAN SUBSTITUTES

One of our major recommendations is that physician substitutes be used to a greater extent to provide ambulatory services to active-duty personnel and to dependents and retirees in accordance with the phased program presented in Section 2.4. This section draws upon the existing literature to describe the content of ambulatory care in the civilian sector and the evidence as to the feasibility of certain changes in current, traditional methods of delivery of care. The selection of any, all, or none of the recommendations must rest with those who will implement and live with any changes made. Such decisions will be based upon the decision-maker's feeling of need for change as well as the volume and perceived validity of evidence offered in support of change.

Unlike research in biochemistry or pathology, for example, the body of existing literature on contemporary methods of providing health care is so meager that one frequently must begin at an elemental level, or else accept cumulative evidence from a variety of papers, any one of which may seem inconclusive but all of which suggest the same conclusions.

5.1.5.1. The Content of Medical Practice

In presenting evidence regarding possible restructuring of ambulatory care in the military service, we will cite data from studies on the content of: (1) pediatric practice, (2) obstetrical practice, (3) internal medicine (particularly chronic disease care) and (4) ambulatory care in general practice (all age groups).

5.1.5.1.1. Pediatric Practice

One of the first studies of the content of pediatric practice was by Aldrich, who accumulated data on the relative frequency of diseases and conditions he encountered over a period of several years.[1]* Forty percent

*See reference list at end of this section.

of the practice work was spent at preventive medicine and 23% in managing upper respiratory tract infections. A more detailed study was reported by Breese, et al. in 1966.[2] Seventy-five percent of all illnesses required only one physician visit; over a ten-year period the mean annual practice workload averaged 55 visits per day.

In 1966 Bergman, et al. reported a time and motion study of practicing pediatricians which has been much quoted.[3] Doctors spent 48% of their time with patients; 50% of patient contacts were well-child care and 22% involved minor respiratory diseases. Of relevance to the military services is a report of Geppert on the composition of pediatric practice at a permanent Army base in the antibiotic era.[4] One of the most recent and largest studies (Yankauer, et al.) surveyed all members of the Fellows of the American Academy of Pediatrics.[5] The study concluded that the content of pediatric practice is such as to make it possible and desirable to delegate approximately 70% of all ambulatory pediatric care to nonphysicians. The American Academy of Pediatrics has established a Committee on Health Manpower and is the most aggressive professional group trying to establish formal training programs that will produce nurse-pediatric practitioners and pediatric associates who will join them in patient care activities.

5.1.5.1.2. Maternal-Obstetrical Care

Nurse-midwives have practiced in developed countries, such as the United Kingdom, and in Eastern and Western Europe for decades. In the United States the Frontier Nursing Service of Appalachia has utilized nurse-midwives. There is a long record to substantiate the quality of care provided by them, in terms of end results (perinatal mortality, maternal mortality, obstetrical complications, etc.). Within the United States two recent demonstration projects have been reported. One entitled, "A Study of the Relative Roles of the Public Health Nurse and Physician in Prenatal and Infant Supervision" was conducted at Montefiore Hospital in New York City.[6] The primary contributions

of this program were to indicate that the majority of the patients in the study accepted the nurse (over 80% wanted her services again) and to describe the prenatal, postnatal, and infant supervision roles performed by the nurse. No obstetrical delivery service was provided by nurses.

The second study, reported by Montgomery, "The Case for Nurse-Midwives" describes their utilization in a rural California hospital faced with a chronic shortage of physicians.[7] During the study year only 360 births occurred. Half of the mothers were delivered by nurse-midwives. The perinatal mortality rate fell from 23.9 to 10.3 per 1000 live births, and prematurity rates dropped from 11% to 6.4%. There was no problem of acceptance by patients, and the percentage of patients seen in early stages of pregnancy doubled.

5.1.5.1.3. Internal Medicine - Chronic Disease Maintenance Programs

Studies of the office practice of internists have been published by Kroeger, Altman, and Clark.[8] It was determined that internists spent 22.6 hours in their office and 9.9 hours in the hospital each week and saw approximately 55 patients in the office, 5 in the hospital, and 5 in the home weekly. These studies were conducted in the early 1960's. A study by Steiger and Yates examined the characteristics and needs of new and old patients coming to the medicine clinic at Temple University.[9] Patients were classified according to their type of needs: specialized-technological-diagnostic on the one extreme, to primarily supportive on the other. The authors estimated that 90% of new patients coming to the medicine clinic needed technologically oriented care, but only 20% of those patients whose diagnoses were established needed such care. They estimated that 4800 of 8000 clinic visits per year (or 40%) "could be managed by nonphysician personnel."

In an experimental study, where internal medicine patients were randomly allocated to control or experimental groups, with measurement of processes, outcomes and other aspects of medical care as well as patient acceptance before and after one year of study, Lewis and Resnick demonstrated that patients who needed chronic disease management (specifically those

with hypertension, arteriosclerosis, several forms of arthritis, physiologic gastrointestinal disorders, obesity, and diabetes) could be managed more effectively and efficaciously by nurses than by clinic physicians.[10] A variety of cost and medical care outcome results favored the delegation of care of these patients to nurses providing care within a series of standing orders, and supported by backup physicians.[11]

5.1.5.1.4. General Practice

There have been more studies of the content of general practice than of any other form of medical care reported in the literature. Crombien reported studies showing the average general practitioner spent two thirds of his practice time in contact with patients.[12] A series of articles by Jacim (in 1966-69) reports results of a prospective record-keeping study in his own general practice.[13] Sixteen percent of the population accounted for 43% of all services rendered. Twenty percent of the practice work was for problems in which no diagnosis was established. This series of articles is commended as examples of the methodology which can be utilized in this field.

Brotherston, et al., reported on general practice in a new housing estate (a population that had recently been rehoused)[14]. A very detailed study was performed. Among the findings: 7% of patients generated 30% of physician visits; 70% of the illnesses required a single visit. A series of studies by Hunt and Goldstein[15] published in 1950 pointed out that skin disorders and trauma were the most frequent diagnostic categories noted in a general practice.

Studies by Logan reported in 1962 gave an average consultation rate in a general practice of 3.8 visits per person. Twenty-three percent of all consults were for upper respiratory disease.[16]

The largest general collection of information on the content of medical practice is published by the National Disease and Therapeutic Index[17] (published quarterly since 1956). A random sample of private practitioners listed in the AMA directory are contacted (about 70% contacted participated; nonrespondents are replaced in the sample); data are collected from 1500

physicians quarterly; diagnoses are recorded by four-digit categories used in the International Classification of Diseases Adapted (ICDA) for hospitals. The following data indicate the type of information available.

- In the year ending December 1968, national estimates (based on their sample) indicate that 1,343,464,000 patient visits were made to physicians in private practice. Thirty-two percent were first visits; 74% took place in physicians' offices. These visits included all age groups and all social classes.
- During 1968 approximately 25% were for examinations, prenatal care, inoculations, vaccinations, and surgical aftercare.
- Approximately 11% of all visits were for diseases of the respiratory system, and over 80% of these were for short-term acute respiratory disease.
- About 10% of the visits were for diseases of the circulatory system, of which over two thirds were chronic.
- Approximately 8% were for dermatologic problems and those associated with the musculoskeletal system, another 8% for injuries, 6% for genitourinary problems, and 5% for gastrointestinal problems.

A recent time and motion study of general practice was conducted by Jason and Craig.[18] They observed eight general practitioners; 693 patients' visits were recorded and analyzed. The average doctor saw 26 patients per day in his office for an average of 8.1 minutes each. Sixteen percent of th time was spent in history taking, 38% in examining and treating the patient, 33% in discussion, and 11% in other activities. They concluded that a minimum of 20% of the patient care provided by physicians could have been delegated to nurses, including two thirds of follow-up, three fourths of dermatological care, and all well-baby care.

Crombian and Cross studied the contribution of the nurse in general practice by classifying 5406 episodes of care into groups in which (1) a nurse could take full responsibility, (2) situations where a nurse could make contributions but the attention of the physician was required and (3) those conditions where the physician was involved exclusively.[19] Conditions grouped into the first category were (a) mild infection of the upper respiratory track, common colds, coughs, and sore throats, with little or no constitutional upset or fever; (b) mild gastrointestinal disturbances, nausea, vomiting, and

diarrhea with no severe abdominal pain or fever; (c) minor traumatic lesions, bruises, cuts, sprains, and abrasions, excluding those which needed surgery; and (d) minor inflammatory lesions of the skins, sties, boils, insect bites, furuncles, paronychia, etc. They included in group 2 (services delegated to nurse after patients had been seen by a doctor) general advice on diet, obesity, peptic ulceration, baby feeding, use of hypodermic syringes for drugs, self administration of drugs, prescriptions, dressings, abrasions, removal of stitches, subcutaneous and intravenous injections, and other simple procedures such as analysis of urine samples, collection of vital signs, etc. (This is a very conservative approach to delegation.) As a result of their analysis of 5406 episodes, they came to the conclusion that the nurse could take full responsibility for 15.6% and assist in an additional 23.7%, or a total of 39.3 % of all episodes. This was estimated by them to result in a 19.2% reduction in the physician's time required. For example, they would have delegated 17% of all skin and connective tissue problems, 17% of all gastrointestinal problems, and 60% of all ear, nose and throat and respiratory problems; furthermore, they would have involved the nurse with the physician in 20% to 40% of all additional complaints in these same categories.

The most recent study of the delegation of primary care to nonphysicians is an experiment being conducted by the University of New Mexico.[20] In Estancia, New Mexico a local retired nurse has been trained to serve as a substitute for a physician in a community of 800 in a county of 6000 which is totally without any physician's services. Under the protocol, the nurse-practitioner provides direct service, operates with standing orders, and has a contact via telephone with a backup physician at the University. She "saves" patients to be seen by a physician once a week or, under certain circumstances, refers them directly to a physician for more immediate care. The program appears to be functioning well; over two thirds of all complaints are being handled on the spot by the nurse-practitioner, another significant fraction handled by remote consultation, and a few held for the physician's visit or referred in.

A number of formal programs to train physician assistants are currently underway,[23] and many more programs are being contemplated.

TABLE 5.1.16

PHYSICIAN REVIEW OF ACTIVE-DUTY PATIENT RECORDS

	Fort Dix	Fort Bragg	Parris Island	Mayport (Destroyers)	March-Norton	Total
No. of Records	148	187	195	71	68	669
No. of Visits	404	609	514	251	378	2156
Time Period (weeks)	8	8	8	52	52	
Average Visits Per Patient	2.7	3.3	2.6	3.5	5.6	
Percent Single-Visit Episodes	62	74	74	66	63	68
Percent Account for 1/2 Visits	23	23	25	23	25	24

TABLE 5.1.17

PHYSICIAN REQUIREMENTS - AMBULATORY SERVICES

(percent of visits)

	Dix		Bragg		Parris Island		Mayport Destroyers		March/ Norton	
Current Practice	80		90		70		100		100	
Proposed	18		16		23		23		31	
Needed		9		7		15		15		23
Confirm Referral		9		9		8		8		8
Clinic Referrals	1		1		2		3		6	

TABLE 5.1.18
DISTRIBUTION OF CHIEF COMPLAINTS
(percent)

	Dix	Bragg	Parris Island	Mayport Destroyers	March/ Norton	Average
Musculoskeletal	35	30	53	34	34	37
Injury	3	13	39	20	16	
Pain in extremity	31	15	12	8	8	
Low back pain	1	2	2	2	10	
Pain/stiffness of neck	0	0	0	4	0	
Respiratory	39	23	16	15	13	21
Cold/cough/ sore throat	38	23	15	15	13	
Chest pain	0	0	0	0	0	
Short of breath	1	0	1	0	0	
Dermatological	7	13	10	4	8	8
Gastrointestinal	6	5	4	4	6	5
Diarrhea	1	1	2	2	2	
Pain in belly	4	2	2	0	2	
Loss of appetite	0	0	0	0	0	
Heartburn/gas	1	1	0	2	1	
Rectal	0	1	0	0	1	
Genitourinary	2	13	6	6	8	7
Pain urinate	2	12	3	4	5	
Swelling/pain testicle	0	1	3	2	3	
Other	11	16	11	36	31	21
Headache	2	4	1	4	2	
Eye	1	2	1	2	7	
Ear	0	1	1	1	7	
Fainted	0	0	0	2	0	
Ill-defined neuropsychiatric	8	7	8	8	9	
Routine checks	0	2	0	19	6	
TOTAL	103	100	100	99	100	99

TABLE 5.1.19

PATIENT CONTACT TIMES AT
DISPENSARY MORNING SICK CALL - RECRUIT BASE
(treatment time excluded)

	Fort Dix Dispensary #2	Parris Island West End Dispensary	
Date	16 Feb. 1970	28 Jan. 1970	12 Feb. 1970
Population at Risk	4000	7000	7000
Corpsman Hours	6:30 - 9:50 a.m.	7:30 -10:30 a.m.	7:30 -10:30 a.m.
MD Hours	8:00 -10:30 a.m.	8:00 -10:30 a.m.	7:30 -10:30 a.m.
Total Patients per Day*	92	265	365
Number at Sick Call	87	125	186
Percent Peak Sick Call	95%	47%	51%
Podiatry Clinic Visits Percent		76 29%	115 31%
Number of Corpsmen (Screening Only)	1	4	5
Corpsmen Minutes	200	720	900
Corpsmen Time per Patient (min.)	2.3	4.8	5.8
Number Seen by MD's	75	105	156
Percent Seen by MD's	86%	84%	84%
Number of MD's	2	2	3
MD Minutes	300	300	450
MD Time per Patient Seen (min.)	4.0	2.9	2.9
Total Average Patient Contact Time (min.)	5.8	7.3	8.2
Referrals**	19%	8%	

* Includes Podiatry Clinic at Parris Island
** Table 5.1.10, "Referrals to Hospital Clinics"

TABLE 5.1.20

COMPARISON OF PROCESS

	CURRENT (Fort Dix)	PROPOSED
Population at Risk	4000	8000
Visits per Day	125	250
Percent Seen by MD	85%	20%
Referrals to Hospital Outpatient Department	20%-25%	10%
Sick Call		
No. at Sick Call	85	150
Screening Corpsmen	1-2	3-4
Average Contact Time per Patient Seen (min.)		
Corpsman	2-5	5
Doctor	2-4	3
Total	5-8	6

5.1.5.2. Utilization of Care by Age and Sex

Americans now visit their physicians, on the average, between five and six times per year. The number of visits per year increases with social class. Those under four and over sixty also have higher rates of visitation. The females in the child-bearing population range also average more visits. (For example, women 20-34, seven to eight per year; males over 60, seven per year; females over 60, ten per year.) The lowest utilization rate is for males between the ages of 15 and 30, whose average is half that for the population in general, or three to four visits per year.[21]

One of the most detailed and recent summarizations of utilization patterns and illness rates has been published by Avnet.[22] This paper includes details on utilization rates for X-rays. For example, males between 25 and 34 in the plan under discussion use X-rays at the rate of 180 per 1000 men per year. This would mean about 20% of the population under care would be X-rayed during the year. The same data on laboratory service utilization would suggest that about 55% of a male population of that age group would have one or more laboratory procedures during a year's time. For males between 25 and 34 (from that same population), the distribution of reasons for seeing the physician was as follows:

30% of all visits were for respiratory diseases

5% to 9% were for dermatological problems

17% to 18% were for musculoskeletal problems

8% were for gastrointestinal problems

2% were for urinary tract problems

These data are cited to permit comparison with the data cited from bases surveyed, for males of the same age group. Incidentally, about 5% of males from 25 to 34 cared for under group health insurance are hospitalized during any one year.

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5.2 DENTAL ASSISTANTS

5.2.1. INTRODUCTION

The use of dental assistants to provide certain elements of dental care can be justified by benefits that are similar to those gained by the use of ancillary personnel for certain elements of medical care: (1) the cost of dental care will be less, and (2) fewer dental officers, who are in short supply[1] will be needed. Where dental assistants have been used on a trial basis, both these expectations have been realized.

The use of an assistant for operative dentistry is now common practice in the military services, and it yields both improved quality and faster work. In this role, assistants clean teeth and help the dentist in his work. There have been experiments, however, in which assistants are used for more exacting tasks and work without the immediate supervision of a dental officer.

Certain aspects of dental care, particularly placing, shaping, and smoothing restorations, lend themselves to using assistants less highly trained than a dentist. If these procedures are done badly, it is fairly easy to detect the flaws by inspection afterward, and the work can be redone. Thus, it is surprising that there is not more widespread use of dental assistants for placing restorations. Extensive inquiries into modern dental practice in the military services show that this innovation would be both possible and practical[2]. The idea is particularly attractive because most dental work on military personnel is of precisely this kind.

A second innovation is less fundamental but nonetheless significant: namely, to design the operatories in a configuration which facilitates the movements of a dentist supervising and working with several assistants while carrying out dental procedures on several patients at a time. Circular operatories,[3,4,5] in which the rooms are arranged in a fan around a central hub, are markedly superior in terms of productivity to conventional operatories strung along a hallway.

Three studies which provide quantitative information on the impact of these two innovations on the productivity of dental officers.

practicing restorative dentistry are reviewed below. On the basis of these findings and a review of other related studies,[6,7] we have analyzed the costs of dental care. These studies are not above criticism -- for example, those described in the next two sections were not "blind," and it can be argued that the increase in productivity when more assistants are used is due solely to the fact that subjects knew they were to be evaluated. Therefore, the specific results are controversial. However, while some of the numbers may be in error, the conclusion to be drawn from them is virtually inescapable: the cost of providing dental care for military personnel can be reduced by using dental assistants in the roles described below.

5.2.2. CLINICAL TESTS AT NAVY DENTAL RESEARCH FACILITY, GREAT LAKES, ILL.

During 1962 and 1963 a group of dentists under the direction of Captain William E. Ludwick, DC, USN, undertook a controlled and objective experiment to shed some light on the quality of work which could be expected of technicians and the quantity of work which could be expected from dentists assisted by technicians using various numbers of operatories[8].

The technicians who participated in this study received special training beyond that received by most dental technicians. All twelve (seven men and five women) had completed the 16-week Navy Dental Technician Training Course but had no further formal training. They ranged in age from nineteen to twenty-three; all were high school graduates, and two had some college education. One had been a dental technician for 23 months, another for 16 months, a third for 6 months, and the others for less than 3 months.

The curriculum for further training was designed to teach the following procedures:

- Placement of a rubber dam
- Placement of cavity liner and base
- Placement of matrices
- Silver amalgam placement
- Carving amalgam restorations
- Placement of silicate restorations

- Placement of temporary restorative materials
- Finishing and polishing restorations.

The course consisted of 150 hours of lecture, laboratory, and clinical training and was given in five weeks.

The experiment was conducted in three phases, each of 12 weeks' duration, called Test A, Test B, and Test C. Test A involved three dentists who were rotated through the three different "systems" described below, so that each officer spent four weeks under each system.

(1) One dental officer and two technicians worked at a single chair using conventional treatment procedures (that is, no treatment procedures were delegated).

(2) One dental officer and three technicians worked at two chairs, with the technicians inserting the restorative materiel in teeth prepared by the dental officer. (That is, the technician placed the base if required and, following inspection by the dentist, put in and shaped silicate or amalgam fillings, which were checked by the dentist.) One technician was assigned to each chair; the third was a rover, assisting the dentist or the other technicians as necessary.

(3) One dental officer and four technicians worked at three chairs, and technicians performed the same insertions as in System 2. Again, one of the technicians was a rover.

The patients, who were recruits undergoing basic training at Great Lakes, required an average of eight restorations. Most did not require complicated restorations but rather routine or moderately complex work. In recording results - that is, productivity as measured by restorations per hour - the actual number of hours worked was used, excluding idle time occurring because patients missed appointments. Not surprisingly, the productivity increased as more chairs and technicians were used, as shown in Table 5.2.1.

TABLE 5.2.1
RESULTS OF TEST A

	System 1	System 2	System 3
Dental Officers	1	1	1
Chairs	1	2	3
Technicians	2	3	4
Average Restorations per Hour	2.6	3.8	5.2
Increase over System 1	-	46 %	100 %

Thus, Test A showed that a dentist's productivity could be increased by using more assistants.

Test B was conceived to establish how much it could be increased by using still more assistants. For this test, Systems 2 and 3 from Test A were repeated, and System 4, consisting of one dental officer, four chairs, and five technicians, were added. The productivity under these systems is shown in Table 5.2.2.

TABLE 5.2.2
RESULTS OF TEST B

	System 2	System 3	System 4
Dental Officers	1	1	1
Chairs	2	3	4
Technicians	3	4	5
Average Restorations per Hour	4.9	5.5	6.3
Increase over System 1	89%	112%	142%

Note that the increases under Systems 2 and 3 in Test B were greater than in Test A; presumably, these differences are due to learning.

Despite the favorable results of Test B, the dental officers concluded that operating with four chairs was excessively stressful for the dentist and the use of three chairs was better. This was done throughout Test C, which was intended to demonstrate that a dentist could operate with three chairs for a long period without excessive stress. All of the dental

officers participating (the original three experimenters plus several others who were used as substitutes when necessary) concurred that the three-chair system was not fatiguing or stressful. Furthermore, the increases in productivity were sustained throughout Test C.

At the conclusion of Test C the restorations were evaluated by independent consultants, who examined not only the patients who had participated in the test but also a control group of patients; the latter had been given conventional treatment, some by dentists who knew their results were to be evaluated (known control) and the others by dentists who did not know this (unknown control). The evaluations, made by consultants who did not know from which of the three groups the patient had come, showed that restorations made by technicians were only slightly inferior to those made by dentists who knew they were to be evaluated. (See Table 5.2.3) Dentists who did not know they were to be evaluated did noticeably more poorly than the other two groups. The evaluations did not consider the quality of cavity preparation.

TABLE 5.2.3
EVALUATION OF RESTORATIONS
(% of total)

Group	Unsatisfactory	Fair	Good	Excellent
Experimental	2	15	50	33
Known Control	2	9	56	33
Unknown Control	5	24	60	11

5.2.3. CONTROL STUDY AT PUBLIC HEALTH SERVICE, DENTAL DEVELOPMENT LABORATORY LOUISVILLE, KENTUCKY

In this study the use of teams of specially trained "clinical dental assistants" was evaluated.[9] Each team was headed by a dentist who provided immediate supervision. A unique feature of the treatment area was the arrangement of dental operatories in the shape of two large "wheels", each consisting of eight operatories surrounding a central supply and sterilization area. One of the wheels had conventional operating equipment and was designated the control wheel; the other was an experimental wheel - that is, it contained some custom equipment and permitted experimentation

in the arrangement of operating facilities. The investigation started in 1965 with a "baseline study", during which the proficiency and productivity of dentists working in the conventional manner was established. The conventional team consisted of one dentist and one chairside assistant without special training, using two operatories. One roving assistant, a receptionist, a clerk, and a sterilization aide provided support for four such dental teams. Thus, each team had the equivalent of one support assistant.

The dental assistants were then given special training to perform selected additional procedures including placing, shaping, and smoothing restorations. They were then employed in experimental teams in a patient service program, each team consisting of a dentist and specially trained auxiliaries. Measurements of team performance were then made and compared with the baseline data.

During the experimental phase of the study, assistants performed procedures that accounted for over two-fifths of the total time in Phase I, which included over half of the time devoted to admission procedures in operative dentistry, nearly half of the time spent in performing basic procedures, and over two-fifths of the time devoted to preventive dentistry. An evaluation panel was established, composed of private practitioners, dental educators, and state dental board examiners, to make an independent evaluation of the clinical work being performed.

During the first experimental phase, the performance of teams consisting of a dentist and four assistants was evaluated. Each team also included a roving assistant, primarily to serve as backup to the other four dental assistants. Nearly 40,000 chairside procedures were performed, timed, and compared with the baseline measurements of the first phase. The results are summarized in Table 5.2.4. Three methods of analysis were used to measure the productivity: number of patients seen; number of dental procedures performed; and number of time points, which are weighted values assigned to procedures, on the basis of average baseline time required by the dentists to complete the procedure. As indicated, the dental teams with four trained assistants saw approximately twice as many patients and performed more than twice the number of procedures and time points as the baseline teams.

TABLE 5.2.4
PRODUCTIVITY OF DENTAL TEAMS

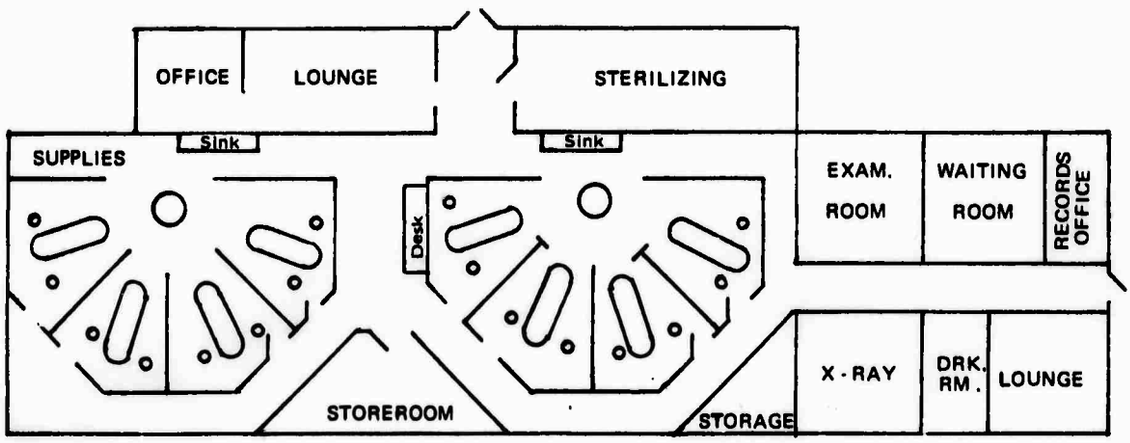
	Baseline Team	Expanded Team
Patients per Day	9.8	20.3
Procedures per Day	43.4	103.6
Time Points per Day	239.5	555.0

Almost 88% of the procedures performed by assistants and evaluated during the experimental phase were judged to have met the required standards for quality of work performed. This percentage not only equalled but somewhat exceeded the acceptability rating for the dentists who participated in the baseline. For every procedure except one, the quality of work performed by assistants was judged at least equal to that performed by the dentists in the baseline phase.

The study concluded that the experimental program had shown that trained dental assistants are able to perform delegated functions as well as the dentists, although more time may be required. With a team of four assistants, a dentist could increase his productivity by as much as 140% by delegating certain functions to the assistants. Preliminary results of additional work in which the team consists of three dental auxiliaries and three operatories per dentist team demonstrate an 80% increase in productivity over the baseline study.

5.2.4. CLINICAL TESTS AT NAVAL TRAINING CENTER, ORLANDO, FLORIDA

The dental clinic at the Naval Training Center, Orlando, Florida, includes both conventional operatories and a new layout, called circular operatories.[3] The circular layout, shown in Figure 5.2.1, uses eight chairs and eight dental officers, each of whom practices four-handed dentistry with a chairside assistant. In addition, there is one "roving" technician and two technicians who operate a central sterile supply room. Thus, the eight chairs are served by eight dentists and 11 technicians. Unlike the experiments at Great Lakes, the technicians did not have any special training beyond the 16-week Naval Dental Technician Course. Staffing in the conven-



Source: Courtesy of Lt. Raymond A. Yukna, DC, USNR

FIGURE 5.2.1 CIRCULAR DESIGN DENTAL CLINIC

tional layout was the same, but the operatories were arranged along a corridor with no convenient communication between them except by going out into the corridor.

During the period from August 1969 to February 1970, data on productivity were gathered by Lt. Raymond A. Yukna, DC, USNR. The dentists did not know that their productivity was to be evaluated; the daily worksheets served as the source.[4,5] Data on both restorations and procedures (in operative dentistry) were collected. The productivity of dentists by either measure increased when they used the circular operatories. The data in Table 5.2.5 compare the productivity of the same dentist working in the two different settings.

TABLE 5.2.5
EFFECT OF LAYOUT ON TOTAL NUMBER OF PROCEDURES PERFORMED

	Restorations	Operative Dentistry Procedures
Conventional Layout	214	397
Circular Layout	280	503
Increase	31%	27%

To compare these data with others, we have converted the productivity in restorations per month to restorations per hour, using 121 working hours per month. This is based upon 168 hours per month less 10% for leave, holidays, and illness less 20% of the remainder for lost time due to broken appointments. (These figures were chosen after consultation with the author of References 4 and 5).

Some have argued that the increases in productivity reported here are due solely to the addition of a "roving" assistant. With available data one cannot refute that assertion, but it must be admitted that circular operatories facilitate the use of a rover, and convenience in moving from chair to chair for the dentist or the roving assistant is the only advantage claimed for the new configuration.

TABLE 5.2.6
EFFECT OF LAYOUT ON NUMBER OF
PROCEDURES PER HOUR

	Restorations per Hour	Operative Dentistry Procedures per Hour
Conventional Layout	1.8	3.3
Circular Layout	2.3	4.2
Increase	31%	27%

5.2.5. COMPARISON AMONG EXPERIMENTS

It is clear from the descriptions of the three experimental programs at Great Lakes, Louisville, and Orlando that the results are not strictly comparable. However, it is possible to put the results in a form that permits rough comparisons of the productivity of a dentist using various numbers of operatories, supported by various numbers of assistants, and working in a conventional or a circular layout.

From the Orlando data, where productivity was measured by counting both restorations and procedures, we obtain a measure of the ratio of procedures to restorations: the value is 1.85 for conventional operatories and 1.80 for circular operatories. Accordingly, we can convert the data gathered at Great Lakes to procedures per hour by multiplying by 1.8. This puts productivity in each of the three studies on the same basis. Admittedly, this comparison is forced because it is not clear whether "procedures" in each study were defined on the same basis, and this detailed information is not available. However, even though particulars in the arguments advanced may be incorrect, the comparison does shed some light on results to be expected using more assistants.

To obtain annual costs for providing dental care as specified, we took the annual salary of a dental officer as $14,000. For dental technicians, we reasoned as follows: The basic training for a dental technician varies in length among the services from nine to sixteen weeks. Costs are difficult to estimate, but discussions with officers in each of the services produced figures between $2500 and $4000, including pay (for an E-3) and travel. We used $3000. Since dental technicians find their training valuable in

civilian life, many leave the service at the end of their tour of duty. Thus we placed the annual cost of a technician at $1000 plus his salary. For technicians with basic dental training, we used $5600 per year and for those with advanced training, $7000 per year.

Costs for operatories include the cost of chair, console, lights, and other equipment, as well as the cost of the building. Equipment costs were established by inquiries to a number of suppliers and dentists, who provided estimates between $6000 and $9000 per operatory. Depreciating the equipment costs over ten years yields an annual cost between $600 and $900; we used $750. Each conventional operatory occupies about 125 square feet. Using a capital cost of $50 per square foot yields a total cost of $6250. Taking a 25-year life for the building leads to an annual amortization cost of $250. Including waiting areas, sterilization rooms, and other support area adds an equal area, and so we have used $500 for the space plus $750 for the equipment to arrive at the total cost of $1250 for the amortized cost of a conventional operatory.

The circular operatories use up somewhat more space because of their central hub area and because of the peculiar shapes of the rooms. The odd shape also increases building costs somewhat, so we have used $1500 as the annual amortized cost of a circular operatory.

These costs are summarized in Tables 5.2.7 and 5.2.8, which show annual costs, productivity, and cost per procedure (using, for the last figure, 1500 working hours per year, which is 52 weeks times 40 hours per week, diminished by 10% for leave, holidays, and illness, diminished by 20% for broken appointments).

On the basis of these studies and our analysis, the lowest cost per restoration in conventional operatories occurs when each dental officer has three assistants who, besides their usual duties, also place restorations. The data also show that costs per restoration are reduced still further by using circular operatories. Despite the fact that Table 5.2.8 shows still further decrease in cost when four operatories are used, the remarks of the Great Lakes experimenters that four chairs created undue stress should be borne in mind. (They observed, for example, that using four chairs forced them to wash their hands 60 times a day.)

TABLE 5.2.7

COMPARISON OF PRODUCTIVITY AND COSTS IN CONVENTIONAL OPERATORIES

	Orlando	Great Lakes	Great Lakes	Great Lakes	Great Lakes
Dentists	1	1	1	1	1
Operatories	1	1	2	3	4
Chairside Assistants	1*	1	2	3	4
Support Personnel	3/8*	1	1	1	1
Procedures per Hour	3.3	4.7	6.8	9.3	11.0
Annual Cost ($000)	22.9	29.2	37.5	45.8	54.0
Cost per Procedure ($)	4.63	4.14	3.68	3.29	3.27

TABLE 5.2.8

COMPARISON OF PRODUCTIVITY AND COSTS IN CIRCULAR OPERATORIES

	Orlando	Louisville	Louisville	Louisville
Dentists	1	1	1	1
Operatories	1	2	3	4
Chairside Assistants	1*	1*	3	4
Support Personnel	3/8*	1*	1	1
Procedures per Hour	4.2	6.8	12.0	16.1
Annual Cost ($000)	23.2	28.2	46.5	55.0
Cost per Procedure ($)	3.68	2.76	2.58	2.29

*assistants not given special training

5.2.6. IMPACT OF CHANGES IN USE OF DENTAL ASSISTANTS

The possible impact of these innovations at Fort Dix, Jacksonville NAS, and March AFB is not easy to assess, because practices in the various dental facilities on these bases vary greatly. Most of the restorative dentistry observed, however, was similar to that practiced at the Naval Training Center at Orlando. Estimates of the proportion of time the dental officers spend in restorative or general dentistry have been made by officers in charge. The number of full-time equivalents thus engaged in each location is given in Table 5.2.9. From Tables 5.2.7 and 5.2.8 the increase in productivity by using four assistants in three operatories in a circular arrangement over that at Orlando in a conventional operatory is 12.0/3.3 or 360%.

This calculation implies that the staff of dental officers engaged in restorative dentistry could be cut to less than a third of its present size, if a larger staff of better trained assistants were used. The impact of these changes is summarized in Table 5.2.10.

TABLE 5.2.9

DENTAL OFFICERS AND ASSISTANTS PRESENTLY ENGAGED IN GENERAL AND RESTORATIVE DENTISTRY

	Ft. Dix	Jacksonville NAS*	March AFB
Total dental officers	58	32	13
Total of other professional staff (assistants)	109	45	43
Dental officers engaged in general or restorative dentistry	40	19	9
Chairside Assistants engaged in general or restorative dentistry	40	19	9
Support personnel	15	7	3

*Includes the Jacksonville Naval Hospital and dental clinics at Jacksonville NAS, Cecil Field, and Mayport.

TABLE 5.2.10

DENTAL OFFICERS AND ASSISTANTS UNDER PLAN MAKING MORE USE OF ASSISTANTS

	Ft. Dix.	Jacksonville NAS	March AFB
Total dental officers	32	20	7
Total of other professional staff (assistants)	125	54	46
Dental officers engaged in general or restorative dentistry	14	7	3
Chairside Assistants engaged in general or restorative dentistry	42	21	9
Roving Assistants	14	7	3
Support personnel	15	7	3

The total impact on annual costs can be derived from these tables. For example, at Fort Dix the 40 dental officers engaged in general and restorative dentistry can be replaced by 14 dental officers and the indicated number of assistants. Using the annual cost per dental officer at Orlando of $22,900, the total cost of general and restorative dentistry at Fort Dix under present conditions is 40 times $22,900, or $918,000. Under the proposed system (typified by Louisville) the annual cost per dental officer would be $46,500, and the total would be 14 times this amount, or $651,000. Thus the total annual saving would be the difference, or $267,000. If we do not include amortization of the capital investment in the computation, then the annual savings in operating expenses are $280,000. However, the capital investment is increased from $20,000 per operatory to $26,250 per operatory. Similar calculations lead to the results in Table 5.2.11.

TABLE 5.2.11
SAVINGS ATTRIBUTABLE TO MORE USE OF DENTAL ASSISTANTS

	Ft. Dix	Jacksonville NAS	March AFB
Annual savings in operating expenses ($000)	280	118	69
Savings in capital costs (space and equipment) ($000)	(302)	(129)	(56)
Annual savings including amortization of capital costs ($000)	267	107	64

For the sake of argument, we have used the presumed increase in productivity to reduce cost of dental care, holding the amount of care constant. It might be more desirable to use increased productivity to provide more care, since many military personnel need more dental work than the present system provides. This choice depends on local circumstances.

Some critics of the experiments cited here have argued that the observed increases in productivity were born of temporary enthusiasm of participants, and that, if the practices recommended here were adopted on a wide scale, the observed increases would not be sustained. There is no answer to this criticism, because evidence for either the assertion or its contrary does not exist. However, the data cited are convincing enough to conclude that the ideas of using more assistants in the roles described and of using circular operatories deserve further evaluation in a larger scale experiment.

5.2.7. REFERENCES

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5.3. NURSING SERVICES

5.3.1. INTRODUCTION

Nursing services are one of the largest items in the operating budgets of military hospitals. For this reason they are an attractive area in which to seek improvements in operating efficiency without compromising the quality of care. We have identified one important way to achieve this goal by building what we have called a light care facility, described in Section 2.3. Patients who were previously scattered through the hospital in different wards are collected into a single area identified as one in which almost no nursing care is necessary. By separating patients into two groups - those requiring nursing care and those not - hospitals obtain a number of benefits besides reduction of the nursing staff; these have been discussed in connection with the light care unit.

However, beyond the removal of patients who do not need nursing care from the acute care hospital, it seems important to seek other economies in providing nursing services. The possibilities in this direction are many:

- Changes in physical layouts intended to minimize walking distance or to improve supervision and discipline;
- Changes in staffing, such as using more nurses' aides, ward clerks, or wardmasters;
- Changes in organization, such as using "floaters" to augment staff wherever needed;
- Aids to scheduling patients and nursing staff, paticularly computer aids which balance patient needs and staff availability;
- Novel room arrangements, such as making the wall of a patient's room facing the corridor out of glass so that a passing nurse can see in, thus providing reassurance;
- Labor-saving schemes, such as cupboards in each room which contain all necessary supplies and are filled from the corridor;
- Elaborate communication systems, such as bedside closed-circuit TV and intercoms;

- Schemes to reduce a nurse's paperwork by providing either "mark sense" forms or computer-based information systems;
- Changes in policies for obtaining nursing personnel, for tours of duty, and for salaries; and
- Selection of the "optimum" (most efficient) size ward or the "optimum" number of beds per room.

We have examined all of these possibilities, some in considerable depth, and some in more cursory fashion. Visiting inspection teams can always find room for improvement in nursing staffing or nursing practices in particular hospitals, such as unnecessary paperwork, unnecessary travel, persons assigned to jobs for which they were not trained, and similar flaws. We found a certain number of such problems. However, they are local problems and not systematic defects. However, when we turn our attention to system changes -- that is, significant changes in nursing staffing or nursing practice -- we have concluded that there are few changes which offer promise of making significant inroads on the cost of nursing services. Nevertheless, there are some improvements possible, and in the remainder of this section we explore some of the possibilities which may bring modest savings to nursing services.

5.3.2. NURSING SERVICES AT THE THREE HOSPITALS

Table 5.3.1 presents some relevant statistics on nursing staff at the three hospitals. The individual figures are only approximate, because the number of staff and their assignments vary from time to time depending on staff authorizations and assignments. Overall, there are about 1.5 patients per member of the nursing staff at Walson, 1.6 at Jacksonville, and a significantly lower number, 0.7, at March. Considering only the nursing staff members assigned to ward duty, Walson has an average of 1.9 patients per nursing staff member, Jacksonville about 2.2, and March about 1.1.

TABLE 5.3.1

TOTAL NURSE STAFFING

	BEDS AVAILABLE	AVG. OCC. CENSUS	TOTAL NURSE STAFF ACT.	WARD STAFF	RN WARD STAFF	RN/ TOTAL WARD STAFF	CENSUS/ WARD STAFF	CENSUS/ TOTAL STAFF	NURSE HOURS/ PATIENT/ DAY
Fort Dix	900	570	388	300	97	32%	1.9	1.5	3.0
Jacksonville	484	330	206	153	57	37%	2.2	1.6	2.7
March	175	145	215	134	46	34%	1.1	0.7	5.3

This is equivalent to provision of about 3 nursing hours per patient per day at Walson and Jacksonville hospitals, and about 5.3 nursing hours per patient day at March AFB Hospital.

A direct comparison of these ratios is somewhat misleading, because of different utilization of holding company (convalescing) personnel, responsibilities for housekeeping duties, severity of illness of patients, seasonality of census, and fraction of the patient population represented by dependents and retirees.

A direct comparison with civilian usage of nursing staff is also somewhat difficult, because of some special circumstances:

- Turnover of staff in military hospitals tends to be high.
- There is thought to be some need to use military nurses in units that have primarily military patients and to use civilian nurses in units that have mainly dependents, which reduces flexibility of nursing assignments.

Table 5.3.1 indicates that in all three hospitals registered nurses (including military and civilian personnel) account for about one-third of the ward staff, for a ratio of about two non-RN staff for each RN. This is an unusually low ratio of nonprofessionals to professionals; in acute general hospitals, ratios of four or five to one are more common. This suggests that

there are opportunities to reduce the requirements for registered nurses by transferring some of their duties to nonprofessional nursing personnel. We discuss several possibilities below.

5.3.3. WARD CLERKS AND UNIT MANAGERS

There is very little utilization of ward clerks in the military hospitals that we have visited. It has been pointed out to us by virtually all the directors of nursing at these hospitals and by the chief nurses of the Army, Navy, and Air Force that there is a major need for ward clerks, who would handle telephone calls, routine correspondence, arrangements for lab tests, many of the clerical duties associated with nursing notes and new charts, filing of lab and X-ray results, census sheets, diet orders, etc. They could be used effectively not only on the day shift but, in many instances, on the evening shift as well.

We estimate that at a minimum (one-shift basis), one ward clerk can be utilized efficiently by every unit of, say, 50 beds. If, as we hypothesize, half the present beds were in a light care unit, Walson Army Hospital could utilize approximately ten ward clerks, Jacksonville five, and March about three. The cost difference between nursing staff and ward clerks would be about $3000 per year, so that in addition to reducing the requirements for trained nursing staff, utilization of ward clerks would save $30,000 per year at Walson, $15,000 at Jacksonville, and $9000 at March.

As far as we have seen, the Army is the only service using unit managers (wardmasters) to any extent. Even this program is not being implemented as well as it might, because of the reluctance of registered nurses to give up their administrative functions. Below we present a suggested list of duties for unit managers.

- Patient Services
  - Publications
  - Coordination of services
  - Coordination of patient treatments and tests
  - Direction and supervision of ward clerks and couriers

- Patient Logistics
  - Admissions
  - Transfers
  - Discharges
  - Coordination of traffic
- Physical Environment
  - Housekeeping - Supervision of maids and porters
  - Repairs
  - Bedside equipment - replacement
  - Budget
- Supplies and Equipment
  - Check supplies
  - Requisition
  - Investigate
  - Storage
- Nonmedical Communications
  - Patients and families
  - Liaison with other departments

Unit managers with the responsibilities indicated presumably would relieve an equal number of registered nurses, who could either be replaced or could devote their time to patient care activities instead of administrative functions. The number of unit managers that can be effectively utilized in each of the hospitals would be equal to the number of ward clerks outlined above, and similar savings would accrue (except, of course, in the Army, which already uses wardmasters).

5.3.4. NURSING FLEXIBILITY

There can be large fluctuations in unit patient census, particularly in smaller units. In some instances there are also wide seasonal fluctuations. Thus, nursing requirements vary considerably, not only from month to month but also on a weekly and daily basis. We have noted that the hospitals are reasonably flexible in terms of assigning nurses to units: the patient-nursing staff ratio varies by a factor of up to 10 to 1 from unit to unit, depending on severity of illness, nursing requirements, and size

of unit. On the other hand, there is a reluctance to switch staff too frequently, since most members of the nursing staff understandably prefer to be permanently assigned to a particular unit, or to become proficient in a particular type of nursing service. Nevertheless, an increase in flexibility in nursing assignments can be highly beneficial by facilitating more efficient utilization of nursing resources. Methods for enhancing flexibility include (1) classification of patient nursing needs, (2) use of floaters, and (3) use of part-time nurses.

5.3.4.1. Classification of Patients

The basic idea here is that all patients in the hospital are classified on a day-to-day basis, by their nursing needs. The classification system is a procedure for providing a more refined analysis of the actual nursing needs required on the basis of each individual's requirements; it allows a more refined analysis of nursing requirements on a unit-by-unit and shift-by-shift basis than can be obtained by merely noting the number of patients on the unit, since even within a unit individual patients may differ considerably in their nursing requirements. One such classification scheme has been developed by Geraldine Pardee (American Journal of Nursing, March 1968). The clerical details of the classification scheme can be handled very well by a ward clerk, once the system has been set up and routinized. The results of such a classification scheme typically indicate that either the number of staff normally assigned is correct, or that one (and occasionally two) staff should be added to or shifted from the particular unit on a given shift and day. Thus, the classification scheme allows a better match between nursing resources and patients' requirements, taking into account the individual fluctuations in patient census and patient requirements. Although the calculations involved are straightforward, they would be done most expeditiously by a computer.

5.3.4.2. Floaters

As we have indicated above, we are aware that nursing staff in general do not like to "float". Nevertheless, there normally are at least a few

nurses who consider themselves flexible and in fact enjoy working on different units, to obtain a variety of nursing experiences. Only a few (5 or 6) such nurses are necessary to provide a considerable degree of flexibility in nursing staffs, particularly when coupled with the implementation of a classification scheme described in the preceding paragraph.

Although there may appear to be reasons for attempting to assign civilian nurses to dependent nursing units and military nurses to active-duty men's units, flexibility may be seriously affected if this policy is rigidly followed. We suggest that removal of this (unofficial) barrier will also enhance flexible nursing assignment.

5.3.4.3. On-Call Nurses

Most community hospitals achieve flexibility through utilization of local on-call nurses. These are typically former nurses who have married but are available on short-term notice, without being committed. We suggest that if administrative and financial procedures could be implemented to allow base hospitals to employ such part-time civilian staff on an ad hoc basis, it could be of great assistance in enhancing flexibility and consequently operating with a lower average staff. Again, it would not require many part-time nurses to provide considerable flexibility; if the names of about 20 were on file, this would insure that at least a few would normally be available on short notice.

5.4. MULTIPHASIC TESTING

5.4.1. INTRODUCTION

Multiphasic testing exists in a variety of forms and is undertaken for a variety of reasons. Briefly, it refers to administering a battery of physiological tests including history taking, usually automated as much as possible, with computer reading and checking of results. The tests are normally given by nurses and aides, although a physician interprets X-rays, electrocardiograms, and eye photographs, and the testing is a prelude to examination by a physician.

Although the concept of multiphasic testing was developed and put into practice shortly following World War II, it more or less died out until clinical applications of computers revived it. The prototypes and models for most systems existing now are those at the Kaiser Foundation Hospitals in California. These were developed during the 1960's with support of the Public Health Service under the direction of Dr. Morris F. Collen. There are numerous imitations and variations, developed with or without federal support, including a pilot project supported by the Department of Defense for the Armed Forces Entrance Examination Station (AFEES) at Philadelphia.[1] There are multiphasic testing facilities at four Public Health Service centers, at several medical schools, and at a number of other medical centers;[2] some commercial firms assemble, sell, and service multiphasic test equipment.

The basic idea is that a detailed and complete physiological profile of a patient will lead to a higher quality of care. Some proponents view multiphasic testing as a screening procedure, analogous to the successful screening of much of the population of the United States for undetected tuberculosis through chest X-rays. The hope is that multiphasic examinations will detect previously unsuspected disease in apparently well people. Other proponents view multiphasic testing as a desirable adjunct to examination by a physician, either as a periodic examination or because of a medical complaint. It is agreed that by providing the physician with a comprehensive, accurate, and legible report in which all abnormal findings have been flagged, he is aided in reaching an accurate diagnosis and instituting suitable therapy.

A third reason has recently been advanced,[3] namely, that multiphasic testing will discourage people who are well from seeking unnecessary care in systems of prepaid care.

Multiphasic testing also has its critics, for it is expensive. Whether it realizes the benefits attributed to it by its proponents in sufficient degree to justify its cost is hard to say. What studies have been done are equivocal.[2,4,6] Despite the doubt, it is possible that multiphasic testing has a place in base-level military hospitals of the new generation. That is the question addressed in this section.

5.4.2. DESCRIPTION OF THE KAISER MULTIPHASIC HEALTH CHECKUPS

The Kaiser multiphasic clinics at San Francisco and Oakland are the prototypes for most other modern testing facilities. These clinics are open from 12:30 p.m. until 11:00 p.m. and can give examinations to 144 people per day, or about 24,000 per year. They are operated by a staff of 30 under a nurse's supervision. No physicians are normally present as part of the direct examination, though physicians do read the chest X-rays, EKG's, and eye photographs. Patients report on a scheduled basis to the clinic, and the complete set of tests takes about three hours. These tests are regarded as a prelude to an examination by a physician, which typically occurs about a week later. The results of the tests, however, are available immediately, and in doubtful cases patients may be asked before they leave to return at another time for further tests.

The multiphasic tests at Kaiser are used mainly as part of periodic physical examinations for apparently well people. However, some physicians find the multiphasic tests useful in assuring that they have obtained a complete clinical picture for patients with complaints. It is also asserted that patients find the apparent thoroughness of the tests, with counters clicking and computers whirring, a reassuring way to be tested.

The tests and activities (called phases) which comprise a multiphasic examination at the Kaiser centers are listed below. A further description is given in Dr. Collen's report on costs.[5]

- Registration and physician-appointment for followup study.
- Electrocardiography, with six leads recorded simultaneously on paper (including cardiologist's interpretation).
- Blood pressure and pulse rate measured in the supine position with automated instruments.
- Weight, subscapular and triceps skinfold thickness, height, and a dozen body measurements recorded by an automated anthropometer and punched directly into cards.
- Chest roentgenography, a 70-mm posteroanterior view (including radiologist's interpretation).
- Mammography (cephalocaudad and lateral views of each breast) in women over the age of 47, with radiologist's interpretation.
- Visual acuity tested by reading a wall chart, and a pupillary light reflex test.
- Ocular tension, measured by a Schiotz tonometer.
- Retinal photography of one eye (with ophthalmologist's interpretation).
- Achilles-reflex one-half relaxation time and an experimental pain reaction test (measured as pain tolerance to increasing pressure on the Archilles' tendon).
- Respirometry with forced expiratory vital capacity (one second, two second, and total) and peak flow.
- Audiometry tested with an automated audiometer for six tones.
- Tetanus-toxoid immunization with a high-pressure jet injector.
- A self-administered medical questionnaire for present and past history, a set of 200 medical questions, and an additional set of 155 psychologic questions on prepunched sort cards for automatic computer processing.
- Clinical laboratory tests, including hemoglobin, white-cell count, Venereal Disease Research Laboratories test for syphilis (VDRL), rheumatoid factor (latex-fixation slide test), blood grouping, eight blood chemical determinations (serum glucose, creatinine, albumin, total protein, cholesterol, uric acid, calcium, and transaminase), urinalysis for pH, blood, glucose, and protein (paper strip tests), and a urine culture for six hours with triphenyltetrazolium chloride.

To obtain medical history and certain psychological data, computer punched cards are used. Each card has a question written on it which can be answered yes or no (for example, "In the past year have you coughed up blood?") and a punched code identifying the question. The examinee is asked to sort the cards into two groups: those to which the answer is yes and those to which the answer is no. The cards are then read by a standard card reader, and the computer record indicates the questions to which the answer was yes. As the example indicates, the questions are phrased so that a positive answer indicates a potentially significant medical finding. Of course, physicians at Kaiser are acquainted with the total list of questions so that by elimination they are aware of the negative answers as well, although these are not printed out.

Data collected at each phase are recorded automatically wherever possible. For example, height is measured by a bar connected directly to the computer via a potentiometer and A/D converter. In this way recording errors are kept to a minimum. This is important; one of the difficulties with multiphasic testing, particularly in its early days, was an excessive number of false positives, which caused needless anxiety and extra work. The very fact that so many variables were being tested made the likelihood of at least one error creeping in rather high.

The results of the examination are assembled and formatted by the computer in a tidy final summary report, generally running to two ordinary size (8-1/2 x 11) pages. In addition to printing the current measurements, the computer also prints the normal range for each variable, the value measured at the most recent prior examination (if there was one) and the range of values observed for this patient in prior tests. Any measurement which falls outside the normal range is flagged, so that at the subsequent examination by a physician his attention is drawn to abnormal findings. All findings (except negative answers to history and psychological questions) are printed. Questions answered positively during the current examination but negatively on the prior one are also flagged. Previous medical advice given is also printed, selected from a long list of standard directions which might be given by a physician.

The staff of the center numbers 31, plus a part-time clerk and four part-time physicians for supervision and for making certain interpretations. The staff consists of the following:[5]

PHASE	NUMBER	TYPE
Registration	2	Receptionists
Electrocardiography	2	Aides
Electrocardiography (file & process)	1	Clerk
Chest X-ray examination	1	Aide
Mammography	2	Aides
(X-ray develop & file)	1	Clerk
Glucose administration	1	Aide
Anthropometry	1	Aide
Blood pressure	1	Nurse aide
Visual acuity	1	Nurse aide
Tonometry	1	Nurse
Respirometry	1	Nurse aide
Ankle test	1	Nurse aide
Hearing	1	Nurse aide
Medical	1	Nurse
questionnaire	1	Nurse aide
Immunization	1	Nurse
Clinical laboratory	5	Technologists
Retinal photography	1	Aide
Retinal photography (file)	1/2	Clerk
Return appointments	1	Receptionist
Data-input operator	1	Clerk
Supervisor	1	Nurse
Relief	1	Nurse
Appointments	1	Clerk
Supervisor	(25%)	MD
Electrocardiographic reader	(20%)	MD
X-ray reader	(20%)	MD
Eye reader	(20%)	MD

Kaiser has achieved one of the lowest costs per examination of any reported. The figure published in 1969 was $21.32 per examination.[5] (Other centers calculate somewhat higher costs. At Alta Bates, for example, the charge is $35.00, suggesting that the cost is higher.) As might be expected, the most expensive single item was salaries for personnel, which contributed $8.60 per examination at Kaiser. Supplies and equipment contributed $2.59, of which nearly half was for reagents and other supplies for the clinical laboratory. Equipment depreciation (straight line at 1.5% per month) added $1.15 to direct costs. The computer, including leasing or depreciation, all supplies, personnel, and so forth, contributed $4.50. The central staff who provided administrative and other personnel cost $2.54. The remainder of $1.94 was accounted for in indirect expenses for space, costs of ownership of the building, and other support such as payroll and personnel.

The clinical laboratory (blood and urine tests) was the single most expensive phase except for mammography. The unit cost for mammography was reported as $1.34 per examination, but, since the test was given only to women over 47, the expense per mammography was $4.90. (Incidentally, we shall delete this cost when comparing military examinations.) The cost of the clinical laboratory tests, which are very extensive, was $4.49 per examination.

5.4.3. BENEFITS ATTRIBUTED TO MULTIPHASIC TESTING

Many benefits are attributed to multiphasic testing, which, if they were realized, might serve to justify its use in the base-level health care system.

- Detect presymptomatic disease or defect or concealed disease or defect.

- Introduce hurdle to dissuade well persons from seeking care unnecessarily and overloading the health care system.

- Save physician time by eliminating need for him to perform examination and by providing a complete, accurate, and legible summary of current findings along with relevant history, thus aiding him in establishing diagnosis or managing overt disease.

- Maintain history and clinical data in a machine-readable form which facilitates recalling history, making comparisons, and carrying out studies.

Detection of presymptomatic disease or defect holds the promise of reducing morbidity and mortality by permitting early diagnosis and prompt intervention. While this thesis seems reasonable, the case has not yet been proven, especially when the costs of providing multiphasic testing are considered. While there are some striking exceptions, such as uterine cancer, there is considerable question as to whether the course of those diseases detectable in the presymptomatic stage can be altered by therapy. Of dubious value, for example, is early detection of diabetes mellitus, although there are physicians on both sides.[6]

Dr. Morris Collen is currently conducting a long-term experiment involving almost 11,000 subscribers to the Kaiser Foundation Health Plan, aged 35-54.[7] There are two groups of somewhat over 5000 each, one of which, the study group, is urged by telephone to come in for a multiphasic examination once each year; the other, a control group, receives no such urging, though they are not, of course, barred from having examinations. About 70% of the study group is examined annually, while only about 22% of the control group is examined. The groups are large enough and the various procedures fair enough so that one would have some confidence in attributing differences to the effect of the examinations. In the results so far reported, one unsurprising effect was that the study group, perhaps having been jogged into awareness of the frailty of life, made more appointments to see a physician (from 2.4 visits per year to 3.0). Hospitalizations and lengths of stay were mixed, and it was difficult to draw any conclusion. There was no significant difference in mortality, but the study has been underway for only six years and the oldest subjects are only 60 now.

The study did reveal that certain conditions which are sought in the multiphasic examinations were indeed identified significantly more frequently in the study group. In men, benign prostatic hypertrophy, clinically important hearing loss, hypertension, and gout were recorded more frequently. In women, diabetes mellitus, rectal polyps, uterine conditions, and enlarged

thyroids were recorded more frequently. Since all of these defects are treatable, it can be argued that multiphasic examinations have reduced morbidity. Two facts are worth noting, however. The study group had a good many more examinations and slightly more appointments with physicians, so the multiphasic features seem less essential than the simple frequency of examinations. Also, the defects discovered are characteristic of the middle-aged population chosen for this study; the military population is much younger, on the average, than this group, and therefore much less prone to these particular afflictions.

Another potential benefit to the military services lies in detection of defects, which, were they overlooked, would result in unnecessary costs to the services. This applies, for example, to the entrance examinations. Failing to find a disqualifying defect before induction involves both the government and the inductee in substantial inconvenience and expense. Furthermore, the population being examined for entrance to the military services, while generally young, come from all levels of society, and nearly half do have disqualifying defects. Therefore, multiphasic examinations may have some merit in AFEE Stations. However, once the population has been screened and only the basically healthy portion taken into the military services, the likelihood of finding defects is greatly diminished and detection of concealed defects through multiphasic testing can be expected to have a low return.

It could be argued that certain members of the military services are motivated to conceal defects because revealing them would cause them to forego some benefits. For example, a pilot might conceal some defect which would cause a loss of flight status, and hence of flight pay. Similarly, retention, training, and promotion are contingent upon meeting certain physical standards. A great many of the physical examinations given in the military services are simply certifications for exactly these sorts of reasons. Since the services have good reasons for requiring such certifications and can be expected to continue giving many physical examinations, this seems to furnish a potential justification for multiphasic testing. To be justified, multiphasic testing should be either better or cheaper, or both. As the discussion of experience at Kaiser indicates, there is no convincing evidence that it is better at detecting defects of the kind encountered in

the military population. But it may be cheaper; we will return to this question in Sections 5.4.4 and 5.4.5.

The argument enunciated by Dr. Sidney Garfield, also of the Kaiser Foundation, is intriguing.[3] A commonly heard complaint in prepaid systems, such as the Kaiser Plans, or in free systems, such as the military services have, is that patients seek care for social or psychological reasons rather than for sound medical reasons. In the usual fee-for-service situation, patients are more reluctant to seek the service because of the fee, and physicians are less concerned about the abuse for the same reason. It can be argued that a patient who seeks care for any reason needs care of some kind, even if it is only a little solicitous attention, and providing it is part of a physician's job. But the cost of this luxury is high, and since physicians are in short supply, it makes sense to discourage this abuse.

Dr. Garfield has suggested that the multiphasic examination could play an important role in reducing the load on a health care system caused by patients whom he classifies as the "well" and the "worried well". The purpose of the multiphasic testing would be to aid in sorting out the patients and establishing priorities for care. Thus the "well" would be discouraged from seeing a physician by the prospect of undergoing a three-hour examination and would be content with treatment at a health care center where exercises, counseling, and educational activities are carried out. The "worried well" would go through the examination and be reassured by the negative findings. The "early sick" would get definitive diagnosis and prompt intervention. The genuinely sick would either be examined, if the disease or injury was not apparent, or they would go directly to the physicians in clinics or hospitals.

The above is an appealing concept, but it is hard to imagine in practice. Placing a hurdle which requires three hours to cross ahead of an appointment with a physician does not seem realistic. What Dr. Garfield evidently imagines, though he does not dwell on it, is that paramedical staff will perform certain diagnoses, provide some treatment, and do some counseling so that patients who do not cross the hurdle are still adequately cared for. As we have elaborated in considerable detail in Section 2.4.(Ambulatory Care Units), this is the direction in which military health care should also go.

But the essence of this plan is more the extended use of paramedical personnel than the introduction of multiphasic testing. For this reason multiphasic testing must be justified on its own merits, for it is not essential.

Finally, there is the fact that multiphasic testing, chiefly because it uses a computer for assembling and, to some degree, analyzing the medical data collected, provides an accurate, legible, organized, and comprehensive record of findings. This record presumably aids the physician in reaching an accurate diagnosis and in managing disease. Without minimizing the value of good records, there is only the equivocal evidence discussed above that actual detection and management of disease is improved.

Closely related is the possibility that, since the physician has all the findings presented to him with abnormal results flagged, the time he needs to spend with a patient is reduced, thereby saving money by allowing a physician to see more patients. This might be possible, but Kaiser's experience does not bear this out. The amount of time per visit - 15 or 20 minutes - at Kaiser is no different from that in other outpatient clinics. It is said that at Kaiser there are fewer visits per episode, but this is by no means an accepted conclusion.

So, out of all the possibilities, we are finally left with the conclusion that, if multiphasic testing has any place at all in the base-level military health care system, it is as a replacement for the large number of certification examinations now given. As we have discussed, there is little basis for expecting that such examinations will be improved in any important way by introducing multiphasic testing. However, automated testing may be cheaper. If costs were even comparable, then automated testing would be desirable.

To examine the costs for giving physical examinations, we have investigated the Physical Examination Section at Fort Dix. This facility gives about the same number of examinations annually as does each of the large Kaiser facilities, and with suitable adjustments it is possible to compare the two. Since automated testing is cheapest when there is a high volume, we would expect that if it can be justified anywhere, it can be justified at Fort Dix. In the next section we describe the Examination Section at Fort Dix, and in Section 5.4.5 we compare it with the Kaiser facilities.

5.4.4. THE PHYSICAL EXAMINATION SERVICE AT FORT DIX

The Physical Examination Service at Fort Dix occupies four wings of the old hospital area. It is set up to administer a variety of physical examinations, and, while certain physicals and findings require referral to WAH, its operation is largely independent of activities at Walson. Presently there are plans for a reception center, to be built at another site, which will contain the Physical Examination Service in addition to other activities.

5.4.4.1. Facilities

The Examination Service consists of a front office; a clerical section; a dressing room; an area for history taking; a roster control area; examination stations for chest X-rays, blood pressure, height, weight, and pulse; urinalysis; an eye lane; serology; audiometry; electrocardiogram; and an examining section for a physician assisted by a corpsman. Operated independently but cooperatively with the Examination Service are a Dental Examination Service and an Optometry Clinic. A listing of the floor areas and staff for each component is given in Table 5.4.1.

TABLE 5.4.1
APPROXIMATE AREAS AND STAFF DEVOTED TO PHYSICAL EXAMINING SERVICE

	Usual staffing (officers and enlisted men)	Floor area (net square feet)
Administration office	1 off, 2 en	300
Clerical area	4 clerks	2,000
Dressing room	1 en	2,100
History taking	2 en	3,200
Roster control and records	3 en	1,400
Station 1 (X-ray, blood pressure, height) weight, pulse)	2 en	900
Station 2 (urinalysis)	1 en	500
Station 3 (eye lane)	1 en	400
Station 4 (serology)	2 en	200
Station 5 (audiometry, EKG)	1 en	900
Station 6 (physician exam)	1 off, 1 en	1,800
Dental examinations*	1 off, 1 en	500
Optometry*	2 off	500
Halliways		1,000
		15,700

* Not administratively part of the Physical Examination Service

5.4.4.2. Staffing

The staff of the Examination Service consists of 22 officers and enlisted men. The staff requirements as given in the Table of Distribution and Allowances, dated 31 December 1969, is given in Table 5.4.2.

TABLE 5.4.2
STAFF REQUIREMENTS

Number	Position	Grade	Military Occupational Specialty	Annual Salary Including Allowances
2	General Medical Officer	Capt.	03100	$28,000*
1	Administrative Officer	Lt.	03506	9,970
1	Chief Dispensary NCO	E7	91B40	8,865
1	Chief Dispensary NCO	E6	91B40	7,594
2	Dispensary Specialist	E5	91B20	11,268
1	X-ray Specialist	E5	91P20	5,634
2	Medical Lab Specialist	E5	92B20	11,268
4	Clerk Typist	E4	71B30	18,388
2	Dispensary Attendant	E4	91B20	9,194
1	Medical Lab Assistant	E4	92B20	4,597
1	Dispensary Orderly	E3	91A10	3,529
1	Supervisor Clerk	GS5	00301	7,000
3	Clerk Typist	GS3	00322	16,719
22				$142,026**

*Physician salaries augmented per Reference 9.

**Salary figures taken from Reference 8.

5.4.4.3. Types of Examinations

The following types of examinations are given by this service:

Separation physicals
Annual physicals
Medical Board physicals
Officer Candidate School physicals
Periodical physicals
Retirement physicals
Re-enlistment physicals
Release from active duty physicals
U.S. Army Reserve enlistment physicals
U.S. Army Reserve appointment physicals
U.S. Army Reserve quadrennial physicals
U.S. Army Reserve commission physicals
National Guard enlistment physicals
National Guard evaluat. n physicals
National Guard retention physicals
Direct commission physicals
U.S. Military Academy physicals
Flight physicals
Extended active duty physicals
Regular Army appointment physicals
Civilian placement physicals
Permanent overseas replacement physicals
Peace Corps physicals
Food handlers physicals
Temporary disability physicals

5.4.4.5. Procedure

Persons reporting for examination proceed through the following steps:

Completion of Form 89 (Medical History)

Completion of heading of Form 88 (Medical Exam)

Headings for urinalysis slip, X-ray record, blood sample

Leave clothes except for shorts in dressing room

Have chest X-ray taken

Have blood pressure and pulse measured

Take own height and weight

Leave urine sample at window

Take visual acuity test and color blindness test

Have blood sample taken

Take audiometer test

Have EKG taken (if required)

Have check by corpsman for tattoos, hemorrhoids, flat feet, large scars, malaria, and physical profile

Have examination by physician for required items on Form 88

Have dental examination

Have optometry examination, if indicated by eye test (about 50% of examinees have optometry examination)

Have records reviewed

This sequence could be completed in less than an hour if there were no delays. Although examinees are spread out among the stations, there are inevitably delays, and more usual times to complete the sequence range between two and three hours.

5.4.4.6. Workload

The workload of the Physical Examining Section varies, and since the first of 1970 it has been declining. A peak occurred in September and October of 1969; the present workload is about 80% of those monthly averages, as shown below.

	September 1969	October 1969
Flight physicals	23	0
Other complete physicals	2,606	2,423
Screening physicals (such as food handlers)	602	761
X-rays	3,208	3,184
Urine tests	4,694	2,501
Blood tests	2,887	6,486
EKG's	180	169
Audiograms	2,650	2,651

This workload amounts to about 120 complete physicals per day on the average. Although many physical examinations are scheduled, certain ones (such as separation physicals for men returning from Vietnam) must be given whenever the situation requires. Thus the workload on certain days may be as high as 200 per day.

5.4.4.7. Equipment

The equipment installed in the Physical Examination Service is described below. Its total value is estimated to be $35,300.

Administrative office

3 desks, chairs, files, etc.

Clerical area

4 desks, chairs, files, typewriters, etc.

2 duplicating machines (must make three copies of each Form 88 and 89 at one cent per copy)

Dressing room

shelves

History taking

student chairs for 140 plus two tables

Roster control and history taking

3 desks, tables, typewriters

Station 1

2 chest X-rays, developing room, scales, blood pressure manometers, etc.

Station 2

urinals, lavatory, microscope, lab equipment

Station 3

eye chart, color blindness cards

Station 4

serology lab equipment

Station 5

7 audiometry booths, EKG recorder

Station 6

physician's examining room

Dental

2 dental chairs

Optometry

2 examining stations

5.4.5. COMPARISON BETWEEN MULTIPHASIC TESTING AND USUAL PHYSICAL EXAMINATIONS

In the analysis to follow, we shall compare the multiphasic testing center at the Kaiser facilities in Oakland, California, with the Physical Examination Section at Fort Dix. We shall imagine that a testing facility like that at Kaiser is to be built at Fort Dix. Thus, the costs we shall derive will not be the same as Kaiser's,because we will imagine it staffed by military personnel with equivalent training. Similarly, we shall make a few other changes, like omitting the costs for mammography, which would not be a part of the military facility. The source for all of the Kaiser costs is the report by Dr. Morris F. Collen.[5] The source for military costs is the data given in the previous section and in Volume 8 (Survey of Military Base Hospitals).

In Table 5.4.3 we have listed the "phases" of the Kaiser tests as they were given in Section 5.4.2. For the civilian staff we have substituted equivalent military staff and shown their annual salaries. The total cost for salaries is $139,473, derived from Reference 8 and 9. To take account of the pay raise of 1970 we have increased this cost by 6% to $148,000. Table 5.4.2 in the previous section shows a total cost for salaries and

TABLE 5.4.3
STAFFING COSTS TO MILITARY OF "KAISER" LEVEL TESTING

Phases	Number	Rank	Specialty	Annual Salary Including Allowances*
Registration	2	E4	91B20	$ 9,194
EKG	2	E5	91B20	11,268
	1	E3	91A10	3,529
Chest X-ray	1	E4	91P20	4,597
[Mammography]	[3]			
Glucose administration	1	E3	91A10	3,529
Anthropometry	1	E4	91B20	4,597
Blood pressure	1	E4	91B20	4,597
Visual acuity	1	E4	91B20	4,597
Tonometry	1	E5	91U20	5,634
Spirometry	1	E4	91B20	4,597
Ankle test	1	E4	91B20	4,597
Hearing	1	E4	91B20	4,597
Medical questionnaire	1	E6	91B40	7,594
	1	E4	91B20	4,597
Clinical lab	5	E5	91B20	28,170
Retinal photography	1	E4	91U20	4,597
Return appointments	1	E3	91A10	3,529
Data input operator	1	E4	91B20	4,597
Supervisor	1	E7	91B40	8,865
Relief	1	E6	91B40	7,594
Appointments	1	E4	91B20	4,597
MD equivalents for supervision, and readings of EKG, X-ray, and eye photograph	2	CAPT.	03100	28,000**
	28			$139,473

*Salary figures taken from Reference 8.

**Physician salaries augmented per Reference 9.

allowancee of $142,026 for the Phyeical Examination Section (PES) at Fort Dix. Since the Kaiser facility does not include coete for examination by a physician, whereas those for the PES do, we have removed one physician, dropping the annual salary cost to $128,026. This amount should then be increased by 6% for 1970, to $136,000.

The cost of suppliee at the Kaieer facilitiee ie given as $62,000, about half of which ie reagente for the automated clinical laboratory. We have estimated that costs for eupplies at the PES are about $30,000 annually. Various eervicee at Kaiser (building amortization, eervices, housekeeping, utilitiee, and maintenance) were estimated to coet $47,000 each year. Based on the fact that the PES occupiee a floor area equal to about 3% of the total floor area of Walson Army Hospital, we have eetimated coete for various eervices to be 3% of the costs developed for theee items at WAH (eee Volume 8) or $36,000.

Kaieer eetimates the annual amortization of equipment (excluding the computer) as $27,000. This is a etraight-line depreciation at 1.5% per month. The purchase cost of equipment at the PES ie eetimated to be $35,300, and, using the eame method of depreciation, the annual cost ie $6300. Finally, the computer and computer eervicee et Kaieer contribute annual coste of $108,000. A summary of all coete is given in Table 5.4.4.

TABLE 5.4.4
SUMMARY OF ANNUAL COSTS FOR PHYSICAL EXAMINATIONS

	Kaieer	PES
Personnel	$148,000	$136,000
Supplies	62,000	30,000
Services	47,000	36,000
Equipment amortization	27,000	6,300
Computer	108,000	-
	$392,000	$208,300
Cost per exam (24,000 exams annually)	$16.30	$8.69

Thus, the cost per examination at the Physical Examination Section is just slightly over half that in a multiphasic testing center comparable to Kaiser's. It should be noted, however, that there are differences besides cost. The clinical laboratory tests on blood and urine are far more numerous at a Kaiser facility,and the history taking and psychological testing are somewhat more detailed than that provided by the standard BOB Form 89, Report of Medical History. More anthopometrical measurements are taken, drops are used in the eye examination, tonometry (for intraocular pressure) is done mechanically rather than manually, and a few additional tests like respirometry, the tendon reflex, and glucose assimilation are included. Thus, the tests at Kaiser are more extensive and complete. However, for the population of active military personnel who are the clientele for the PES, the value of these additional tests is marginal.

On balance, then, we conclude that multiphasic testing is too much more expensive than the present methods of giving certification physical examinations to be justified.

5.4.6. DISCUSSION AND CONCLUSIONS

On the basis of an analysis of the benefits to be derived from automated multiphasic testing and the costs for providing it, we have concluded that as matters stand now it has no place in the base level military health care system. One of the important reasons for reaching this conclusion, which is different from that reached by the Kaiser Foundation and the Public Health Service, is that the military population is generally young and healthy, having been selected for those attributes, and the additional tests provided by multiphasic testing are not likely to be important to this group. For this group the kind of examinations implied by BOB Form 88, Report of Medical Examination, and Form 89, Report of Medical History, and as specified in various regulations, is adequate.

Nevertheless, understanding of physiological processes is increasing rapidly, and the relevance and importance of a wider variety of tests is increasing. Although Forms 88 and 89 have not changed much in the last 25 years (the current edition of Form 88 is dated 1956 and of Form 89 is dated 1965), it is quite probable that more tests will become part of normal exam-

inations in the future. If this is the case, automation becomes more attractive. Moreover, 28% of the cost of Kaiser multiphasic tests is contributed by the computer; thus, when computers become more extensively used in health care (which will not be for some years, as we discuss in Section 7.5), the incremental cost of the computer for multiphasic testing will not be so great.

We are not aware of any developments beyond those just remarked upon which can be expected to make multiphasic testing a great deal different in the next decade from what it is now. Therefore we identify no R&D specifically needed in the field of multiphasic testing except for that associated with development of computer uses. (As we have said, the application of multiphasic testing in Armed Forces Entrance Examinations Stations (AFEES) is another matter, for the population has not previously been screened.)

5.4.7. REFERENCES

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5.5. OBSTETRIC SERVICES

5.5.1. INTRODUCTION

It has been suggested that it may be more economical for the DOD hospital system to eliminate certain services (e.g., all medical services for dependents) and have the services provided by the private health care sector instead. To shed light on this issue, we have carried out an analysis of the cost of providing obstetric care through DOD hospitals. The calculations are provided in detail for Walson Army Hospital, and similar results are derived for Jacksonville Naval Hospital and March AFB Hospital. This analysis is of interest for the following reasons:

The issue itself is of considerable interest and is somewhat controversial so that any insights gained will be useful.

The analysis illustrates the difficulty, under current accounting systems, of developing the relevant costs; in this case, of providing obstetric, labor-delivery, and nursery services for maternity patients and newborn infants.

The analysis helps focus attention on the magnitude of the different items that contribute to the total cost of providing services.

In 1965, Ernst & Ernst carried out a study for the Department of Defense entitled "Dependents' Medical Care in Civilian and Military Hospitals - a Cost Comparison." The study stated that obstetrical care could be provided in military hospitals at a cost of approximately $300 per case, versus $345 in civilian hospitals (as determined from Medicare reimbursements). The report did not indicate, however, how these costs were determined for military hospitals, nor the component cost elements. The costs were for the year ending 30 June 1963; it would be expected that since that time, costs in both military and civilian hospitals will have changed. Accordingly,

we have carried out a completely independent analysis.

Most of the analysis presented is based on costs at Walson Army Hospital, Fort Dix. The Obstetric Service at Walson Army Hospital (WAH) currently has approximately 1250 deliveries per year, down from 1500 per year during 1959-1965. There are 32 ante/post partum beds available in the Obstetrics Ward, and 30 bassinets in the Newborn Nurseries. The census averages 17 patients in the OB unit and 15 in the nursery, or about 50% of available beds. Patients are initially seen in the OB/GYN clinic as outpatients approximately ten times, before they deliver. Patients may attempt to see the same physician each time, but he may not always be on duty during these times. Also, the patient is delivered by the physician on duty in the delivery unit at the time. The nurse staffing in the post partum and delivery units tends to be more heavily civilian than the rest of the hospital. For example, at WAH about two-thirds of the staff in these units is civilian, while at Jacksonville and Beaufort these units are almost entirely civilianized. At March, on the other hand, only 15% of the nursing staff in these units is civilian.

In terms of volume, the other two hospitals with which we are primarily concerned, Jacksonville and March, have approximately 1450 and 700 deliveries per year respectively, so that Walson Army Hospital falls between these two. The overall approach to providing obstetric services is quite similar at all hospitals, as is the characteristically low level of occupancy in the Obstetric and Nursery Units.

5.5.2. COST ANALYSIS

To build up the cost of providing obstetrical services, we estimated separately the following cost elements. They are also tabulated in the functional cost sections of Volume 8 (Survey of Military Hospitals).

5.5.2.1. Physician Services

Table 5.5.1 lists the medical staff and secretaries currently assigned to the OB/GYN Service at WAH. The annual costs indicated for the two levels of physicians include the staff rates as taken from the army manual on Standard Rates for Military Personnel Services, which includes allowances for various fringe benefits, as well as basic pay. In addition, incremental an-

nual rates have been included for the supplementary pay that physicians receive. The stenographers' annual salaries have been estimated at the middle of the appropriate Civil Service GS level in each case.

The head of the service estimated that physicians divided their time approximately equally between obstetrics and gynecology. This estimate appears quite reasonable, inasmuch as the number of outpatient visits in the OB/GYN Clinic is divided approximately equally between obstetrics and gynecology, and the number of gynecological procedures is also about equal to the number of deliveries. This ratio also appears to hold true for the other hospitals which are under study. Accordingly, we have estimated the cost of physicians' services as 50% of the total OB/GYN staff cost, or $55,000 per year. Since Walson Army Hospital has approximately 1250 deliveries per year, this cost totals approximately $44 per case.

5.5.2.2. Clinic Costs

Table 5.5.2 shows the staff assigned to the OB/GYN Clinic and their estimated annual salaries. As with the OB/GYN medical staff costs, we have estimated the OB costs as 50% of the total, or $18,000. These costs, therefore, approximate $14 per case.

5.5.2.3. Nursing Services

Table 5.5.3 shows the nursing staff currently assigned to the OB delivery, post partum and nursery units. There is a total of 29 nurses currently assigned to these units at an estimated annual cost of $185,000, or $147 per case.

5.5.2.4. Housekeeping and Utilities Cost

Walson Army Hospital has contracted for the housekeeping of the hospital (washing of floors, windows, etc.). This contract currently costs $564,000 per year. In addition, the utilities cost, including water, sewage, heat, electric and refuse disposal total another $224,000, so that these two cost elements amount to $788,000 for the hospital as a whole (Table 5.5.4). As indicated in Table 5.5.4, the square footage taken up by the OB Labor and Delivery, Nursery and Formula, OB Ward, and half the OB/GYN Clinic amounts to approximately 11,000 square feet net area, or about 5% of the

total area of the hospital. We have, thus, estimated the annual housekeeping and utility cost as 5% of $788,000 or $38,000. This cost element, therefore, contributes $30 per case.

5.5.2.5. Laboratory and X-ray

In order to obtain an estimate of the lab tests provided obstetric patients at Welson Army Hospital, we examined a sample of fifteen medical records of obstetric patients who had delivered from 27 September to 10 October 1969. This was a sample of records that had been completed by the OB/GYN secretary; the lab tests had already been entered into the record. Since the results were quite consistent, this size of sample proved adequate for our purposes.

The medical record indicated that the normal set of laboratory procedures for an obstetric patient included a chest X-ray, a urinalysis, four hematocrits, a serology and blood typing workup, and an antibody test. In addition, each patient received a PAP smear which was entered into her outpatient record, and most also received a pregnancy test which also would have been entered into the outpatient record. If there were complications, then additional urinalyses and bacteriology tests might be carried out. The average frequency of tests per patient is indicated in Table 5.5.5.

Table 5.5.5 also shows the number of "points" associated with each test or procedure, as indicated on AR40-24 Medical Laboratory Activities Report. On the average, a patient receives lab tests equivalent to approximately 24 points, plus a chest X-ray.

During FY 1968 the estimated cost of the pathology lab was $544,000; $190,000 for military labor, and $352,000 for civilian labor and supplies (hand-written sheets prepared for us by Management Services Offices, WAH). This works out to about 36 cents per point. These costs probably underestimate the total actual cost, in that military labor is costed only at salary cost, and space costs are not included. If these were added, the total cost per point might be approximately 50 cents. This suggests that the total cost of laboratory procedures was about $12. If we add $3 for a chest X-ray then the total average cost per patient for these procedures is approximately $15.

5.5.2.6. Supplies

In FY 1969, medical and other supplies allocated to the hospital medical departments totaled $262,000 (data provided by Management Services Office, WAH). We estimate that obstetric and nursery patients accounted for about 5.7% of inpatient days. Using this factor to allocate supply costs to obstetric patients, this cost element amounts to $15,000, or $12 per case. It is likely, however, that obstetric and nursery patients use a larger amount of supplies than the average patient, or $24 per case.

5.5.2.7. Linen Costs

The total cost of laundry services allocated to the hospital is $176,500. Since obstetric and nursery patients represent 5.7% of patient days, we have allocated 5.7% x $176,500, or $10,000 to laundry costs. This represents $8 per case for the cost of laundry services.

5.5.2.8. Food Costs

We understand that dependent patients are required to pay for the cost of the food portion of the meals. In addition, however, the hospital spent $1,179,000 on food preparation in FY 1969 (data supplied by Management Services Office, WAH). The hospital serves approximately 33,300 rations per month, or 400,000 rations per year. The preparation cost, therefore, amounts to about $3 per ration or patient day. We have, therefore, estimated the nonpaid cost of the meals as approximately $12, for a four-day average stay.

5.5.2.9. Overhead Cost

A certain fraction of the overhead cost associated with the hospital, such as keeping of records in the business office, will depend on the number of inpatient admissions and inpatient days. The most relevant costs would appear to be the "account 1100" costs which amount to $315,000 for the Registrar's Office and $80,000 in personnel, or a total of $395,000, which might be dependent on the number of patients served. If we allocate these costs in proportion to the fraction of medical composite units accounted for by OB patients (Table 5.5.6), about 3.2%, or an estimated $12,500 of overhead is allocated to the provision of obstetrical care at WAH, or about $10 per case.

5.5.2.10. Facility Amortization

The total cost of construction of WAH was $10,401,000 plus $2,154,000 for equipment, or a total of about $29 per gross square foot (Table 5.5.7). Allocating 5% of the cost to the OB service, we obtain our estimated $600,000 for OB facilities. This represents, in a sense, "sunk" costs; elimination of the service would, however, free up the space and facilities. If we amortize the building over 25 years and the equipment over 10 years, the facility costs amount to $30,000 per year, or $24 per case.

We estimate that current construction costs are about 50% higher, or about $45 per square foot (Table 5.5.8), so that current construction costs would be about $900,000. Thus, elimination of the service in a new hospital would save this amount of initial investment. If we prorate the facility over 25 years and the equipment over 10 years, the annual facility and equipment cost (in a new hospital) is about $45,000, representing $36 per case.

5.5.3. DISCUSSION

Table 5.5.9 summarizes the various cost elements in the provision of obstetrical care at Walson Army Hospital. It is clear that, considering the various assumptions that we had to make in allocating the different costs to the OB Service, the individual cost elements have a fair degree of uncertainty, estimated to be on the order of $\pm$ 20%.

Table 5.5.9 indicates that the total cost of the Obstetric Service at WAH is about $415,000 per year or $330 per case. Of this total cost, approximately $75 is for the prenatal and physician care, and about $255 is for hospital-based services. As might be expected, the single major cost in hospital services is the nursing staff, which amounted to about $150, or 55% of the hospital costs. Medical staff costs (physicians and nurses) amounted to over 60% of the total cost of care. The total cost of the care would be somewhat higher in the case of a newly built hospital because of increased amortization cost of facilities and equipment.

Table 5.5.10 shows for comparison the estimated costs for Obstetric Services at Walson, Jacksonville NAS and March AFB Hospitals. The estimated per case cost, at March, with a case load about half that of the other two hospitals, is $392, or 20% higher than the cost at Walson or Jacksonville Hospitals.

5.5.4. COMPARISON WITH CHAMPUS COSTS

Data from the Comptroller of CHAMPUS, on physician and hospital charges for obstetrical (and other) patients for 1968, have been obtained (Table 5.5.11). The average physician charge for ante-partum, confinement, and post-partum per case was $180. The average hospital cost per patient day for deliveries was $72.65 and average length of stay 4.4 days; the average hospital bill was, therefore, $320. The cost per patient day was close to or exceeded $100 in the Pacific states, Nevada, and Washington, D.C. Incidentally, patient-day costs increased almost 15% since 1967. In New Jersey, the average hospital cost per patient day was $68.04 and average length of stay 4.7 days, for a total hospital bill of $320 also. (The average stay at WAH is about the same.) The total cost per case was, therefore, $500. In California and Florida the costs were $549 and $529, respectively.

Most of the admissions for deliveries are dependents of active duty personnel, who are required to pay $25 per admission. Thus, the net average cost to DOD, for obstetric patients under CHAMPUS, is $475 in New Jersey. This compares with the $330 estimated for provision of obstetric care at Walson Army Hospital. The difference is, thus, on the order of $145, or approximately $135 at a new facility. This represents a 40% cost saving. The major part of this savings is due to the lower cost of providing prenatal and physicians' services - $75 versus $180. This is apparently due to lower salaries paid to physicians in the services versus private physicians; lower physician office overhead; and more efficient utilization of obstetricians. The load carried by the average obstetrician in the services would represent a very active practice for a private obstetrician, particularly since obstetrics represents only about half the workload in OB/GYN. The net savings of providing obstetric services at the three hospitals, instead of through the CHAMPUS program, thus totals $180,000, $265,000, and $90,000 respectively (Table 5.5.10).

5.5.5. EFFECT OF VOLUME ON COST

Of the individual cost elements summarized in Table 5.5.10, the primary items which are expected to be cost-volume dependent are nursing staff and

facility costs. As number of deliveries decrease, a comparatively larger number of beds and nursing staff per 100 patients is required, because of the larger fluctuations in census.* These two items amount to about half the average cost, at the current volume at WAH. We would expect the cost of the other items to be fairly independent of volume of deliveries in the hospital.

Table 5.5.12 shows a comparison of physician staffing for Walson Army Hospital, Jacksonville NAS, and March AFB, and for Beaufort, where we also obtained detailed information on obstetric staffing. The ratio of deliveries per doctor varies from 140 deliveries per year per obstetrician at March, to 210 at Beaufort. March recently increased the number of OB/GYN physicians from four to five; under the former staffing, the average would be 175 deliveries per physician, consistent with WAH and Jacksonville.

The ratio of nursing staff to number of obstetric patients is higher at March than the other three hospitals (Table 5.5.13). Beaufort, with comparatively few nurses, appears to be as efficient as Walson and Jacksonville.

We have plotted in Figure 5.5.1 the expected number of nursing staff per 100 deliveries, utilizing data from the Army Staffing Guide†, from the literature references, and from the data presented in Table 5.5.13. The curve indicates that the number of nursing staff required per delivery increases rapidly as the number of deliveries decreases below 1250 per year. For example, the number (and cost) of nursing staff per delivery increases by about 50% if the annual volume decreases to 600 per year. Thus, the sizable cost advantage of DOD hospitals over the private sector (via CHAMPUS) appears to be eliminated if the number of deliveries is as low as 500 per year.

*References: 1) H.B. Wolfe et al., "A Study of Obstetrical Facilities, Proceedings of the Symposium on Health", Operations Research Society of America, 1969, p. 367.

2) J.D. Thompson and R.B. Fetter, "The Economics of the Maternity Service", Yale Journal of Biology and Medicine, Vol. 36, 1963, p. 91.

†"Staffing Guide for Army Medical Department Activities", Pamphlet 616 - 557, June 1969, p. 2-42 to 2-44.

As indicated in Table 5.5.14 over 60 CONUS base hospitals, or about 45% of the hospitals with obstetric facilities, fall in this category. In particular, over half the Air Force hospitals have fewer than 500 deliveries per year. We suggest that it will be useful to examine these hospitals for potential transference of their obstetric services to the private sector (or to other base hospitals). The decision in each instance will, of course, depend on factors other than the economics, including:

- In the case of isolated bases, there may be insufficient nearby private or community facilities to handle the load.
- There may be a need to "stockpile" obstetricians for unforeseen surges in demand.
- Obstetricians may be available anyway, because of the way the draft laws work.

We conclude that under current circumstances, most DOD hospitals can provide obstetric services much more economically than subcontracting these services to private physicians and non-DOD hospitals. The only health care facilities that could approximate the lower DOD cost might be clinic-oriented facilities such as the Kaiser Permanente Hospitals, which provide obstetric care in similar fashion to DOD hospitals, or clinics where the care is subsidized to provide teaching experience for interns, for example. If the volume of deliveries at the hospital is too low, however, this cost advantage disappears.

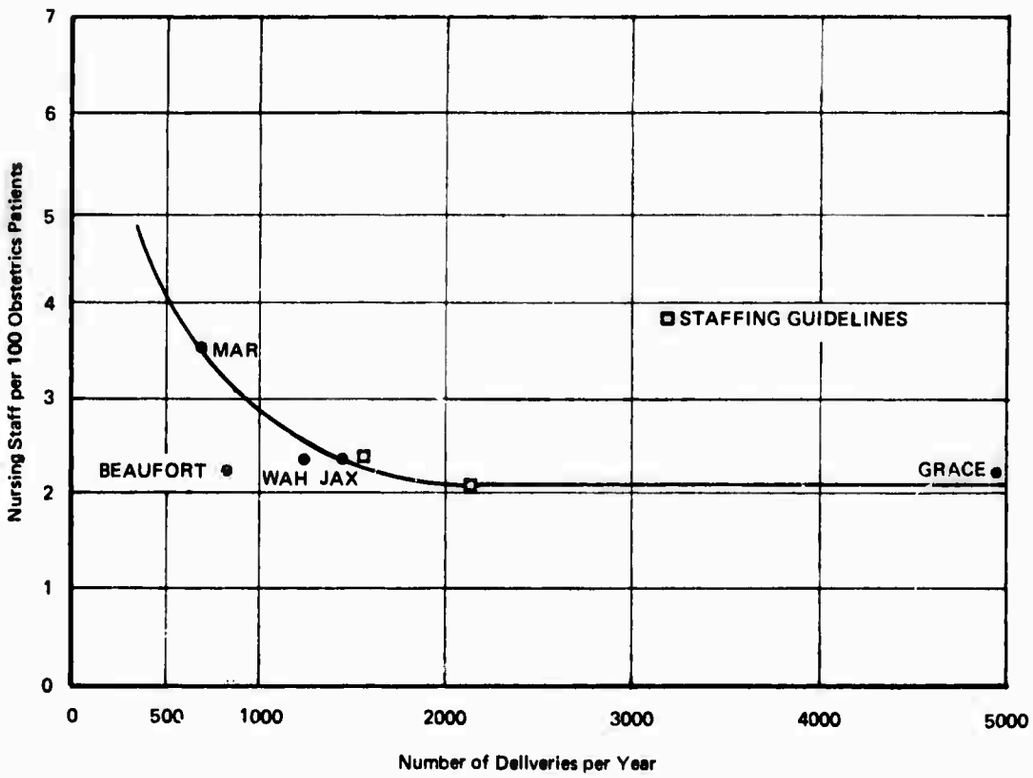

FIGURE 5.5.1 NURSING STAFF VERSUS NUMBER OF DELIVERIES

TABLE 5.5.1
COST OF OBSTETRICS AND GYNECOLOGY STAFF - WAH

	Grade Level	No.	Annual Cost	Total Cost
Chief of Service	Major	1	$17,600	$ 17,600
Physicians	Captain	6	13,300	79,800
Stenographers	GS4	1	6,300	6,300
Typists	GS3	1	5,600	5,600
TOTAL		9		$109,300

Note: 1) Army staff rates taken from AFM-177-101 (c91), 26 June 1969, Standard Rates for Military Personnel Services, which include composite pay, allowances, and entitlements.

2) Physicians' rates include incremental rates of $3,400 for Grades 4-6 and $1,300 for Grades 1-3, (AR 37-39, January, 1968).

3) Civilian rates from Compensation Schedule, 1 July 1969, Step 5.

TABLE 5.5.2
OBSTETRICS AND GYNECOLOGY CLINIC

	Grade Level	No.	Annual Cost	Total Cost
Head Nurse	GS7	1	$ 8,700	$ 8,700
Specialist	SP4	1	4,600	4,600
Specialist	PFC	2	3,000	6,000
Nurse's Aid	GS3	3	5,600	16,800
TOTAL		7		$ 36,100

Note: 1) Army staff rates taken from AFM-177-101 (c91), 26 June 1969, Standard Rates for Military Personnel Services, which include composite pay, allowances, and entitlements.

2) Physicians' rates include incremental rates of $3,400 for Grades 4-6 and $1,300 for Grades 1-3, (AR 37-39, January, 1968).

3) Civilian rates from Compensation Schedule, 1 July 1969, Step 5.

TABLE 5.5.3
COST OF OBSTETRICS AND NURSERY NURSING STAFF - WAH

	Grade Level	No.	Annual Cost	Total Cost
RN, ANC	Major	1	$14,200	$ 14,200
RN, ANC	Lieutenant	1	10,000	10,000
ANC	SP5	2	5,600	11,200
ANC	Private	5	3,000	15,000
ANC	SP4	1	4,600	4,600
RN	GS6	10	7,800	78,000
NA	GS4	2	6,300	12,600
NA	GS3	7	5,600	39,200
TOTAL		29		$184,800

Note: 1) Army staff rates taken from AFM-177-101 (c91), 26 June 1969, Standard Rates for Military Personnel Services, which include composite pay, allowances, and entitlements.

2) Civilian rates from Compensation Schedule, 1 July 1969, Step 5.

TABLE 5.5.4
MAINTENANCE AND UTILITY COSTS FOR OBSTETRICS - WAH

	Net Square Foot Area[a]
Labor and Delivery	2,793
Nursery and Formula	1,810
Obstetrics Ward 32 x 150	4,800
OB/GYN Clinic 50% x 2873	1,437
	10,840
TOTAL HOSPITAL	224,000
	4.8%

Housekeeping Cost[b]	$563.628
Utilities Cost[b]	224,178
Total	$787,806

[a]Utilization Study of WAH, July 1963.

[b]Data supplied by Major Finklestein, Service & Supplies Division. WAH.

TABLE 5.5.5
OBSTETRICS PATIENTS - LAB TESTS

Test	Average Frequency per Case	Points	Total Points
Pregnancy	1	2	2
PAP Smear	1	3	3
Urinalysis	2	2	4
Hematocrit	4	1	4
Serology, Type, Antibody	1	5	5
Antibody	1	5	5
Bacteriology	.5	2	1
			24
Chest X-ray	1		

TABLE 5.5.6
MEDICAL COMPOSITE UNITS - WAH

	No. per month	MCU	Total MCU per month
Admissions	3,000	10	30,000
Patient-days	16,500	1	16,500
Clinic Visits	60,000	0.3	18,000
Deliveries	100	10	1,000
			65,500
	Obstetric MCU		
Deliveries	100	10	1,000
Patient-days (including infants)	800	1	800
Outpatient Visits	1,000	0.3	300
TOTAL			2,100 per month

Note:
1) OB accounts for 2,100/65,000 = 3.2% of MCU.

TABLE 5.5.7
CONSTRUCTION COSTS - WAH

	Total[a]	Per Square Foot Gross	OB Allocation	Annual Cost
Structure	$10,401,000	$24.36	$499,000	$20,000
Equipment	2,154,435	5.04	103,000	10,000
TOTAL	$12,555,436	$29.40	$602,000	$30,000

[a]Provided by Major Finklestein, WAH.

TABLE 5.5.8
CURRENT OBSTETRICS FACILITY COSTS - WAH

	Construction Cost	Amortization Life	Annual Cost
Structure	$750,000	25 years	$30,000
Equipment	150,000	10 years	15,000
TOTAL	$900,000		$45,000

TABLE 5.5.9
OBSTETRICS COSTS - WAH

Cost Elements	Total	Per Case
Medical Staff	$ 55,000	$ 44
Clinic Staff	18,000	14
Nursing Staff	185,000	148
Housekeeping and Utilities	38,000	30
Laboratory	19,000	15
Supplies	30,000	24
Linen	10,000	8
Food Preparation	15,000	12
Overhead - Business Office	12,500	10
Facilities (Current)	30,000 (45,000)	24 (36)
	$412,500 (427,500)	$329 (340)

TABLE 5.5.10
COST OF OBSTETRICS - NURSERY

	Walson	Jacksonville	March
Volume per year	1250	1450	700
Medical Staff[2]	$55,000	$65,000	$37,500
Clinic Staff	18,000	29,000[5]	5,000[6]
Nursing Staff	185,000	220,000	157,000
Housekeeping and Utilities[4]	38,000	28,000	8,000
Laboratory[1]	19,000	22,000	10,500
Supplies[1]	30,000	35,000	17,000
Linen[1]	10,000	11,500	6,000
Food Preparation[1]	15,000	17,500	8,500
Overhead[1]	12,500	14,500	7,000
Facilities[3,4]	30,000	25,000	18,000
Total	$412,500	$467,500	$274,500
Per Case	$330	$322	$392
CHAMPUS per Case Cost	475	524	504
CHAMPUS Cost	594,000	731,000	367,000
Net Savings	$181,500	$263,500	$92,500

[1] Based on per case costs, Table 5.5.9.

[2] Based on 50% of OB/GYN MD's.

[3] Amortizing the building over 25 years and equipment over 10 years.

[4] OB and Nursery is estimated to be 5%, 5%, and 6% of total hospital at Dix, Jacksonville and March, respectively.

[5] Half the outpatient staff of 4 RN's and 4 NA's assigned to OB.

[6] Half of one RN equivalent.

TABLE 5.5.11

OBSTETRIC CHAMPUS COSTS* (1968)

	Hospital Cost per Patient Day	Average Days	Hospital Cost	MD Fee	Total Cost per Patient	Less $25 Deductible
New Jersey	$68.04	4.7	$320	$180	$500	$475
California	99.81	3.7	369	180	549	524
Florida	64.63	5.4	349	180	529	504

*Data obtained from the Comptroller, CHAMPUS: "Twelfth Annual Report, Civilian Hospital and Medical Program of the Uniformed Services, Calendar Year 1968".

TABLE 5.5.12
COMPARISON OF OBSTETRICS PHYSICIAN STAFFING

	Walson	Jacksonville	March	Beaufort
Deliveries per year	1,250	1,450	700	850
OB/GYN Physicians	7	9[a]	5[b]	4
Deliveries per doctor	180	160	140	210

[a] Includes 2 interns and 2 residents.
[b] Recently increased from 4.

TABLE 5.5.13
COMPARISON OF OBSTETRICS - NURSERY STAFFING

	Walson	Jacksonville	March	Beaufort
Deliveries per year	1,250	1,450	700	850
RN's	14	15	12[a]	11
Auxiliary Staff	15	19	12.5[a]	8
TOTAL STAFF	29	34	24.5[a]	19
Cases per nurse staff per year	43	43	28.5	45
Nurse Staff per 100 patients	2.3	2.3	3.5	2.2

[a]Corrected for Gynecology patients.

TABLE 5.5.14

NUMBER OF DELIVERIES AT BASE HOSPITALS

	Total Number of Hospitals	Number with less than 500 Deliveries per Year	Percent
Army[a]	36	12	33
Navy[b]	30	6	20
Air Force[c]	79	45	57
Total	145	63	43

[a] Personnel Utilized, Corresponding Workloads and Staffing Ratios in Army Hospitals in Continental United States by Command, Installation - Hospital Function and Category of Personnel - for the first, second, third, and fourth quarters, FY 1969.

[b] Admissions and Births in United States Naval Hospitals and Medical Centers, Fiscal Year 1969.

[c] Number of Deliveries in Air Force Facilities, Calendar Year 1968.

5.6. PATIENT MONITORING EQUIPMENT

5.6.1. INTRODUCTION

The basic idea of patient monitoring in intensive care units is that patients who are acutely ill, either because of heart attack, infection, or a major operation, are also unstable physiologically. Hence, their condition may deteriorate with great rapidity and suddenness. Therefore, such patients should benefit from nursing care at regular, frequent intervals. Such nursing care should include the measurement of significant physiological variables, as well as personal observations of the patients' condition. If a careful record is kept of all data and observations, it is thought that trained diagnosticians will be better able to detect deteriorating conditions and timely corrective actions may be begun. The elements of intensive care are, therefore, accurate and timely observations, diagnostic interpretation of the results, and timely intervention in the case of deteriorating conditions. It is generally believed that intensive care does speed recovery and reduce mortality, though to what extent is still a matter of study. Intensive care has been widely adopted in hospitals throughout the country. In particular, intensive care areas are used for myocardial infarction patients, severely ill general medical patients, and postsurgical patients.

Human physiological stability is maintained by a complex and tightly integrated control system which maintains physiological variables within remarkably narrow limits despite wide variations of external conditions. This property of living organisms is called homeostasis. Because of this it is difficult to detect many types of instabilities until the patient is in a severe decline, and the homeostatic mechanisms can no longer control what is going on. Thus it has been conjectured that more accurate data, more frequently taken, may indicate trends at an earlier time than would otherwise be available through normal data taking, thereby reducing morbidity and mortality.

5.6.2. DESCRIPTION AND STATE OF THE ART

Staffing of intensive care units is done by a specially trained cadre of nurses and assistants. In general, the ratio of nursing personnel to

patients varies between 1 to 1 and 1 to 3, depending on the particular hospital and the nature of the intensive care area. Because intensive care areas are manned on a twenty-four-hour schedule and maintain a high ratio of nurses to patients, there is presently, and there will probably continue to be, a shortage of trained intensive care nurses.

Because of this shortage, there is some motivation to use equipment which lightens the nurses' load. There are over three dozen U.S. manufacturers of equipment for the intensive care market. The piece of equipment usually found in all intensive care wards is an EKG (electrocardiogram) monitor. Such a monitor,in its simplest form, displays only the EKG. More sophisticated forms allow display of heart rate, allow alarms for heart rate going above or below certain limits, and may provide delayed memory loops so that when the heart rate exceeds or goes below limits, a separate recording on magnetic tape may be made. Some units are available which record the number of irregular beats per unit time, as well as recording the wave shape of the beats themselves.

In most hospitals, both military and civilian, even those with a great amount of sophisticated electronic equipment, one finds that the alarms are often turned off, that the electronic recording units are generally not operating, and that the equipment is used only as a means for gathering accurate data on a prescribed schedule. The false alarm rate for most monitored physiological variables is so high that it is intolerable for the nursing staff to have audible alarms. Hence, the only alarm that is commonly used is a high or low heart rate alarm.

Data gathering intervals in intensive care wards vary from hospital to hospital and ward to ward. In general, they may be as frequent as 15 minutes and as far apart as two hours,with the exception of course, of the EKG, which is normally monitored continuously.

For the intensive care units in base-level military hospitals,EKG monitors of the kind briefly described above are the rule. We see no reason to change the practices of equipping, staffing, or operating these units.

5.6.3. COMPUTER-AIDED SYSTEMS

There is currently a good deal of work in computer-aided intensive care monitoring, which provides a number of derived physiological variables which may be more indicative of patient condition than the variables measured without machine aid. Existing systems of this kind are all experimental. A list is given in Table 5.6.1 showing which variables are monitored. One current problem is that the variables that are measured tend to be strongly coupled to one another and it is hard to know which is the primary site of the instability. It is one of the ambitions of computer-aided monitoring to be able to eliminate the coupling of the measured variables and to derive appropriate variables for the different physiological systems (respiratory, cardiovascular, renal).

Besides the systems listed, there have been other efforts. Commercial manufacturers have invested in these systems, and a large amount of capital funding has been supplied by Health Services Research and Development Division of the Department of Health, Education and Welfare.

These programs have produced a number of different working systems with certain common characteristics:

(1) a periodic measurement of physiological variables;

(2) the display of the results of these measurements in a form convenient for making diagnostic judgments on the patient's evolving condition;

(3) the ability to enter nursing notes or other appropriate data on the system;

(4) the ability to obtain derived variables;

(5) accuracy heretofore unknown; and

(6) clarity of presentation not available with manual systems.

TABLE 5.6.1

LARGE-SCALE COMPUTER-AIDED PATIENT MONITORING SYSTEMS

	Pacific Medical Center Palo Alto, California	Mayo Clinic Rochester, Minnesota	University of Alabama Birmingham, Alabama	Veterans Administration Hospital Minneapolis, Minnesota	Latter Day Saints Salt Lake City, Utah	Massachusetts General Hospital Boston, Massachusetts	University of Minnesota Minneapolis, Minnesota
Cardiac output (by measuring aortic pressure)				x	x	x	x
Central venous pressure	x		x				x
Fluid balance (by measuring infusion and discharge)		x	x				
Respiration rate	x		x	x	x		x
Exhaled pressure pO_2	x						
Exhaled pressure pCO_2	x						
Tidal volume	x						
Computer	IBM 1800	IBM 1800	IBM 1800	CDC 3200	CDC 3300	CDC 3300	Honeywell 516

All systems take electrocardiograms and monitor the output for various characteristics, such as heart rate, pulse shape, etc.

Some of the systems maintain measurements of fluid balance for the patient and actually can administer and change the rate of intravenous infusion. Some of the systems monitor respiratory variables, including CO_2 and oxygen exchange, as well as minute volume and tidal volume.

All of the systems that we have seen are in a state of flux. The reason for this is, basically, that the search is still going on to find the most appropriate physiological variables to measure, to determine the frequency at which variables should be measured, and to present, in optimum fashion, the data for evaluation by the physician.

We expect, in the next three or four years, that much of the present research effort will crystallize with some protocols for measuring variables, for finding reduced variables, and for displaying them and/or presenting the physician with printouts which would make automated patient monitoring systems a more useful clinical tool. Present system evolution is going ahead at a rapid pace. The number of centers with installed capabilities and installed beds in computer-aided intensive care is increasing, and the number of physicians aware of the systems and their capabilities is also increasing.

At this time, it should be clearly stated that such systems cannot be justified on a cost basis. No one has demonstrated that such systems save manpower. The justification for the use of computer-aided intensive care can only be on medical grounds at this time. We would expect in the next four years for the cost situation to improve somewhat. However, these systems are expensive. The cheapest, which is at the University of Minnesota, cost $350,000 for the hardware alone. The cost of the software is comparable, and this system, like all the others, is still regarded as experimental. It is not reasonable to expect that computer costs can be markedly reduced by making the patient monitoring system part of a larger hospital computer system. As we have argued in Section 7.5, there are far too many problems with time-shared real-time hospital computer systems to consider making patient monitoring another function of a larger system. For the time being, patient monitoring should be done with a stand-alone system.

The only possible justification for undertaking large-scale computer-aided patient monitoring in military hospitals is to develop additional experimental data. Conceivably,such a program might be justified in one of the military referral hospitals, but we can see no justification in the base-level hospitals, where comparatively few of the patients require treatment in an intensive care unit at all. Furthermore, as far as care in an ICU is concerned, military hospitals differ not at all from other hospitals, so whatever results do eventuate from other programs will be applicable to DOD. Because the costs are very high and the benefits still uncertain, large-scale computer-aided patient monitoring should not be planned for the "new generation" hospitals.

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5.7. INPATIENT SURVEYS

As described in more detail in the following pages, an assessment was made of patients' ability to care for themselves in the three hospitals studied. These data serve as background for the estimates made in Section 2.3 of required size and staff for light care units. All patients in each hospital on certain days were assessed by appropriate members of the hospital's own staff. Each patient's record was reviewed with the Head Nurse on the unit and her assessment recorded. Seven such one-day reviews were made in the three hospitals studied.

To document the fact that by civilian standards patients in military hospitals are on the average not very sick, we analyzed records of 28,000 patients discharged from the three hospitals. This allowed us to determine characteristics of stay, types of diagnoses which were most prevalent, and other characteristics. The data were available on Jacksonville and March AFB in machine readable form. For Walson Army Hospital such data were not available and, therefore, we coded data from individual summary sheets covering 6000 admissions during a peak month and a low month.

5.7.1. JACKSONVILLE NAVAL HOSPITAL

Another measurement of the nonseverity of the conditions of the Jacksonville patients that dav was the fact that the two fully staffed and equipped intensive care units with a total of 30 beds had only two patients.

We also reviewed the detailed reports on deaths that had occurred at the Jacksonville Hospital during the last 21 months. This review showed 177 deaths during that time, 14 of them active military and 163 retirees or dependents. Compared with civilian hospitals, this is an extremely low death rate, which reinforces the observation that patients in military hospitals are on the average not as sick as their civilian counterparts.

To further clarify this observation we reviewed the DOA cases (dead on arrival). In the 21 months we covered, 75 DOA cases came to the Jacksonville Hospital - these included 47 active military and 28 retirees or dependents. Many of these deaths, of course, were due to accidents. In 21 months 61 active military died in the Jacksonville area, but only 14 of these in the hospital. Table 5.7.1 shows a detailed breakdown.

Another measurement of acute illness of admitted patients is the daily report of critically ill patients.* Because military hospitals have a very efficient system of reporting such data and notifying the next of kin as well as headquarters in Washington, we were able to review the records. They indicated a very few critically ill patients beyond those already mentioned in the reports on deaths.

The ability of inpatients to care for themselves was first analyzed in detail at the Jacksonville Naval Hospital on 22 October 1969. On that date Jacksonville had 484 beds plus 36 bassinets. The hospital census for that day showed a total of 409 patients plus 8 newborn. Thus, on the basis of the census, 75 beds and 28 bassinets were empty.

With the assistance of the nursing and medical staff, and particularly with the close personal cooperation of the Assistant Chief Nurse, Cdr. Shirley Parent, NC USN (in the absence of the Chief Nurse), we carried out a detailed analysis of every one of the patients shown on that day's census. We actually visited every ward, reviewed every patient's chart and discussed every patient with the nurse supervisor on every floor. We also checked every bed.

The results of this survey indicated that 38 of the 409 patients listed on the census were actually subsisting elsewhere and convalescing in their homes at the base, in the Jacksonville area or elsewhere. These patients were carried on the census to keep track of them, since they had to continue to be treated or checked on by the medical staff.

On the basis of the survey, therefore, the Jacksonville Hospital, on 22 October, had 113 empty beds plus 28 empty bassinets. These empty beds were in the following wards:

8E	Sick Officer Quarters	14
8W	Female (Medicine and Surgery)	6
7E	General Surgery, male	3
7W	General Medicine, male	19
6E	Orthopedics, male	3
6W	Surgical - Dental, male	8

*In military hospitals this report includes patients in whom, for example, terminal cancer has been diagnosed, even though such patients may be fully ambulatory at the time or even return home.

5 W	Obstetrics	10	
5 E	Gynecology	2	
4 SE	Pediatrics	11	
4 SW	Neuropsychiatric	3	
4 NE	Contagion - Neurology - Dermatology	4	
3 W	Convalescent patients	2	
3 NE	Medical ICU	14	
3 SE	Surgical ICU	14	
		113	Total

5 SW Nursery 28 empty bassinets

We then reviewed the 371 inpatients plus 8 newborn, and noted the following points:

- One hundred and fifty of the patients were fully ambulatory (74 of them in the convalescent ward area). These 150 patients required very little nursing or medical care, if any. They generally had their meals at the hospital cafeteria and did not use their hospital beds except at night and in some cases sparingly during the day. Some of these patients -- women and children -- ate in the ward area because it was felt they should not go to the cafeteria.

- Another 70 patients were fully ambulatory but remained in their ward area at least for meals. These were patients on special diets (not available at the cafeteria) or suffering from neuropsychiatric or dermatological conditions that made it inadvisable for them to eat in the cafeteria. Of these 70 patients, however, all but 11 of the neuropsychiatric cases walked around the hospital.

- An additional 39 patients were semiambulatory. Most of these did not require bed rest but needed wheelchairs or crutches to move around. Many of them were orthopedic cases.

We therefore concluded that although Jacksonville Hospital has 484 beds and 36 bassinets, only 112 patients and 8 newborn required bed care, with or without toilet privileges. To this we could add the 11 neuropsychiatric cases mentioned before plus seven pediatric cases.

Thus, we have noted that at the Jacksonville Hospit.. 22 October 1969:

- There were only 112 patients and 8 newborn requiring bed care, plus 18 psychiatric and pediatric ambulatory patients.

- That 241 patients occupying beds at night could possibly have used other less intensive facilities if these were available.

- That 113 beds and 28 bassinets were empty.

We then analyzed ward staffing. In our analysis we excluded the allocations of nursing staff to areas such as outpatient, emergency room, central supply, inhalation therapy, and operating rooms.

Nursing staff assigned to the ward areas at Jacksonville Hospital during the week of our visit showed:

Nurse Corps Officers	34
Civilian Registered Nurses	18
Nursing Assistants	25
Ward Clerks	2
Hospital Corpsmen	55
Hospital CorpsWaves	19
	153

This tabulation shows a high ratio of qualified nurses to corpsmen and assistants. It also indicates a high average number of nursing hours per inpatient requiring care. Illustrations of this high average are:

TABLE 5.7.1

DEATH CASES

	Active Military	Retirees and Dependents	Total	Deaths 48 hours after Admission	Medical Deaths	Dead on Arrival	
						Active Military	Retirees & Dependents
1968							
January	1	4	5	4	5	2	2
February	0	8	8	5	5	3	3
March	1	10	11	9	8	1	3
April	0	6	6	3	4	1	4
May	0	12	12	6	6	2	0
June	1	4	5	4	4	4	0
July	0	8	8	5	2	2	1
August	1	6	7	6	4	4	0
September	0	5	5	1	1	4	1
October	2	9	11	6	2	1	2
November	0	8	8	7	6	2	0
December	0	14	14	[illegible]	6	1	0
Totals	6	94	100	64	53	27	16
1969							
January	0	6	6	4	4	1	1
February	3	9	12	7	6	5	1
March	0	6	6	2	1	1	1
April	1	8	9	7	3	1	1
May	2	10	12	8	6	1	3
June	1	8	9	7	7	1	4
July	0	8	8	3	2	2	0
August	1	6	7	6	4	4	0
September	0	8	8	5	4	4	1
9 Months Total	8	69	77	49	37	20	12
21 Months Total	14	163	177	113	90	47	28

- Twenty-nine members of nursing staff, including 12 officers of the Nurse Corps, assigned to the intensive care units (2 patients on October 22).

- Fifteen members of nursing staff including 5 civilian RN's assigned to the nursery (8 newborns occupying bassinets on October 22).

- Thirteen members of nursing staff, including 7 officers of the Nurse Corps, assigned to the Pediatric Ward (7 children in cribs on October 22).

Of course, nurses have to be available on standby to handle fluctuations in patient loads, to train newly reported military or civilian nurses, or for other assignments or rotational programs.

5.7.2. WALSON ARMY HOSPITAL

Col. Matlock, Chief of Nursing at Walson Army Hospital (WAH), carried out a survey of patients for us on October 22 to 23. In her survey she utilized classification that divides patients into four categories:

> Category 1 patients require intensive nursing care. They include the acutely ill, those who require continuous treatment, or those who must be rigidly controlled. Examples include cardiac patients having frequent changes in pulse rate, diabetic patients in early stages of illness, certain surgical patients, obstetric patients in labor, and premature babies.
>
> Category 2 patients require moderate nursing care and include moderately ill patients and those requiring periodic treatment and/or observation. These include patients undergoing numerous diagnostic procedures and laboratory studies, certain surgical patients, certain prenatal patients, newborn infants, and the like.

Category 3 patients require a minimal amount of nursing care. These are convalescent-type patients and patients requiring little treatment and/or observation. For example, tuberculosis patients with negative sputum, ambulatory obstetric patients, and neuropsychiatric patients on open ward.

Category 4 patients require neither nursing care nor professional nurse supervision. The patient can go to the dining hall for meals and be seen as an outpatient. These patients include those awaiting administrative action, orthopedic patients in casts and orthopedic patients whose only treatment consists of physical therapy and periodic visits to their medical officer, certain neuropsychiatric ulcer patients, and the like.

The classification of patients by these categories is shown in Table 5.7.2. Out of a total occupied-bed census of 675, 208 were in Category 4 (30.8%). An additinnal 247 (36.6%) were in Category 3. Thus, only 32.6% were in Categories 1 and 2. According to the classification, Category 4 patients could be considered ambulatory patients and good prospects for an extended care facility. The largest fraction of these patients occurred in the Neuropsychiatric and URI Wards and in orthopedics.

In Table 5.7.3 is shown several of the statistics normally compiled at Walson Army Hospital, namely patients termed "seriously ill" or "very seriously ill" and "premature". Most of the patients in the first two categories are either heart attack victims or cancer patients. They are all Category 1 patients though they do not comprise the totality of that category. It is clear that out of the total census, very few fall into these groups which require intensive care.

5.7.3. MARCH AIR FORCE BASE HOSPITAL

Two inpatient surveys were conducted at March AFB: one on 23 October 1969 and another which began on 17 November 1969, covering some of the wards, and completed on 21 November 1969. Regarding the 23 October survey of the patients at March Air Force Base (Table 5.7.4), the following points should be noted:

- The Air Force does not have two different figures on occupancy of beds - census and actual. If the person is not sleeping in the hospital, he is not counted.

- In Table 5.7.4 Dependent Category 3 (Fully Ambulatory) is significantly affected by the obstetric cases. If the six obstetric cases were removed from the 17, the percentage of total beds occupied would be 24.4%.

- Patients who are in the Recovery Room count as being in bed on the normally assigned ward.

TABLE 5.7.2

CLASSIFICATION OF PATIENTS BY NURSING CARE REQUIREMENTS

WALSON ARMY HOSPITAL

22-23 October 1969

WARD	TYPE	CENSUS	CLASS I	II	III	IV
2A	Men's Surgical	41	5	10	15	11
2B	Women's Medical	4		1	1	2
	" Surgical	33	8	11	6	8
2C	Surgical	5	5			
3A	Pediatric Medical	4		2	2	
	Surgical	8	2	4	2	
3B	Obstetrics	16	0	6	2	8
3BN	Nursery	18	4	9	5	
4A	Surgical	22		4	12	6
4B	Neuropsychiatric	37	2	6	2	27
5A	Medical URI	18			8	10
	Surgical	21			2	19
5B	Medical	3		3		
	Surgical	38	1	1	36	
6A	Orthopedic	48		7	25	16
6B	Orthopedic	40	2	18	14	6
7A	Medical URI	72	3	23	23	23
7B	URI	64	4	20	20	20
8A	URI	72	3	23	23	23
8B	Pneumonia	46		10	28	8
9A	General Medical	46		10	18	18
9B	ICU	19	10	3	3	3
Total		675	49	171	247	208
Percent			7.3%	25.3%	36.6%	30.8%

TABLE 5.7.3

AVERAGE SERIOUSLY ILL AND VERY SERIOUSLY ILL PATIENTS

WALSON ARMY HOSPITAL
1969

Quarter	Seriously Ill	Premature Births	Very Seriously Ill	Premature Births
1	13.1	2.1	2.8	.35
2	6.9	1.3	3.1	.89
3	6.3	2.1	2.1	.22
Average	8.8	1.8	2.7	.50

TABLE 5.7.4

OVERALL TOTALS - PATIENT COUNT for 23 October 1969
MARCH AFB HOSPITAL

	1. TOTAL Beds Occupied	%	2. Fully Ambulatory Eat in Cafeteria	%	3. Fully Ambulatory Eat in Ward	%	4. Semi-Ambulatory	%	5. In Bed	%	Seriously Ill
Officers	7	100	2	28.6	3	42.8	1	14.3	1	14.3	--
Enlisted & NCO	55	100	16	29.1	7	12.7	13	23.6	19	34.6	2
Dependent	45	100	5	11.1	17	37.8	4	8.9	19	42.2	2
Retired	25	100	1	4.0	5	20.0	6	24.0	13	52.0	4
Retired Depdendent	23	100	--	--	12	52.2	7	30.4	4	17.4	1
TOTALS	155	100	24	15.5	44	28.4	31	20.0	56	36.1	9

1. Beds Occupied -- All patients counted in census sleep in hospital.

2. Fully Ambulatory -- Can or do take meals in cafeteria -- cafeteria was limited in size.

3. Fully Ambulatory -- Takes meals on floor. Does not go to cafeteria because of difficulty in sitting or because of nursing control.

4. Semi-Ambulatory -- Can go to toilet and move around with help in some cases.

5. In Bed -- Strictly confined to bed.

Seriously Ill -- Classified as seriously ill -- included in figures for in bed.

Regarding the inpatient bed survey of 17 to 21 November 1969 (Table 5.7.5) the following points should be noted:

- The occupancy of beds is 82.4% using 175 beds as a base. However, 200 beds are available, the 25 additional being nonoperational (not occupied under normal conditions but available and ready to go). Using 200 beds as the base, gives an occupancy of 72%.

- Of the total beds occupied during the period of survey, 43.8% were occupied by active-duty personnel. This compares with 40% in the previous survey on 23 October 1969.

Inpatient Category	17-21 November 1969 Survey	23 October 1969 Survey
Officers	4.2%	4.5%
Enlisted & NCO	39.6%	35.5%
Dependent	29.8%	29.0%
Retired	15.3%	16.2%
Retired Dependents	11.1%	14.8%
	100.0%	100.0%

- The percentage of fully ambulatory inpatients is 50% as compared with 44% under the previous survey.

TABLE 5.7.5

SUMMARY TABLE - PATIENT COUNT for 17-21 November 1969
MARCH AFB HOSPITAL

	1. TOTAL Beds Occupied	%	2. Fully Ambulatory Eat in Cafeteria	%	3. Fully Ambulatory Eat in Ward	%	4. Semi-Ambulatory	%	5. In Bed	%	Seriously Ill
Officers	6	100	4	66.7	--	--	--	--	2	33.3	--
Enlisted & NCO	57	100	27	47.4	6	10.5	6	10.5	18	31.6	1
Dependent	43	100	14	32.6	8	18.6	4	9.3	17	39.5	3
Retired	22	100	6	27.3	3	13.6	3	13.6	10	45.5	2
Retired Dependent	16	100	3	18.7	1	6.3	6	37.5	6	37.5	2
TOTALS	144	100	54	37.5	18	12.5	19	13.2	53	36.8	8

1. Beds Occupied -- All patients counted in census sleep in hospital.

2. Fully Ambulatory -- Can or do take meals in cafeteria -- cafeteria was limited in size.

3. Fully Ambulatory -- Takes meals on floor. Does not go to cafeteria because of difficulty in sitting or because of nursing control.

4. Semi-Ambulatory -- Can go to toilet and move around with help in some cases.

5. In Bed -- Strictly confined to bed.

Seriously Ill -- Classified as seriously ill -- included in figures for in bed.

CAMBRIDGE,
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