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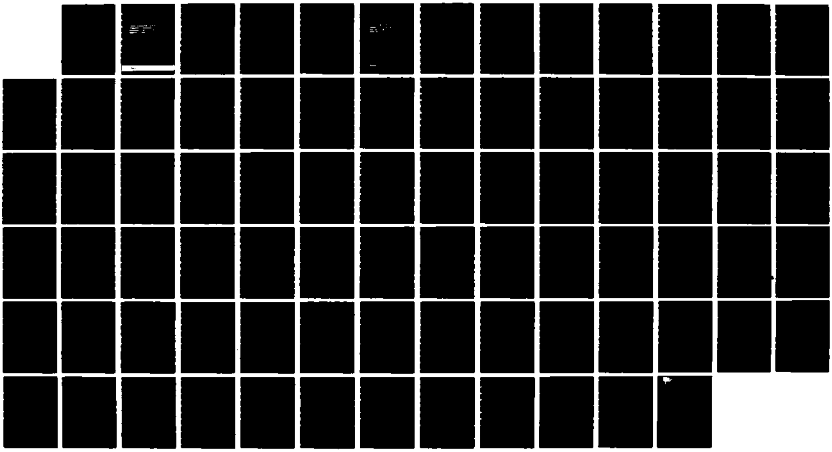
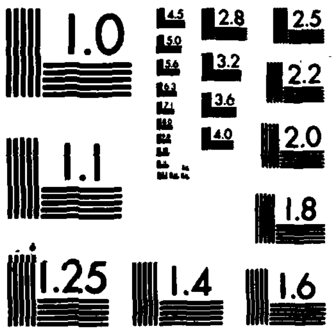
UNCLASSIFIED F49620-82-C-0018 F/G 5/9 NL





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# Costs, Productivity, and the Utilization of Physician's Extenders in Air Force Primary Medicine Clinics

Joan Buchanan, Susan Hosek

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**Library of Congress Cataloging in Publication Data**

Buchanan, Joan, 1947-
Costs, productivity, and the utilization of
physician's extenders in Air Force primary
medicine clinics.

"Prepared for the United States Air Force."
"April 1983."
Bibliography: p.
"R-2896-AF."
1. United States. Air Force—Medical care.
2. Physicians' assistants—United States. 3. Nurse
practitioners—United States. 4. Clinics—Employees.
I. Hosek, Susan, 1944- . II. United States.
Air Force. III. Rand Corporation. IV. Title.

[DNLM: 1. Physicians' Assistants. 2. Primary health
care—Manpower—United State . 3. Costs and cost
analysis. 4. Military medicine—United States.
W 21.5 B918c]
UG983.B83 1983 358.4'1345'0973 83-4578
ISBN 0-8330-0497-2

Published by The Rand Corporation

# REPORT DOCUMENTATION PAGE

**READ INSTRUCTIONS BEFORE COMPLETING FORM**

**1. REPORT NUMBER**
R-2896-AF

**2. GOVT ACCESSION NO.**
AD-A140 994

**3. RECIPIENT'S CATALOG NUMBER**

**4. TITLE (and Subtitle)**
Costs, Productivity, and the Utilization of Physicians's Extenders in Air Force Primary Medicine Clinics

**5. TYPE OF REPORT & PERIOD COVERED**
Interim

**6. PERFORMING ORG. REPORT NUMBER**

**7. AUTHOR(s)**
Joan Buchanan
Susan Hosek

**8. CONTRACT OR GRANT NUMBER(s)**
F49620-82-C-0018

**9. PERFORMING ORGANIZATION NAME AND ADDRESS**
The Rand Corporation
1700 Main Street
Santa Monica, CA 90406-2138

**10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS**

**11. CONTROLLING OFFICE NAME AND ADDRESS**
Requirements, Programs and Studies Group (AF/RDQM)
Office, DCS/R&D and Acquisition
Hq USAF, Washington, D.C. 20330

**12. REPORT DATE**
June 1983

**13. NUMBER OF PAGES**
68

**14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)**

**15. SECURITY CLASS. (of this report)**
Unclassified

**15a. DECLASSIFICATION/DOWNGRADING SCHEDULE**

**16. DISTRIBUTION STATEMENT (of this Report)**
Approved for Public Release; Distribution Unlimited

**17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)**
no restrictions

**18. SUPPLEMENTARY NOTES**

**19. KEY WORDS (Continue on reverse side if necessary and identify by block number)**
Air Force
Medical Personnel
Medical Services
Cost Analysis

**20. ABSTRACT (Continue on reverse side if necessary and identify by block number)**
see reverse side

This report addresses the question of whether the extensive use of physician's extenders--nonphysicians trained to perform some of the medical and administrative tasks traditionally performed by physicians--in Air Force hospitals is cost-effective. Specifically, it examines the productivity of extenders in outpatient care and the costs of procuring and using extenders. The authors focused on one type of extender, physician's assistants (PAs), who are typically Air Force corpsmen with one year of classroom and one year of clinical training. The general conclusions were the following: In typical Air Force primary adult medicine clinics, PAs can substitute for physicians one-to-one for 80-90 percent of the patients whose problems lie within the PA's expertise. Relying on PAs to perform most of the primary medicine workload is currently cost-effective, and will remain so until the earnings of civilian physicians decrease markedly relative to the earnings of PAs.

R-2896-AF

# Costs, Productivity, and the Utilization of Physician's Extenders in Air Force Primary Medicine Clinics

Joan Buchanan, Susan Hosek

June 1983

A Project AIR FORCE report
prepared for the
United States Air Force

35th Year
Rand
SANTA MONICA, CA. 90406

# PREFACE

In 1976-1978, as part of a study of "Air Force Health Delivery Systems" for Project AIR FORCE, Rand assisted the Air Force Surgeon General with a demonstration project in the use of physician extenders. The project, conducted in four typical Air Force hospitals, increased the role of extenders in the primary medicine clinics. This report, the last of three evaluating the demonstration project, estimates measures of the cost and productivity of physicians and extenders and assesses the cost-effectiveness of relying more heavily on extenders to deliver primary medicine. It was prepared as part of the Project AIR FORCE research study effort "Air Force Medical Resources Planning."

The first report in the series—G. A. Goldberg and D. G. Jolly, *Quality of Care Provided by Physician's Extenders in Air Force Primary Medicine Clinics*, R-2436-AF, January 1980—evaluated the quality of extender care. Acceptance of the demonstration project's changes by the clinics' patient population was the topic of the second report—D. Maxwell Jolly, *Patients' Acceptance of Physician's Assistants in Air Force Primary Medicine Clinics*, R-2620-AF, September 1980. Other Rand publications concerning extenders include S. D. Hosek and C. R. Roll, Jr., *Military Utilization of Physician's Assistants*, N-1019-HA, April 1979; and S. D. Hosek, *Potential Civilian Earnings of Military Physician's Assistants*, N-1342-AF, February 1980.

The research reported here was conducted under the Project AIR FORCE Resource Management Program.

# SUMMARY

This report addresses the question of whether the extensive use of physician's extenders —nonphysicians trained to perform some of the medical and administrative tasks traditionally performed by physicians—in Air Force hospitals is cost-effective. Specifically, it examines the productivity of extenders in outpatient care and the costs of procuring and using extenders. We focused primarily on one type of extender, physician's assistants (PAs), who are typically Air Force corpsmen with one year of classroom and one year of clinical training. Our general conclusions were the following:

- In typical Air Force primary adult medicine clinics, PAs can substitute for physicians one-to-one for 80-90 percent of the patients whose problems lie within the PA's expertise.
- Relying on PAs to perform most of the primary medicine workload is currently cost-effective, and will remain so until the earnings of civilian physicians decrease markedly relative to the earnings of PAs.

In the past, physicians' extenders have helped the Air Force overcome physician shortages. In the mid-1970s, when the military health care system began to suffer serious shortages in active duty physicians, first in primary care specialties, including internal medicine and family practice, and then in other specialties, the Air Force Surgeon General's Office began to look to physician's extenders to augment the available physicians. In particular, PAs and primary care nurse practitioners (PCNPs), two new types of extenders, began to substitute for physicians in Air Force adult primary medicine clinics. However, because these providers were new both to the Air Force and to other health care providers, no precedents existed for determining their proper use.

In 1976, the Surgeon General approved a two-year demonstration project designed to show whether the primary medicine clinics could rely heavily on PAs and/or PCNPs to provide services. Four typical Air Force hospitals restaffed their primary medicine clinics to achieve a ratio of approximately two extenders to every physician. Rand developed guidelines for the clinics' operations and evaluated the project along three dimensions: quality of care, patient attitudes, and cost-effectiveness. Mirroring the Air Force as a whole, the demonstration project employed many more PAs than PCNPs, and we therefore place more emphasis on the PA results in this report.

Except at real rates of 10 percent or higher, even the more expensive Air Force-trained PAs currently entail significantly lower personnel costs than either Armed Forces Health Professions Scholarship Program (HPSP) or volunteer physicians. At a 5 percent real discount rate, these PAs are 30 percent less costly than Health Professions Scholarship Program physicians and 10 percent less costly than volunteer physicians. The Air Force procures both physicians and PAs from more than one source, and personnel costs thus differ in both magnitude and timing. To capture these differences, we constructed a billet costing model that sums indefinitely into the future the discounted costs of filling a physician or extender billet from alternate sources. Because some personnel entail heavy up-front costs while others impose higher delayed costs, relative provider group costs depend heavily on the real discount rate. Our cost estimates indicate that compared with HSPS physicians, volunteer physicians are cheaper to procure but may earn higher pay and serve fewer years. While we estimated costs

for directly procured physicians as well as Air Force-trained physicians and PAs, our analysis of the cost-effectiveness of extenders is based only on the costs estimated for the primary procurement sources: HPSP physicians and PAs trained in the Air Force's in-house program.

We measured productivity in two ways: by estimating *production functions* and by conducting activity analyses. For patients the PAs were trained to treat, neither approach showed significant differences between physicians' and PAs' productivity. Both approaches used patient encounter data collected during the demonstration project. An earlier report (Goldberg and Jolly, 1980) found that the project's PAs and PCNPs also delivered quality of care comparable to the physicians' quality.

Using the activity analysis results, we staffed two hypothetical clinics, both seeing 150 patients per day, which is close to the project clinics' average. The two examples differed only in the complexity of the diagnostic mix, from the least to the most complex we observed at the project clinics. Our activity analysis indicates that the most cost-effective staffing pattern includes three physicians and eight or nine PAs, depending on the complexity of the workloads. However, because this staffing pattern extrapolates beyond our data, a less risky option would involve four physicians and seven or eight PAs. At FY 1981 procurement cost and compensation levels, a 2:1 staffing option decreases personnel costs 20 percent over an all-physician staff.

At the most efficient staffing levels, physicians' roles are limited to supervising PAs, taking referrals from PAs, and treating the small number of patients with more serious problems. These roles call for more highly trained physicians, primarily board-certified family practitioners and internists.

# ACKNOWLEDGMENTS

This project was initiated, and Rand's participation in the demonstration project was carried out, under the leadership of David Chu. This report inevitably carries his strong imprint. Project colleagues George Goldberg and David Jolly provided valuable assistance and review as well as the results of their own research, upon which we draw throughout the report.

Richard Buddin initiated the production function analysis; his results laid the foundation for our analyses. Jane Peterson performed much of the programming and data management. Robert Kane and Adele Palmer reviewed an earlier version of the report.

We are particularly grateful to those in the Air Force who worked with us. The Office of the Surgeon General initiated the demonstration project and assisted our evaluation in numerous ways. The late Fred Ippoliti, the project monitor through most of the project, generously gave of his time and experience. The staffs at the project's demonstration sites (Chanute, Dyess, Fairchild, and Nellis Air Force Bases) carried out the project and willingly supported our evaluation. We are especially indebted for their help to the hospital commanders: Colonel Gilbert Kitching, Colonel Blair Behringer (ret.), Colonel Thomas Coolidge, and the late Colonel William Walter.

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# I. INTRODUCTION

In 1976, the Air Force initiated a two-year demonstration project to test the feasibility of intensive utilization of physician's extenders in their primary medicine clinics. Four typical Air Force hospitals restaffed their primary medicine clinics with extenders and physicians in the ratio of 2:1. This unusually intensive use of extenders reflected the simple mix of problems handled in these clinics; data previously collected from nine Air Force clinics of varying sizes had indicated that at least three-quarters of the patient visits were for problems extenders are trained to treat.

This report is one in a series evaluating the demonstration project. Two earlier reports found that quality of care and patient satisfaction were sustained during the project.[1] Here, we address the questions: (1) What are the relative costs of employing extenders versus physicians in Air Force primary medicine clinics? (2) How productive are these two provider groups? and (3) Did the demonstration project clinics deliver efficient medical care, or should the 2:1 ratio be altered?

To answer these questions, we compared the costs and productivities of physicians trained in family practice or internal medicine and physician's assistants (PAs), the type of extender most commonly used in Air Force primary medicine clinics. The cost model we used calculates the discounted FY 1981 costs of indefinitely staffing a single physician position or a single PA position. These costs include procurement or training costs, salaries, and retirement pensions paid to every individual needed to fill the position. We take two approaches to measuring productivity: production functions and activity analysis. Production functions allow us to determine the form of the relationship between the total number of patients seen by a clinic in a given time period, the inputs of physicians' and extenders' time, and other variables. With activity analysis, we can evaluate the alternative provider combinations competent to treat each class of patient visits and to identify the least costly combination. From the activity analysis results, we infer whether the demonstration project's physician to extender ratio was too high or too low.

The Air Force turned to physician's extenders to help solve problems arising after military conscription ended in 1973. Because of the large gap between military compensation levels and civilian physician incomes, recruiting physicians was expected to be particularly difficult, but the Air Force did not begin to experience physician shortages immediately. The draft-period Berry Plan, through which medical students contracted to enter active duty service after they completed residency training, continued to supply physicians for at least three more years. The first shortages developed in the mid-1970s in family practice and general internal medicine. Since that time, the HPSP program and increase in physician pay have eliminated the primary care shortages. These programs have also increased the costs of military physicians. However, in 1976, the Air Force was more concerned about maintaining service levels than about decreasing costs.

Physician's extenders offer one way of conserving scarce, expensive physician time. For some time, nurse practitioners specializing in pediatrics and ob/gyn have been commonly employed in the Air Force and in other military and civilian settings. In the late 1960s, two new types of physician's extenders, physician's assistants and primary care nurse practi-

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[1] Goldberg and Jolly (1980) and Jolly (1980).

tioners (PCNPs), became available to treat common adult medical problems. The Air Force established an in-house training program for PAs in 1971 and introduced the first graduates into its clinics in 1973, just as the draft ended. A less ambitious program was also established for PCNPs.[2] Clearly, PAs and PCNPs could alleviate critical primary medicine shortages. However, whether the Air Force could rely heavily on these extenders without eroding quality of care and patient satisfaction was unknown. No civilian experience with intensive use of PAs or PCNPs was available to draw upon.

The current less severe physician supply picture has caused some to question the continuing need for a large physician's extender force. But physicians are considerably more expensive than extenders. This report is concerned whether the demonstration project's use of physician's extenders is now and will continue to be cost effective.

Section II describes the demonstration project, the participating clinics, and the data used for this evaluation. Section III presents the cost model and estimates. In Sec. IV, we describe our analyses of the the provider groups' productivities in outpatient care and evaluate further changes in the staffing ratio. Finally, Sec. V summarizes the report's findings and reviews the implications of future changes in the supply of primary medicine physicians and physician's extenders, and civilian medical trends.

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[2] The PA program admitted students from the large pool of Air Force medical corpsmen; the smaller PCNP program reflected the smaller pool of nurses available for further training.

# II. THE DEMONSTRATION PROJECT

The Air Force Surgeon General approved a demonstration project in 1976 to see whether a major expansion in extender utilization would work in typical Air Force clinics. He asked Rand to establish general guidelines for the project, advise participating hospitals on implementing the guidelines, and evaluate the clinics' operations. The project began in October 1976 and officially ran for two years.

Rand's guidelines are reproduced in Appendix B. For this report, the statement of the project's purpose is fundamental:

> *To test the concept* of using a richer mix of physician extenders, Rand has proposed a demonstration *at a limited number of bases*. This also allows the Air Force *to develop the details* of how such a concept might work before final decisions on future Air Force medical staffing are taken.

We have italicized key phrases to emphasize that the project was not an experiment designed to identify the optimal utilization of extenders. Instead, it explored the feasibility of using many more extenders than the Air Force had used before 1976. A cautious approach to expanding extender use was also dictated by the limited availability of civilian experience to draw upon.

The implications for this study of the project's purpose will be described more fully in Sec. III. To anticipate the main point, our analysis has necessarily emphasized showing whether the project's expanded extender utilization makes economic sense; however, we do identify conditions that might lead to further changes in provider mix to improve primary medicine clinic operations.

Provider productivity and costs depend on clinic organization and operating procedures, in addition to staffing ratios. This section summarizes how the clinics were selected for participation in the study, how they were staffed and operated, and how we collected the data used here to measure productivity.

## CLINIC SELECTION

Rand and the Surgeon General's Office chose the four demonstration project clinics jointly. Typical of the Air Force system, the clinics were located in 25-to-100 bed hospitals operated by the larger Air Force Commands. We excluded overseas clinics. The clinics chosen were located at Chanute AFB, Dyess AFB, Fairchild AFB, and Nellis AFB. We also studied two nondemonstration clinics at Charleston AFB and Luke AFB. Table 1 shows the location, command, patient population, and hospital size for each base. The typical Air Force outpatient facility contains four usually separate clinics in which patients might seek primary medical care services other than pediatrics and gynecology:

1. General Therapy Clinic: The basic primary care clinic for adults and sometimes older children, similar to a civilian general practice or family practice.
2. Flight Surgeon's Office: Responsible for primary care and monitoring duty fitness for personnel on flight status. Fliers require special medical care, much of it preven-

Table 1

CHARACTERISTICS OF THE DEMONSTRATION BASES, FY77

| | Chanute | Dyess | Fairchild | Nellis | Charleston | Luke |
|---|---|---|---|---|---|---|
| Location | Vicinity Champaign-Urbana Illinois | Abilene Texas | Spokane Washington | La Vegas Nevada | Charleston So. Carolina | Phoenix Arizona |
| Command | Air Training Command | Strategic Air Command | Strategic Air Command | Tactical Air Command | Military Airlift Command | Tactical Air Command |
| Active duty households | 8,100 | 5,000 | 4,300 | 8,000 | 4,500 | 7,100 |
| Estimated retired households | 2,000 | 4,800 | 3,600 | 2,800 | N.A. | N.A. |
| Operating medical/ surgical beds (1974) | 55 | 40 | 50 | 35 | 0 | 70 |
| Medical/surgical outpatient visits | 112,000 | 95,100 | 94,000 | 134,900 | N.A. | 163,000 |

tive. The flight surgeons frequently deliver this care on the flight line rather than in the clinic.

3. Internal Medicine Clinic: Strictly for patients who need the services of an internist rather than a family practitioner or general practitioner; at Fairchild, not distinct from the General Therapy Clinic.
4. Emergency Room: In most Air Force hospitals, handles primarily off-hours and overflow walk-in patients rather than true emergency patients.

During the demonstration project, the first three clinics operated with the richer mix of extenders. Below we describe the staffing and distribution of workload in these clinics.

## AIR FORCE PHYSICIAN EXTENDERS

Physician's extenders are nonphysicians trained to perform some of the medical and administrative tasks traditionally performed by physicians. This report examines extenders trained to treat common medical conditions occurring in adults. As previously mentioned, most Air Force physician's assistants, or PAs, are former medical corpsmen who have received two years' training in primary medicine.[1] The Air Force training program includes one year of classroom instruction in the basic sciences and a one-year rotation through the outpatient clinics of a large Air Force hospital. Upon graduation, the PA receives a Bachelor of Science degree, and almost all take and pass the certification exam administered by the National Commission on Certification of Physician Assistants.

The primary care nurse practitioner, or PCNP, is a Registered Nurse who has received additional training similar to the PAs' training. However, in 1976, many Air Force PCNPs had attended civilian training programs that differ in curriculum.

The Air Force has emphasized the use of PAs, rather than PCNPs, in its primary adult medicine clinics. The larger pool of corpsmen can easily supply qualified PA trainees, while the smaller pool of nurses must also fill competing demands for pediatric and ob/gyn nurse practitioners (and other specialized nurses). Approximately half the extenders were experienced, the others were new graduates.[2]

## CLINIC STAFFING

To staff the General Therapy, Flight Surgeon's, and Internal Medicine clinics, Rand first estimated the primary medicine workload each base's active duty and retired patient population should generate and then determined the number of physicians and extenders needed to perform the workload. At the time, this method contrasted with normal Air Force manning standards, which were based [illegible] historical, rather than prospective, workload.[3]

To estimate the workload each base's population should present to an adequately staffed primary medicine clinic, we [illegible] data from a 1974 Rand survey of active duty households at nine Air Force bases.[4] These data indicated that the average active duty household had just over three persons and made 13 [illegible] outpatient visits annually.[5] From patient encounter data at

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[1] The Air Force has directly recruited only a few civilian PAs.

[2] By the time we collected data, the new extenders had almost a year's experience.

[3] The Air Force is currently developing a population-based health care manning method.

[4] The nine bases were Dyess, Homestead, Keesler, March, Mt. Home, Nellis, Peterson, Robins, and Williams.

[5] Chanute's active duty population contained just over 5,000 trainees. We assumed half were single and half married, but without children.

the same nine bases, we also knew that 60 percent were visits to the primary medicine clinics. We calculated that each active duty household at the four demonstration bases would generate 8.1 primary medicine visits annually.

We had no data on the size of the retired population served by each demonstration base. Therefore, to account for the retired workload, we inflated our active duty estimates by the historical contribution of retirees to each hospital's primary medicine workload.

At each base, we agreed with the hospital commander on a target number of providers needed for the base's estimated workload. At Dyess, Fairchild, and Nellis, we aimed for a 2:1 ratio of extenders to physicians. Chanute serves a large number of trainees, who more often present simpler conditions for treatment; here, the ratio was 3:1. The target staffing for all four bases totalled 15 physicians and 32 extenders. As Table 2 shows, the added requirement for flight surgeons and anomalies in the Air Force assignment system caused the actual staffing during the data collection period to differ considerably from the target staffing (1.3:1).

## Table 2

## CLINIC STAFFING

| | Primary Care Physicians | Flight Surgeons | Total Physicians | Extenders |
|---|---|---|---|---|
| Demonstration Clinics | | | | |
| Chanute | 4 | 0 | 4 | 8 |
| Dyess | 4 | 2 | 6 | 7 |
| Fairchild | 2 | 2.5 | 4.5 | 6 |
| Nellis | 4 | 3 | 7 | 8 |
| Total | 14 | 7.5 | 21.5 | 29 |
| Nondemonstration Clinics | | | | |
| Charleston | 4 | 4 | 8 | 4 |
| Luke | 12 | 4 | 16 | 4 |
| Total | 16 | 8 | 24 | 8 |
| All clinics | 30 | 15.5 | 45.5 | 37 |

As we will show in Sec. IV, if we measure staffing by outpatient clinic manhours (rather than number of providers), the provider ratio came close to the 2:1 target (1.95:1).

The target staff numbers included only providers needed for primary medicine. The physicians were frequently out of the clinics, performing other duties. At all bases but Chanute, flight surgeons supervised PAs and saw nonflyers. Outpatient care accounts for only part of a flight surgeon's duties. Consequently, the number of flight surgeons actually assigned to each base was correspondingly larger. In practice, the several flight surgeons usually shared PA supervision.

Because the physicians supervised two or three extenders and limited their practice to the more complex conditions seen in their clinics, board-eligible or board-certified internists or family practitioners were preferred. However, because of shortages of the more highly trained specialists, many of the physicians were general practitioners. The remainder were typically internists. Today, in contrast, the Air Force primarily employs family practitioners and internists.

## WORKLOAD DISTRIBUTION

Our earlier research showed that patients strongly prefer the continuity of care associated with being assigned to a single provider or team of providers (Armor, 1979). To facilitate this continuity and guarantee that the extenders would be supervised, each hospital created provider teams, typically consisting of one physician and two or three extenders. Each patient was assigned to a provider team.

Within each team, the extenders saw most patients coming in for the first time with a new complaint. If possible, the extenders diagnosed and treated the patient without referring to the team physician. The extenders asked their supervising physician for a consultation for approximately 6 percent of the patients—or about 1.5 patients per day. They referred another 9 percent directly to the team physician or a specialist, usually for a return appointment.[6]

The Air Force allows physician extenders to prescribe directly from a list of common medications. Physician counter-signatures are still required for medications not on the list. But the drain on physicians' time is far less than in the civilian sector, where most states allow either no or very limited independent prescription.[7]

## *DATA COLLECTION*

To perform our evaluation of the demonstration project, we collected detailed data on clinic operations. In 1977, after the project had been under way for over six months, we fielded a Patient Contact Record (PCR) for a month at each base.[8] Patients provided information about themselves (age, sex, military status, etc.), their presenting complaint, and if and when they had an appointment. Then the health provider(s) furnished the visit's medical details. He checked off the diagnosis or problem from a list of the more common diagnoses adapted from the ICDA classification system of the Royal College of General Practitioners. Specifically, we used a modification developed by the University of Rochester for use in training family practitioners. The PCR's list accounted for 80 to 85 percent of the conditions seen in our sample clinics.

We also asked the providers to check off the seriousness of the patient's condition, the diagnostic and treatment procedures he performed, any form of consultation requested, and visit disposition. The categories used to indicate seriousness and disposition come from the National Ambulatory Medical Care Survey. We devised our own lists of procedures and consultation types.

When the patient arrived, the receptionist used a time clock to stamp the date and time on the record. Another time stamp indicated when he was called to a treatment room. At the visit's end, the patient indicated how much time he spent with each provider he saw. We

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[6] More detailed data on consultation and referral, including frequency and appropriateness, may be found in Goldberg and Jolly (1980), Sec. IV.

[7] Our quality-of-care analysis found no evidence that the extenders, acting on their own, improperly prescribed (Goldberg and Jolly, 1980).

[8] Appendix A reproduces the Patient Contact Record.

asked him to check one of six time intervals: none, less than a minute, 1–5 minutes, 5–10 minutes, 10–20 minutes, 20–30 minutes, more than 30 minutes.[9]

In addition to collecting PCR data for a month in the primary medicine clinics, we also collected data for a week in the specialty clinics. This report uses only the primary medicine data. The total number of records collected at each base is: Chanute, 5010; Dyess, 4304; Fairchild, 3780; Nellis, 4959. The total is just over 18,000 records collected.

The PCR data were collected from mid-March through late June. Subsequently, we also fielded the PCR in the primary medicine clinics at Charleston AFB (3042 in four weeks in July) and Luke AFB (3532 in two weeks in October).

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[9] In 1974, we collected similar data at nine bases. In addition to stamping the record with the time at arrival and entry to the treatment area, we also stamped it when the patient left the treatment area. We were thus able to validate the patients' treatment time estimates with the time-clock estimates. Although the latter estimate was larger because of time spent waiting in the treatment area, the two estimates were highly correlated.

# III. PROVIDER COSTS

In this section, we measure and compare the long-run cost of employing an additional physician in the outpatient clinics with the cost of using a PA in that role. The methodology we use determines the cost to the Air Force of staffing a position with a particular category of personnel. We construct a billet cost model that calculates expected expenditure streams over time as a function of continuation behaviors. Recruitment, training, wage, and retirement cost are included in the expenditure stream for each labor category. Because the expenditure profiles for each category differ, expected annual costs are projected into the future, discounted, and summed. Each year, according to his group's continuation probability, the practitioner either opts to remain in the service an additional year at a given salary expense or leaves, which necessitates recruiting a new provider.

Most Air Force PAs are recruited from individuals already in the service who are trained in an Air Force program and subsequently remain in the service until they are eligible for retirement, or beyond. Physicians, however, are recruited through a medical school scholarship program or directly from the pool of trained physicians and are characterized by substantially lower continuation rates. The lower continuation rates imply that new physicians must be recruited more frequently. Because fewer physicians reach retirement eligibility, the additional physician procurement costs are partially offset by lower aggregate retirement costs. The interplay of all these variables points to the need for a fairly sophisticated cost measurement scheme that can incorporate these expenditures over time.

## METHODOLOGY

The billet cost model estimates the expected discounted cost of maintaining a position indefinitely with one type of personnel. Different labor categories must be evaluated separately and then compared.

When the Air Force staffs a position using a particular category of provider, the cost equals the (summed) expected discounted costs incurred each year; the infinite planning horizon facilitates the calculations and eliminates inequities introduced with an arbitrary finite horizon. Each provider serves a period of time for which the Air Force pays procurement costs, bonuses and salaries, and possibly retirement pay. The period of service and the costs vary with the provider's category, continuation probabilities, and promotion schedule. When the provider leaves the service, the Air Force must procure a new individual and begin a new cost cycle. We assume that the cost patterns and the continuation probabilities remain stationary over time. This assumption, together with an infinite planning horizon, implies that the expected discounted costs from the point of each new procurement equal those from the initial procurement. Thus, the cost model is recursive.

### Mathematical Formulation

At the beginning of the planning horizon, the Air Force obtains a person from provider group $s$ at a procurement cost of $T_s$. The remaining costs also depend upon the provider category. Computing the expected discounted cost for each year requires knowing whether the practitioner remains in the service another year. When he remains, the cost is just his salary plus bonus pay. Conversely, when he leaves, a new recruit is needed and the cost cycle begins again. The expected discounted costs from this point forward are the same as those from the beginning of the planning horizon forward, because costs are stationary and the horizon is infinite. If the provider has served 20 years before leaving, we add a discounted retirement annuity.

Symbol definitions are provided in Table 3.

## Table 3

### LIST OF SYMBOLS

| | |
|---|---|
| $\Phi_s$ | expected discounted cost of staffing a position with labor class s. |
| $e^{-rt}$ | discount factor at the end of year t. |
| $h_s$ | years until mandatory retirement for a provider from provider category s. |
| $l_s$ | expected years from age at entry until provider and spouse die for provider from category s. |
| $P_s(t/t - 1)$ | conditional probability that a provider from category s remains in service another year given he has been a medical provider for t - 1 years. $P_s(t/t - 1) \equiv 0$ for $t \geq h_s$. |
| $p_s(t) = \prod_{j-1}^{t} P_s(j/j - 1)$ | probability that a provider from category s remains at least t years. $P_s(0) \equiv 1$. |

$$R_s(t - 1) = \frac{F\left(e^{-rt} - e^{-rls}\right)}{r} \quad \text{where } F = \begin{cases} 0 & \text{for } t < 20 \\ \text{Retirement Wage} & \text{for } t \geq 20 \end{cases}$$

which is the discounted value of the retirement annuity for a provider who retires after t - 1 years of service.

| | |
|---|---|
| $T_s$ | procurement cost for a provider from category s expressed as a future value to the availability date. |
| $W_s(t)$ | salary plus bonus cost in year t for a provider from group s. |

Let $\Phi_s$ denote the expected discounted costs for a category s provider; then $\Phi_s$ may be thought of as the sum of annual terms. At the beginning of each year, t, we observe that with probability $P_s(t/t - 1)$ the current provider will remain an additional year and receive wages and bonus pay equal to $W_s(t)$. Alternatively, with probability $1 - P_s(t/t - 1)$ the current provider leaves and a new cycle $\Phi_s$ begins. For computational convenience we assume providers leave only at the beginning of a year and that wages are paid out at the end of each year, so the discounted wage cost is $W_s(t)e^{-rt}$ while new cycle costs are discounted at $e^{-r(t-1)}$. The discounted retirement annuity $R_s(t-1)$ included for all terminating providers is zero when the completed years of service, $t-1$, total less than twenty. This annual expression is given in Eq. (1) below.

$$P_s(t/t-1)W_s(t)e^{-rt} + (1 - P_s(t/t-1))(\Phi_s e^{-r(t-1)} + R_s(t-1)) \tag{1}$$

To accumulate these annual terms we multiply the conditional probabilities of remaining or terminating by the probability of reaching year $t-1$, $p_s(t-1)$. The probability of reaching year 0 is one, that is $p_s(0) \equiv 1$. These annual terms are summed over the years until mandatory retirement, year $h_s$. The conditional probability of staying during the mandatory retirement year, $P_s(h_s/h_s-1)$, and for any year thereafter is by definition equal to zero.

Adding procurement costs gives the expected total discounted costs as in Eq. (2).

$$\Phi_s = T_s + \sum_{t=1}^{h_s} p_s(t-1)\left[P_s(t/ts-1)W_s(t)e^{-rt} + (1 - P_s(t/t-1))(\Phi_{s\,Fe}{}^{-r(t-1)}\,R_s(t-1))\right] \tag{2}$$

This expression may be solved for $\Phi_s$ yielding

$$\frac{\Phi_s = T_s + \sum_{t=1}^{h_s} p_s(t-1)\left[P_s(t/ts-1)W_s(t)e^{-rt} + (1 - P_s(t/t-1))\,R_s(t-1))\right]}{1 - \Sigma\, p_s(t-1)(1 - P_s(t/t-1))e^{-r(t-1)}} \tag{3}$$

Our model assumes providers spend their entire military careers in the outpatient clinics. Although a small number of physicians from all specialties enter administrative positions and executive medicine, we feel this simplification is justified because each physician has only a small chance of holding one of these posts.

The cost computation for two years might be pictured as in Fig. 1. At each node, one path or another is undertaken with some probability. Squares represent path endpoints. The probability of reaching the top node along the upper path equals the product of the probabilities along each segment of the path. This may be interpreted as the probability that a provider from procurement source s remains in the service at least two years.

## Provider Categories

This report examines two primary care provider categories: primary medicine physicians and physician's extenders. Although the physician category includes general practitioners, the responsibilities of extender supervision call for the added training of family practitioners and internists. In the Air Force, the extender category is dominated by PAs. Therefore, we estimate the costs of using a family practitioner or an internist against using a PA to fill a primary medicine slot.

In addition to physicians and PAs, we also compute the cost of a medical corpsman position. In Air Force primary medicine clinics, corpsmen perform most of the medical sup-

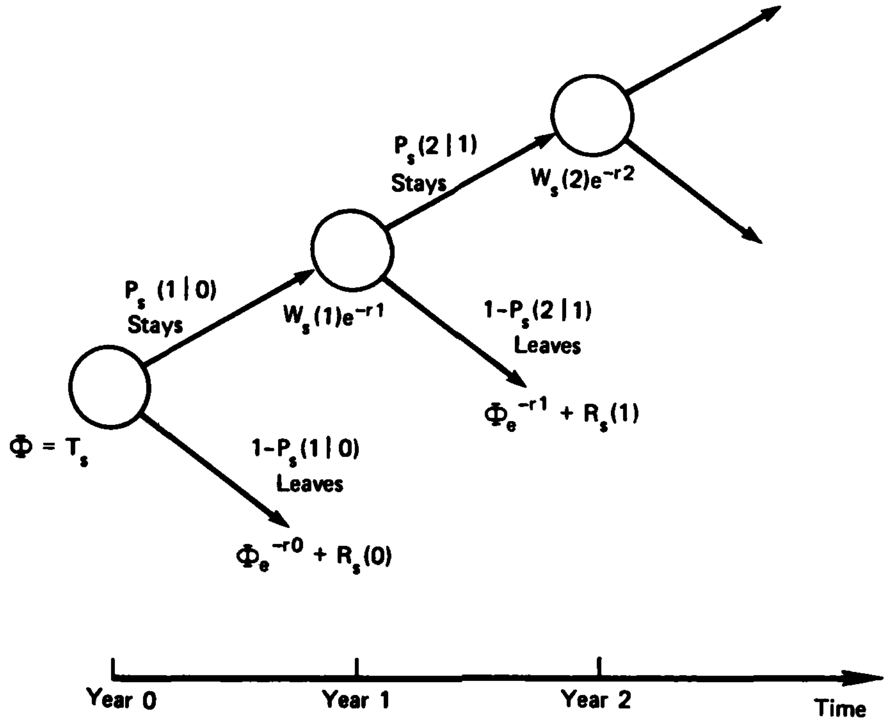

Fig. 1—Expected discounted cost computation

port duties. We use the corpsman cost figures in Sec. IV, which discusses patient care productivity.

## Provider Characteristics

Table 4 summarizes the basic characteristics of the health care personnel whose costs we calculate below. The Air Force procures most new physicians from two sources: the Health Professions Scholarship Program (HPSP) and the Volunteer Recruiting Program.[1] The HPSP program offers medical students tuition and a stipend in return for a year's active duty service for each year of support. The typical HPSP family practitioner or internist is supported through four years of medical school. He then either enters active duty status and completes three years of residency training in an Air Force hospital or is deferred for similar civilian residency training. He therefore begins his Air Force primary medicine practice as a 29-year-old captain (O-3) with either 3 years or no years of prior active duty service.

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[1] The military medical school, called the Uniformed Services University of the Health Sciences, will not provide substantial numbers of family practitioners or internists for some years.

## Table 4

### PROFILES OF AIR FORCE PRIMARY MEDICINE CLINIC PERSONNEL

| | | | Profile Upon Beginning Clinic Practice | | | |
|---|---|---|---|---|---|---|
| Personnel Type | Procurement Pool | AF Sponsored Training | Grade | Years of Credited Service | Age | Special Pay |
| HPSP physician | U.S. medical students | 4 years scholarship to civilian medical school. AF or civilian 3 year residency | 0-3 | 0-3 | 29 | up to $21,000 |
| Volunteer physician | Civilian practice | None | 0-3 or 0-4 | 0 | 35 | up to $21,000 |
| AF trained PAs | Medical corpsmen | 2 years | 0-1 | 8 | 28 | no extras |
| Corpsmen | Enlisted recruits | 6 weeks | E-2 | 0 | 20 | no extras |

The Volunteer Recruiting Program recruits fully trained physicians from civilian practice. The physician's entry grade depends on the length of his residency training and on how many years he has practiced medicine. Family practitioners and internists may enter as captains (O-3) or majors (O-4). Volunteer physicians enter the Air Force at widely varying ages. We assumed an entry age of 35 and grade of major (O-4).

Although the Air Force has recruited some trained civilian PAs, it primarily relies upon in-house trained PAs. Medical corpsmen with three or more years of experience may apply for two years of PA training. In recent years, this experience has averaged from five to seven years. As a result, the typical PA completes his training at age 28 with eight years of prior service. He must complete a four-year obligated service period, leaving only eight years until retirement eligibility. The Air Force commissions PA graduates as second lieutenants (O-1). Congress has mandated that PAs not be promoted beyond the rank of major (O-4).

Medical corpsmen are selected from enlisted recruits and given six weeks' training. They begin clinic work at age 20 and with the rank of airman (E-2).

## DATA

Our model depends on the long run level of total costs and on the relative contribution of the procurement, salary, and retirement cost components for each provider type. These are affected by the absolute value of these components and by the promotion and continuation rates associated with the provider type. The continuation rates determine how often a new recruit is needed, whether or not retirement eligibility is reached, and how large the salary component becomes.

### Procurement Costs

The primary procurement costs are recruitment and training program expenditures. These costs typically accrue for several years before the provider is available to deliver care routinely. For example, a family practitioner may apply to the HPSP program eight years before availability, attend medical school commencing seven years and finishing three years before, and then undertake residency training for the three years immediately preceding availability. This family practitioner receives residency training either in the Air Force or in a civilian hospital. We assume that military residents deliver care that just offsets their training costs. HPSP participants receive no Air Force support during civilian residencies. Therefore, no costs accrue during the residency years, and all recruitment and scholarship costs are incurred four to eight years before availability. Table 5 displays and compares procurement expenditure streams across provider categories.

Volunteer physicians' procurement costs include only recruiting and basic training. The recruiting cost figure equals the average across all volunteers, regardless of specialty and qualifications. The marginal recruiting cost of well-trained physicians, even in family practice, was probably higher.

In theory, the costs of Air Force-trained PAs should include the costs of supplying trainees through the corpsmen force. Because the PA program draws on experienced, highly

## Table 5

### FY80 PROCUREMENT COSTS

| Date (years before start date) | HPSP Physicians | Volunteer Physicians | PAs | Corpsmen |
|---|---|---|---|---|
| 0 | 1960[a] | 1960[a] | | 4363[b] |
| 1 | | 5900[c] | 8500[d] | 1100[c] |
| 2 | | | 37527[b,e] | |
| 3 | | | 1100[c] | |
| 4 | 14000[f] | | | |
| 5 | 14000[f] | | | |
| 6 | 14000[f] | | | |
| 7 | 14000[f] | | | |
| 8 | 2600[c] | | | |

[a] Physician Orientation Costs, Management Analysis Division, Air Training Command.

[b] Basic and corpsmen training costs, Management Analysis Division, Air Training Command.

[c] Recruiting Costs, Health Professions Recruiting Division, Headquarters USAF Recruiting Services, Air Training Command.

[d] Second year training costs, Management Analysis Division, Air Training Command. We assumed that one-half of the second year training costs are recouped in clinic services.

[e] First year training costs, Management Analysis Division, Air Training Command.

[f] HPSP costs, Health Policy and Plans Division, Directorate of Medical Plans and Resources, Office of the Surgeon General.

capable corpsmen, this cost includes the value of their forgone product. As we cannot easily measure the value of the forgone product, our model omits it.[2] However, we do add the cost of procuring and training a replacement corpsman. We further assume that even with maximal expansion in the PA program, the training program draws a small enough percentage of the corpsmen to leave corpsmen continuation rates and recruiting costs unaffected.

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[2] Some highly qualified corpsmen might leave the service without the career advance offered through PA training.

## Salary, Allowances, and Bonus Pay

All wage costs depend on pay grade and years of prior service. Computations include quarters and subsistence allowance. We used the schedule of basic pay and allowances effective October 1980.[3]

In addition, physicians receive bonus pay based on years of creditable service and whether or not they are board certified. Creditable service includes residency training and years spent as a medical officer in the Public Health Service or Uniformed Services. The physician bonus schedule, given in Table 6, does not include incentive special pay, typically allocated to the scarcer surgical specialties.

Table 6

PHYSICIAN BONUS PAY

| Years of Creditable Service | Without Board Certification | With Board Certification |
|---|---|---|
| 1-5 | 14,000 | 16,000 |
| 6-7 | 19,000 | 21,000 |
| 8-9 | 18,500 | 20,500 |
| 10-11 | 19,000 | 21,500 |
| 12-13 | 18,000 | 21,000 |
| 14-17 | 17,000 | 21,000 |
| 18-21 | 16,000 | 21,000 |
| 22 or more | 15,000 | 20,000 |

## Promotion Schedules

A practitioner's promotion schedule and entry grade depend on his training and prior service. Table 7 presents the promotion schedules we use. Many physicians are promoted promptly through lieutenant colonel (O-5), but PAs may have to wait longer before receiving their promotions.

Recall that volunteer physicians may enter laterally; internists and family practitioners may begin their service as captains (O-3) or majors (O-4). HPSP physicians are commissioned as captains. The Air Force has been commissioning its PAs upon completion of training with the rank of second lieutenant (O-1). The PA commissioning program has come under Congressional fire; pending resolution of this issue, we assume future PAs will be commissioned.[4]

Given current policy prohibiting PA promotions beyond major, the time in grade figures beyond O-3 are hypothetical.

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[3] The Regular Military Compensation schedule, RMC, includes the tax advantage, which is not a cost to the Air Force, so it is not used here.

[4] Hosek (1980) compares civilian PAs' earnings with military officer, warrant officer, and enlisted military pay. The results suggest that an ample supply of well-qualified PAs (or corpsmen applicants) may not be available without commissioning.

Table 7

PROMOTION SCHEDULES, YEARS IN GRADE

| Rank | | HPSP Physician | Volunteer Physician | PAs[a] | Corpsmen[b] |
|---|---|---|---|---|---|
| E-2 | | -- | -- | -- | 1 |
| E-3 | | -- | -- | -- | 2 |
| E-4 | | -- | -- | -- | 3 |
| E-5 | | -- | -- | -- | 7 |
| E-6 | | -- | -- | -- | 4 |
| E-7 | | -- | -- | -- | 3 |
| Second Lieutenant | 0-1 | -- | -- | 2 | -- |
| First Lieutenant | 0-2 | -- | -- | 2 | -- |
| Captain | 0-3 | 3 | -- | 7 | -- |
| Major | 0-4 | 5 | 5 | 6 | -- |
| Lieutenant Colonel | 0-5 | 7 | 7 | 6 | -- |

[a] See Hosek (1980).

[b] Manpower Personnel Center.

## Continuation Probabilities

Each provider category is characterized by its own continuation behaviors. These determine how often new recruits are needed and whether retirement annuities are incurred. The initial estimates for our conditional continuation probabilities are the yearly retention factors for each provider type from the Health Policy and Programs Report Number 110-80 entitled "Physician Retention and Outlook with an Analysis by Specialty" by John Bircher (June 1981).

The product of these conditional probabilities from year 1 to year t yields the probability that an individual from the group remains in the service at least t years. A plot of the latter probabilities is frequently referred to as a continuation curve. We developed smooth approximations to the continuation curves derived from Bircher's estimates. These facilitate sensitivity analysis. Detailed development is presented in Appendix D.

## Retirement Costs

Providers completing twenty years of service or more receive retirement benefits based upon the highest grade attained and the number of years in service. For officers, three years' tenure in any grade are required to retire at that level. Retirees receive one half of their basic pay for twenty years of service plus an additional 2.5 percent of their base pay per year beyond twenty up to a maximum of 75 percent. A retirement annuity is then paid out each year from retirement until death. The continuation curves incorporate each group's retirement probability distribution. We include the discounted value of the retirement annuity as a retirement cost.[5]

Retirement benefits, when earned, are paid out until age 80. Military actuarial tables give life expectancy of 76.8 years for officers at age 35. Eighty years was chosen because all providers are assumed married, and many spouses live longer and collect some survivors' pay.

## COMPUTATIONAL RESULTS AND SENSITIVITY ANALYSIS

Because we are looking at cost streams through time, the discount rate selected will affect the relative costs of each provider type. As no consensus exists on the one appropriate real discount rate, we present results for three real rates: 10, 5, and 2 percent. Discount rates reflect the time value of money; thus a high rate would favor provider types with low procurement cost and higher retirement costs, and the low rate is less sensitive to when expenditures are made. Provider cost comparisons are displayed in Table 8. The dollar values for the procurement, salary plus bonus, and retirement cost components; the total cost per accession; and the expected discounted cost figures are expressed in thousands of dollars. The three cost components may be thought of as expected costs per accession, and their relative importance as a percentage of the expected total cost per accession are given in the lower portion of the table. The recursion factor, in the upper portion of the table, corresponds to the denominator in expression (3) and represents the proportion of the total discounted cost played by the cost per accession.

Since the Air Force largely relies on the HPSP program and its PA training program for primary medicine providers, we used these groups as our baseline. Table 8 indicates that relatively more of the HPSP physician costs are procurement costs, while PAs have larger retirement cost components. The typical PA enters the service at age twenty and receives his corpsman and PA training on the job. Physicians generally train outside the military and enter the service later. Thus, PAs are younger when they retire and receive retirement pay for a longer period. Annual retirement pay, which is based only on salary and does not include the bonus, differs less than active duty pay. In addition, PAs having higher continuation probabilities are more likely to reach retirement eligibility.

The total discounted costs of PAs relative to physicians are shown as the provider cost ratios at the bottom of Table 8. PA costs range from 60 to 90 percent of physician costs, depending upon the discount rate. In Sec. IV, we accept the 5 percent discount rate and use these relative costs: 1.0 for physicians, .7 for PAs, and .2 for corpsmen.

### Sensitivity Analysis

We have chosen the HPSP physician group to demonstrate the effect of altering some of our assumptions.

In Table 9 we depict HPSP physician costs under four sets of assumptions. Set one reproduces the figures from Table 8. In set two we ask how our results change when we lower retention rates. Here we see that the expected cost per accession drops because of lower salary and retirement cost components. However, the total discounted cost changes little. With new

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[5] Volunteer physicians entering after age 40 will not be eligible to retire before mandatory termination at age 60. We have ignored this relatively small group.

## Table 8

### PROVIDER COST COMPARISONS

(Costs reported in thousands)

| | HPSP Physician | | | PA | | | Corpsmen | | |
|---|---|---|---|---|---|---|---|---|---|
| Discount rate | .10 | .05 | .02 | .10 | .05 | .02 | .10 | .05 | .02 |
| Procurement cost | 105.4 | 79.7 | 67.5 | 56.7 | 51.7 | 48.9 | 5.6 | 5.5 | 5.5 |
| Salary cost | 210.9 | 292.0 | 368.9 | 154.7 | 207.5 | 250.8 | 33.4 | 42.2 | 49.7 |
| Retirement cost | 2.9 | 15.2 | 43.9 | 26.1 | 88.5 | 209.8 | .5 | 2.7 | 8.0 |
| Total per accession | 319.2 | 386.9 | 480.3 | 237.5 | 347.7 | 509.5 | 39.5 | 50.4 | 63.2 |
| Recursion factor | .515 | .334 | .162 | .644 | .410 | .192 | .376 | .225 | .632 |
| Total discounted cost | 620 | 1157 | 2969 | 369 | 848 | 2654 | 105 | 224 | 620 |
| Cost component distribution (percentages) | | | | | | | | | |
| Procurement cost | 33 | 21 | 14 | 24 | 15 | 10 | 14 | 11 | 9 |
| Salary cost | 66 | 75 | 77 | 65 | 60 | 49 | 85 | 84 | 78 |
| Retirement cost | 1 | 4 | 9 | 11 | 25 | 41 | 1 | 5 | 13 |
| Provider cost ratios (relative to HPSP physician costs) | 1.0 | 1.0 | 1.0 | .6 | .7 | .9 | .2 | .2 | .2 |

## Table 9

### Sensitivity of HPSP Physician Expected Cost Figures

(Costs reported in thousands)

| | Continuation Curve Estimates | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Civilian Residency | | | | | | Military Residency | | | | | |
| | High Retention | | | Low Retention | | | High Retention | | | Low Retention | | |
| Discount rate | .10 | .05 | .02 | .10 | .05 | .02 | .10 | .05 | .02 | .10 | .05 | .02 |
| Procurement cost | 105.4 | 79.7 | 67.5 | 105.4 | 79.7 | 67.5 | 105.4 | 79.7 | 67.5 | 105.4 | 79.7 | 67.5 |
| Salary cost | 210.9 | 292.0 | 368.9 | 191.0 | 257.3 | 318.5 | 219.1 | 297.5 | 369.0 | 199.6 | 264.4 | 322.2 |
| Retirement cost | 2.9 | 15.2 | 43.9 | 2.1 | 10.8 | 31.3 | 4.7 | 21.9 | 59.6 | 3.4 | 15.9 | 43.3 |
| Total per accession | 319.2 | 386.9 | 480.3 | 298.5 | 347.8 | 417.3 | 329.2 | 399.1 | 496.1 | 308.4 | 360.0 | 433.0 |
| Recursion factor | .515 | .334 | .162 | .474 | .300 | .143 | .510 | .327 | .156 | .470 | .290 | .139 |
| Total discounted cost | 620 | 1157 | 2969 | 630 | 1159 | 2927 | 646 | 1220 | 3176 | 656 | 1220 | 3122 |
| Cost component distribution (percentages) | | | | | | | | | | | | |
| Procurement cost | 33 | 21 | 14 | 35 | 23 | 16 | 32 | 20 | 14 | 34 | 22 | 16 |
| Salary cost | 66 | 75 | 77 | 64 | 74 | 76 | 67 | 75 | 74 | 65 | 73 | 74 |
| Retirement cost | 1 | 4 | 9 | 1 | 3 | 8 | 1 | 5 | 12 | 1 | 4 | 10 |

physicians being recruited more frequently, procurement costs are substantial, ranging from 14 to 35 percent.

Sets three and four assume the physicians complete a military residency instead of a civilian residency. Here both the costs per accession and the totals increase. Physicians spend fewer years in the outpatient clinic until retirement eligibility is reached and receive higher wages for their military residency experience. Of course, these results assume the Air Force will retain military residents and civilian residents at the same rate.

### Directly Procured Providers

Volunteer physicians represent an alternative to HPSP physicians.[6] Their cost profiles are shown in Table 10. HPSP physicians are 20 to 40 percent more expensive than volunteer physicians depending upon the discount rate used.

Current Air Force policy recruits PA trainees from the corpsmen pool, accepting only the best of this group. An alternative to this procedure is to recruit PA trainees directly from the enlisted pool. Continuation probabilities should decline with this approach. We assume that such a group would have retention rates similar to nurses. The cost profile for these PAs are found in Table 10. Current PA policy increases relative PA costs from 10 to 40 percent.

In theory, PAs could be recruited directly from civilian training programs. Recruiting trained personnel is more costly; we assume the cost increases to $3550, the level of nurse recruiting cost. A $2000 cost for an orientation program, similar to that of physicians, is also included. From Table 10 we see that this policy might reduce costs by as much as 40 percent, reducing the cost ratio of PAs to HPSP physicians to only .4.

## SUMMARY

PA/MD cost ratios range from .5 to 1.1 depending upon the type of physician and PA, and the discount rate. For the following analysis we assume a 5 percent discount rate and use the current recruiting policies for PAs and physicians (HPSP program). This yields a PA/MD cost ratio of .7. The corpsmen/MD ratio is .2 regardless of the discount rate. These figures estimate the costs of the providers without regard to their skills. Although we have analyzed quality of care and productivity differences between MDs and PAs, we have not investigated such differences within either provider class.

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[6] In the past, compared with HPSP physicians, many entering volunteer physicians have been less well qualified. Equally qualified volunteers may cost more to recruit and retain, but no evidence exists on this point.

## Table 10

## SENSITIVITY ANALYSIS USING OTHER PRIMARY CARE PROVIDER PROCUREMENT POLICIES

(Costs reported in thousands)

| | Volunteer Physicians | | | PAs<br>No Corpsmen Experience | | | PAs<br>Civilian Trained | | |
|---|---|---|---|---|---|---|---|---|---|
| Discount rate | .10 | .05 | .02 | .10 | .05 | .02 | .10 | .05 | .02 |
| Procurement cost | 8.5 | 8.2 | 8.0 | 53.8 | 49.0 | 46.4 | 5.9 | 5.7 | 5.6 |
| Salary cost | 164.0 | 210.5 | 251.2 | 100.1 | 137.3 | 171.4 | 94.9 | 133.5 | 170.5 |
| Retirement cost | 1.2 | 5.6 | 14.9 | 4.2 | 19.9 | 56.9 | 3.4 | 17.7 | 52.9 |
| Total per accession | 173.7 | 224.3 | 274.1 | 158.1 | 206.2 | 274.7 | 104.2 | 156.9 | 229.0 |
| Recursion factor | .402 | | .113 | .475 | .301 | .143 | .480 | .308 | .148 |
| Total discounted cost | 432 | 916 | 2430 | 333 | 684 | 1923 | 217 | 509 | 1547 |
| Cost component distribution (percentages) | | | | | | | | | |
| Procurement cost | 5 | 4 | 3 | 34 | 24 | 17 | 6 | 4 | 3 |
| Salary cost | 94 | 94 | 92 | 63 | 67 | 62 | 91 | 85 | 74 |
| Retirement cost | 1 | 2 | 5 | 3 | 10 | 21 | 3 | 11 | 23 |

# IV. PROVIDER PRODUCTIVITIES

Although physician's extenders typically cost less than primary medicine physicians, utilizing extenders need not be cost effective. Conceivably, physicians could redeem their added salary costs by being sufficiently more productive in patient care. In this section, we report our analyses of provider productivities during the demonstration project and combine the evidence on productivities and costs to explore the cost effectiveness of the project's staffing ratio.

One purpose in conducting the demonstration project was to measure extenders' productivity when they treat most primary medicine patients in a typical Air Force clinic. In 1976, the existing evidence on extender productivity all related to civilian office practices in which extenders played only a minor role (Reinhardt, 1973). Although intended to remedy this lack of relevant information, the project was not designed as an experiment to determine the optimal provider mix.[1] Instead, it allows us to determine if the changes in patient care productivity add to or detract from personnel costs when clinics rely heavily on extenders.

Provider productivity in outpatient care has two dimensions. First, each provider allocates his working time between outpatient care activities and other activities. Competing activities include other productive work in the hospital, such as inpatient care, and nonproductive activities. Second, two providers who spend equal time seeing similar outpatient caseloads will typically differ in the volume of patients they can treat. In both dimensions, we might expect to find individual and group differences in productivity. That is, physicians (and extenders) differ from one another, but physicians as a group may differ systematically from extenders.

We first present data from several sources to suggest how the project's physicians and extenders allocated their time to nonoutpatient work, nonproductive activities, and outpatient care in the primary medicine clinics. We conclude that the time allocation data do not show differences in nonproductive times between provider groups; therefore, the cost ratios from the previous section adequately measure the relative costs of provider outpatient contact minutes. However, the primary medicine physicians do spend more time on other productive activities and less time on outpatient care than extenders do.

We then describe two approaches we used to estimate the outpatient productivity of a minute of each provider's time. One approach is production function estimation, which relates a clinic's patient volume in each time period to the time inputs of each provider group, as well as other variables. By comparing provider costs and productivity, we can see whether the provider mix is approximately efficient. Another approach is activity analysis. Here, we categorize the caseload, identify alternative provider "teams" available to treat each category and the associated per visit time inputs, and allocate the total caseload to minimize provider costs, subject to various constraints. Reinhardt compares these two approaches, pointing out that production function estimation assumes the production process has a random element and permits the researcher to evaluate the statistical significance of his results. However, the production function uses but a single measure of output. Activity analysis permits a fuller specification of output, but the results are sensitive to the specifications of output and pro-

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[1] Such an experiment would require differing ratios at enough clinics to separate the productivity effects of the staffing ratio from the effects of other clinic characteristics.

vider teams. In addition, the production process is seen as deterministic rather than stochastic. Because our data are better suited to activity analysis, we base our conclusions on this approach. However, the production functions we estimate would support the same conclusions.

The unit of output is the patient visit. A better measure would have been the set of visits needed to treat an episode of illness. By measuring productivity in visits, we run the risk of missing differences in productivity attributable to differing numbers of visits per episode. However, the Patient Contact Records cover only a four-week period, which is too short to reliably measure episodes. Based on Goldberg and Jolly's (1980) broad evidence, it is unlikely that we overstate PA productivity by ignoring return visit ordering rates.

With both techniques, we find that, during the demonstration project, physicians and extenders were equally productive during the time they devoted to outpatient care. So long as extenders cost less to employ and continue to match physicians' productivity in outpatient care, the Air Force should rely on extenders to treat the majority of its primary medicine patients. Primary medicine physicians should be assigned to treat the minority of patients whose problems fall outside the extenders' expertise, to guarantee the extenders are adequately supervised, and to sustain patient acceptance.

## ALLOCATION OF TIME

To measure provider input, we use data from the Patient Contact Records (PCRs) on contact time, or the time providers spend face-to-face with patients. Contact time excludes such outpatient care activities as record review or consultation, when they are performed out of the patient's sight. Here, we compare the provider groups' allocations of time between outpatient care contacts and other activities. The data suggest the extenders spent far more time with outpatients than the physicians did.

### Sources of Time Allocation Data

From the PCRs, we know how much time each provider spent with each patient, or with all the patients he saw in any given time period. Although the PCR data probably underestimate the clinics' actual patient visit outputs and provider time inputs by not having complete PCRs for all patients, we do not believe the underestimation differs by provider group. The patient rather than the provider supplied the time information immediately after the visit; the likelihood of patients' compliance should not depend on the type of provider seen. We corrected occasional patient misidentifications of providers—usually, mistaking PAs for physicians or PCNPs for nurses—by checking the provider ID codes.

To supplement the PCR data, we asked the providers to complete a daily "Effort Report." This form, reproduced in Appendix C, gives the number of hours each provider devoted to major activities, including inpatient care, outpatient care, telephone consultations, record keeping, etc. Of the 50 providers in the primary medicine clinics, 39 completed one or more Effort Reports. On average, respondents completed 14 of the maximum 20 reports possible. Almost all Effort Reports described an eight-hour day. Therefore, we have used these data only to estimate the number of hours each provider group devoted to outpatient care conditional on working a complete day.

To estimate absence rates, we surveyed the PCR data for each morning and afternoon. If we found no records at all for a given provider ID, we marked that provider absent. We found that the physicians were absent one day more than the PAs were. The PA figure corresponds to a 1978 Air Force estimate that its officer personnel were not available to perform their assigned duties 13.5 percent of the time.[2]

## Results

Table 11 summarizes the data on provider groups' time allotments to outpatient care. We have separated the flight surgeons from the other primary medicine physicians and PAs from PCNPs. The flight surgeon and PCNP figures are based on data from only seven individuals each.

Table 11

ALLOCATION OF TIME TO OUTPATIENT CARE

| | Physicians | | Extenders | |
|---|---|---|---|---|
| Item | GPs Internists | Flight Surgeons | PAs | PCNPs |
| Contact minutes per day (mean) | 102.4 | 79.9 | 162.7 | 116.6 |
| Half-days worked in clinic per week (mean) | 6.8 | 5.7 | 8.5 | 7.4 |
| Hours of outpatient care per full day worked (median) | 5.5 | 5.9 | 6.6 | 5.6 |
| Average contact minutes per hour of outpatient care | 27.4 | 23.8 | 29.0 | 28.1 |

Flight surgeons must routinely spend time on the flight line and in the air. Therefore, we estimate they average a day less in the outpatient clinics than the other primary medicine physicians.

Comparing the general practitioner-internist group with the PAs, we see that the PAs typically spent considerably more time with outpatients. However, there was no appreciable difference in the proportion of an hour's outpatient care time spent in patient contact. Instead, the difference apparently lies in the number of hours devoted to outpatient care. The physicians were absent from the clinics more often and they spent more time on inpatient care and other duties.

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[2] Doering, Perry, and Shishko (1979) summarize and compare nonavailability data from all three services.

Half the one-day difference between physicians and PAs is easily explained. The physicians at the demonstration hospitals, but not the PAs, shared emergency room on-call duty. In compensation, the physicians were typically given an afternoon off each week. The remaining half-day gap probably reflects the physicians' wider responsibilities. But this is also the one estimate related to provider inputs from the PCRs that relies upon physician compliance in completing the data instrument. If the physicians did not supply their ID numbers we cannot credit the visits to them. We do know that the physicians were less likely to be diligent in completing PCRs; we may be overestimating their absences.[3]

Not surprisingly, the Effort Report data indicate that when both physicians and PAs worked a full day, the former spent less time in outpatient care. The hour's difference is largely due to the physicians' greater inpatient duties.

The physicians who were not flight surgeons reported averaging 1.5 hours each weekday on inpatient activities; flight surgeons and extenders averaged .5 hours. Data taken from the Air Force's monthly Report of Patients system in FY77 suggest the four demonstration hospitals admitted about 15 medical inpatients each per week, including quarters or "infirmary" patients. If this inpatient burden was primarily borne by the 15 internists and family or general practitioners, it represents between three and four nonquarters admissions for each physician, or around 15 patient-days. If we subtracted a physician from the staff at each hospital with no change in the inpatient workload, this workload would increase by no more than a third, or from 1.5 to a maximum of 2.0 hours a day.

For the purposes of addressing outpatient clinic staffing (below), we use these findings on time allocations to infer that: (1) differences in contact times observed for physicians and PAs probably reflect the two groups' assigned responsibilities, and we need not adjust the cost ratios from Sec. III for differences in nonproductive time; and (2) a conservative estimate of the outpatient care time gained by adding an additional physician or PA to these primary medicine clinics would equal the average daily contact times we estimated from the PCR data (the figures in the first row of Table 10). The second inference is that the inpatient load on each primary medicine physician remains constant.

## PRODUCTION FUNCTION ANALYSIS

Production functions estimate the relationship between output and both labor and capital inputs. Labor inputs are usually measured by manhours or number of workers. The demonstration project clinics possessed much the same capital equipment. With no good measure of the number of providers available to treat patients, we instead used the less desirable labor input measure, contact time.

In effect, contact time measures the utilization rate of the labor input. It would be a poor measure if we wanted to estimate the production possibility frontier—the *maximum* output that can be produced with a given set of providers. But we are interested instead in estimating the average output we can expect the providers to produce, and how the output changes with the provider mix. Because all the clinics reported they typically filled their primary medicine appointments and they experienced at least some overflow of the emergency room, the staffing was apparently not excessive. In this case, we believe the contact times give us a reasonable measure of available provider inputs.

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[3] If so, we are correspondingly overestimating the proportion of their outpatient care time spent in patient contact.

The general form of the production function we estimated is

$$V_{ijk} = f(MD_{ijk}, PA_{ijk}, NP_{ijk}, O_{ijk}, J; Z_{ij})$$

where i refers to the clinic (General Therapy or Flight Surgeons), j indicates the base, k the day or half-day, and V = the number of patient visits; MD = total physician contact time; PA = total PA contact time; NP = total PCNP contact time; O = total contact time by corpsmen, nurses, and other support personnel; J = base indicator; Z = vector of other variables.

The unit of observation is a clinic session. For the demonstration bases, this is a half-day. The variation in output (visits) and inputs (contact times) arises from both staffing differences across clinics and provider availability across days. Recall that the availability of overflow clinics (the emergency rooms) and their routine daytime use by primary medicine patients give us some assurance we are measuring average attainable productivity, not the productivity of chronically underutilized providers. We are, however, observing the combined effects of changing the number and ratios of providers and changing the outpatient care time input per provider.

## Data

The PCR data were used to estimate the production function. Each PCR represents one visit, even if just for a prescription refill. We combined all the records for a clinic during each morning or afternoon, as indicated by the time stamped as the patient arrived. We summed the number of visits, the contact times, and the proportion of visits falling into various categories of interest. We excluded a few observations with only a few visits, suggesting the clinic was essentially closed that morning or (usually) afternoon. The flight medicine clinics were kept separate from the other primary medicine clinics; the general therapy and internal medicine clinics were combined because they were physically combined at Fairchild. Chanute, as an airman training base, has no flight medicine clinic.

We created a second sample including the data from Luke AFB and Charleston AFB. In this sample the unit of observation is a clinic-day. This sample is labeled the whole-day sample, in contrast to the demonstration base or half-day sample.

## Specification

We estimated both linear and nonlinear specifications of the production relationship.[4] The linear specifications gave the best fit. The data cover only a narrow portion of the potential production surfaces as represented both by output level and provider mix. Any nonlinearities may be evident only over a wider range of provider ratios.

Table 12 defines the variables used in the regressions and Table 13 gives the variable means and standard deviations. Very few patients have problems the providers believe to be serious; less than one-third are slightly serious or serious. The consultation rate is correspondingly low.[5] Less than 40 percent of the visits are made by active duty personnel; retirees and dependents round out the case mix and create a practice little different from civilian primary (adult) medicine practices. Chanute accounts for fewer observations because it has no flight medicine clinic.

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[4] The specification Reinhart (1973) developed has been used in succeeding health manpower studies. It assumes output is zero, with no physician input, an invalid assumption in this case.

[5] For more detailed analysis of consultation patterns, see Goldberg and Jolly (1980).

## Table 12

### VARIABLE DEFINITIONS

| Variable | Definition |
|---|---|
| VISITS | Total patient visits (to each clinic during each day or half-day) |
| MDTIME | Total contact time in minutes by all physicians |
| PATIME | Total contact time by all PAs |
| NPTIME | Total contact time by all PCNPs |
| OTHTIME | Total contact time by all other staff, including corpsmen and nurses |
| PASK | Percent of visits with a consultation, not for prescription signature |
| PSER | Percent of visits described by providers as serious or very serious |
| PFLY | Percent of visits made by active duty personnel on flying status |
| PADEP | Percent of visits made by active duty dependents |
| PRET | Percent of visits made by retirees and retired dependents |
| CHAN<br>DYESS<br>NELLIS<br>CHARL<br>LUKE | Dummy variables indicating Chanute, Dyess, Nellis, Charleston or Luke; Fairchild is the omitted variable. |

The demonstration clinics actually employed 30 extenders and 21.5 physicians for an extender-physician ratio of 1.33. In terms of contact time, however, the ratio was 2.25. As expected, adding Charleston and Luke greatly decreases this ratio. However, in both samples, the ratio varied considerably, from less than 0.5 (20 percent of all bases' clinic sessions and 45 percent of project bases' clinic sessions) to more than 4.5 (5 and 15 percent respectively).

## Results

Table 14 shows the production function coefficients estimated for four samples. The first two columns include only the four demonstration sites, with and without the Flight Surgeon's office, the last two columns add Charleston and Luke. At the bottom are the ratios of the marginal products of PAs and physicians for each specification. The difference between the

Table 13

VARIABLE MEANS
(Standard deviations in parentheses)

| | Half-Day Sample | | Whole-Day Sample | |
|---|---|---|---|---|
| Variable | All Clinics | General Therapy and Medicine | All Clinics | General Therapy and Medicine |
| VISITS | 42.7 | 54.6 | 79.1 | 107.8 |
| | (24.4) | (25.0) | (46.6) | (44.3) |
| MDTIME | 140.8 | 177.2 | 327.7 | 421.2 |
| | (97.5) | (94.5) | (227.4) | (250.1) |
| PATIME | 254.0 | 344.6 | 398.6 | 581.6 |
| | (206.6) | (216.5) | (379.3) | (393.2) |
| NPTIME | 63.0 | 62.0 | 122.1 | 150.9 |
| | (71.9) | (58.9) | (142.1) | (142.0) |
| OTHTIME | 133.1 | 158.5 | 266.4 | 322.0 |
| | (143.2) | (163.3) | (243.7) | (298.9) |
| PASK | .074 | .076 | .081 | .099 |
| | (.056) | (.053) | (.070) | (.080) |
| PSER | .062 | .065 | .053 | .060 |
| | (.061) | (.059) | (.049) | (.045) |
| PFLY | .096 | -- | .152 | -- |
| | (.127) | | (.198) | |
| PADEP | .293 | .287 | .290 | .299 |
| | (.106) | | (.087) | (.080) |
| PRET | .324 | .356 | .270 | .331 |
| | (.143) | (.152) | (.152) | (.132) |
| CHAN | .143 | .248 | .101 | .183 |
| DYESS | .282 | .248 | .201 | .183 |
| NELLIS | .300 | .261 | .216 | .202 |
| CHARL | -- | -- | .090 | .165 |
| LUKE | -- | -- | | .083 |
| N | 280 | 161 | 199 | 109 |
| PATIME+NPTIME / MDTIME | 2.25 | 2.29 | 1.59 | 1.74 |

estimated coefficients on MDTIME and PATIME is significant only in Eq. (3). Equations (1) and (2) indicate that the demonstration project's PAs and physicians were equally productive in seeing outpatients.

Although PCNPs appeared to make more productive use of their contact time than PAs (or physicians), they devoted proportionately less time to patient contact than PAs did. In addition, the PCNP results are based on only a few individuals.

Except in Eq. (2), clinic output significantly declined with consultations (PASK) and problem complexity (PSER) as measured by the provider. The careful medical attention given flying personnel in the Air Force can be seen in the negative coefficient on PFLY. Among other patient groups, only retirees affected output. The base differences were slight; interac-

## Table 14

### Regression Coefficients

(t-statistics in parentheses)

| | Half-Day Sample (Demonstration bases) | | Whole-Day Sample (All bases) | |
|---|---|---|---|---|
| | All Primary Medicine Clinics (1) | General Therapy and Medicine (2) | All Primary Medicine Clinics (3) | General Therapy and Medicine (4) |
| $R^2$ | .9454 | .9389 | .9690 | .9578 |
| CONSTANT | 10.70 | 13.67 | 19.94 | 31.09 |
| | (3.73) | (3.21) | (3.14) | (2.25) |
| MDTIME | .0766 | .0678 | .0875 | .0838 |
| | (14.7) | (8.81) | (17.5) | (10.08) |
| PATIME | .0748 | .0781 | .0716 | .0676 |
| | (21.5) | (15.3) | (17.3) | (9.80) |
| NPTIME | .0988 | .0864 | .0939 | .0817 |
| | (16.7) | (6.59) | (13.5) | (6.42) |
| OTHTIME | .0201 | .0257 | .0165 | .0272 |
| | (3.58) | (3.12) | (2.63) | (2.91) |
| PSER | -16.89 | -5.94 | -27.08 | -47.21 |
| | -(2.53) | (-0.53) | (-1.52) | (-1.42) |
| PASK | -16.68 | -15.75 | -34.01 | -13.70 |
| | (-2.46) | (-1.55) | (-2.62) | (-0.62) |
| PFLY | -20.21 | -- | -31.69 | -- |
| | (-4.59) | | (-4.73 | |
| PADEP | -4.523 | -11.05 | -11.41 | -22.29 |
| | (-1.09) | (-1.55) | (-1.29) | (-1.24) |
| PRET | -8.334 | -14.63 | -13.81 | -27.72 |
| | (-2.04) | (-2.41) | (-1.33) | (-1.43) |
| CHAN | 2.024 | -.7376 | 8.324 | -.1986 |
| | (0.80) | (-0.21) | (1.46) | (-0.02) |
| DYESS | 3.859 | 7.482 | 6.624 | 9.009 |
| | (3.34) | (3.16) | (2.71) | (1.64) |
| NELLIS | .4583 | 3.285 | .3060 | 3.156 |
| | (0.37) | (1.46) | (0.12) | (0.65) |
| CHARL | -- | -- | .4519 | -5.102 |
| | | | (0.15) | (0.58) |
| LUKE | -- | -- | -1.431 | -4.951 |
| | | | (-0.29) | (-0.47) |
| $MP_{PA}/MP_{MD}$ | .98 | 1.15 | .84 | .82 |

tions between the time variables and the base dummies revealed only that PAs at Fairchild were less productive than their colleagues at the other bases.

These measures of PA productivity bear a striking resemblance to survey data collected by Mendenhall, Repicky, and Neville (1980). They obtained detailed information, some of it similar to our PCR data, covering three days from 697 general medicine practices employing one or more PAs or nurse practitioners. The 356 PAs they surveyed averaged 14 patient encounters per day and 188.5 contact minutes. This corresponds to 12 encounters and 162.7 contact minutes for the demonstration project PAs. Their estimates are higher because they rescheduled the data collection period around absence for illness, vacation, etc. With comparable data, we would probably estimate more encounters and contact time for the demonstration project PAs.[6]

### Implications for Clinic Staffing

In Sec. III, we estimated that the cost of a PA ranges from 40-90 percent of a physician's cost depending on which procurement source and discount rate we used. However, during the demonstration project, physicians were not more productive. These results, together with our earlier findings on quality of care and patient satisfaction (summarized below), imply the Air Force can confidently rely on PAs to see the bulk of its primary medicine patients. Of course, this implication is valid only for clinics similar to the projects' clinics, especially in size; we cannot say whether our results would hold in much larger clinics.

## CONSTRAINTS ON CLINIC STAFFING

Utilization of extenders in Air Force primary medicine clinics will reflect more than provider costs and productivities. Efficiency should dictate staffing only within bounds set by quality of care and patient satisfaction. Two previous reports, Goldberg and Jolly (1980) and Jolly (1980), examined the quality of care delivered by physicians and extenders and patient satisfaction during the demonstration project. For each of the project's clinics, Jolly (1982) then has calculated the proportion of the workload requiring a physician's attention either to insure high quality or in recognition of patient preferences.

Goldberg and Jolly found that during the demonstration project the quality of primary medicine care did not diminish, even though many patients who had traditionally seen physicians instead saw extenders. They concluded that extenders can deliver comparable care for patients with those types of problems the extenders have been trained to treat. However, some primary medicine patients do present problems outside the extenders' expertise. In assessing alternative staffing ratios, we must be certain the ratios provide enough physicians to treat these more complex conditions.

Patient acceptance of the demonstration clinic was good. Confidence in Air Force extenders' ability, initially widespread, remained high. At the same time, patients approved the project's other features, notably the panel concept, made possible by the provider teams. A minority remained unfavorable to the concept of physician's extenders. When questioned about their confidence in extenders' ability to handle specific problems (cold, abdominal pain,

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[6] It is interesting that Mendenhall, Repicky, and Neville (1980) report physicians see many more patients than the demonstration project physicians (8 vs. 19), but the difference is due to the much reduced Air Force contact times. Air Force physicians devote less time to outpatient care than these civilian physicians do.

earache, etc.), the unfavorable group did express some support of extender care of more simple conditions. Of course, even those favorable toward extenders did not feel confident about having extenders treat more complex problems.

To explore the limits of the Air Force's ability to rely on extenders, Jolly constructed several decision rules. These rules dictate the share of the clinics' caseloads that require a physician. Each rule specifies the diagnoses that (1) are inappropriate for extender treatment, based on quality of care considerations and (2) although within the extenders' expertise, require physician care for some patients uncomfortable with seeing an extender.

Inferring decision rules from the quality-of-care analysis was the easier of the two. Goldberg and Jolly had categorized all diagnoses appearing on the PCR as follows: (1) MD usually needed, (2) MD may be needed, (3) MD usually not needed. The first and third categories included those diagnoses for which the medical community agrees that extender treatment is clearly inappropriate or appropriate, respectively. Physicians disagree on the suitability of the second group for extender treatment. Jolly devised two quality-constraint rules: One assigns only the first group to physicians and the other assigns both the first and second groups to physicians.

The difficulty in designing rules reflecting patient attitudes toward seeing extenders lay in the survey data from which attitudes were measured. First, the survey did not ask respondents directly about their willingness to see an extender. Jolly had to infer willingness from questions about extenders' ability to handle specific problems and general favorableness toward the concept of physician's extenders. Some expressing doubt about extenders' ability to handle a problem nevertheless may have been willing to see an extender initially and rely on him to consult the physician as necessary. In fact, the bases reported almost no instances of patients preferring a physician appointment to the offered extender appointment. Second, the survey asked respondents only about extenders' ability to handle eight conditions. Jolly had to match all other diagnoses to one of these eight; however, the physicians' workload share did not change a great deal if the matching scheme changed.

In selecting which of Jolly's six acceptance-constraint decision rules we would base our physician staffing constraint on, we recalled the earlier reports' findings that both quality of care and patient satisfaction remained high during the demonstration project. Five of the six rules called for physicians to handle a larger share of at least one clinic's workload than they actually handled during the four-week data collection period. Without evidence of either quality or patient attitude problems, we have elected to use the least limiting rule. It specifies that all diagnoses in the "MD usually needed" must be assigned to physicians. In addition, for each of the eight conditions specified in the patient attitude survey and the diagnoses matched with each, those patients both unfavorable toward extenders and unsure of extenders' ability to handle that problem are assigned to physicians.[7]

Using the actual casemix and attitudes toward extenders prevailing at each demonstration base and applying this least constraining rule gives us the following estimates of the minimum physician shares of the four clinics' workloads: Chanute, 7 percent; Dyess, 18 percent; Fairchild, 17 percent; Nellis, 16 percent. The Chanute estimate is lower because its large student population presents a simple casemix, and its patients were unusually favorable toward extenders. We used more detailed versions of these estimates to constrain the staffed patterns we derived from an activity analysis of the clinics' outputs.

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[7] The attitude questions were actually asked separately for PAs and PCNPs. Except for gynecological care, the results differed little. Jolly used the slightly lower figures for PAs.

Air Force primary medicine clinics may be able to make more intensive use of extenders than most comparable civilian providers. We estimate that from 82 to 93 percent of the visits to the demonstration project clinics could be delegated to the extenders, compared with estimates of 61–83 percent in similar Health Maintenance Organization (HMO) clinics and a much lower 28–50 percent in solo or group fee-for-service practices (Record, 1981). Like HMOs, Air Force clinics serve somewhat younger and healthier patients. Because these patients pay no outpatient visit fee, they probably seek care more often for minor problems.

## ACTIVITY ANALYSIS

We used activity analysis to compare provider productivities in treating patients in different diagnostic groups. We estimated the times various providers or provider teams took to treat patients in each diagnostic group. Subsequently, we approximated production isoquants that display the combinations of physician and PA time inputs capable of treating specific patient caseloads. Based on the provider cost ratios and time allocations, we selected productive staffing patterns for two prototype clinics.

### The Activity Analysis Model

Activity analysis, or linear programming, is a tool that may be used to identify alternative resource combinations capable of producing a specified set of outputs and allocate resources to alternative activities according to some criterion, frequently cost minimization. These assignments or resource allocations may be constrained in different ways, often by restricting the activity-resource combinations to a subset of those possible or by restricting the total available amount of some resources.

Activity analysis models assume that outputs are proportional to inputs; if an activity's inputs are doubled, then so is its output. The production function estimates support this assumption, at least within the range of outputs and inputs we observed. In order to conduct an activity analysis, one must first define the activities to be considered and measure the input resources required for each unit of output. New activities may be defined to represent different outputs or alternative production methods that reflect new input resource combinations.

Our model describes how physicians and PAs can be used together in outpatient clinics to treat various patient caseloads. It characterizes these caseloads according to the number of visits of a given type. Physicians and PAs may be used either alone or in combinations with corpsmen and sometimes even with one another. Thus, we define several different provider teams, some or all of which may treat each visit type. An activity in the activity analysis is now defined as a particular provider team treating a patient for a specific visit type. Let the variable $X_{ij}$ designate the number of times team i treats patients for visit type j. The constant $a_{ijk}$ represents the time provider type k, working on team i, spends on each visit of type j. Thus when team i is a physician and a corpsman, two $a_{ijk}$ measure the amount of physician time and the amount of corpsmen time required as they work in combination to treat a patient for visit type j.

We wish to assign teams to visit types so as to result in the least costly combination of total provider resource costs. Quality of care, patient attitudes, teaching needs, and other considerations constrain the provider team-visit type of assignment.

PA interviews and a preliminary review of our data revealed that teaching was an important output not directly measured in the PCR data. In the interviews, ongoing physician contact and accessibility were repeatedly mentioned as primary factors in a successful program. The data indicated that 5 percent of all visit types were treated by teams with both a physician and a PA. Because the teaching output is unmeasured, activity analysis would never find this team to be cost effective. We therefore impose "teaching constraints," which require that 5 percent of all visit types be handled by a "teaching" team containing both physician and PA members.

Our model has two additional sets of constraints. One ensures that sufficient resources are provided to treat the entire caseload, and the other sets supply ceilings on resources. By varying the supply ceilings, we identify alternative resource combinations capable of handling the caseload and thus trace out a production isoquant.

A mathematical formulation of the model is given below with the following notation:

Let the subscripts

$i = 1, \ldots \bar{I}$ denote provider teams, where $I_p$ is the set of provider teams that includes physicians

$j = 1, \ldots \bar{J}$ denote visit types

$k = 1, \ldots \bar{K}$ denote resource types (physician time, PA time, or corpsmen time)

$t =$ the provider "teaching" team.

The constants

$a_{ijk} =$ patient contact time for provider type k as a member of team i while treating a patient for visit type j

$C_{ij} =$ relative cost per case for team i treating visit type j

$D_j =$ number of cases of visit type j

$Q_j =$ number of cases of visit type j that must be seen by a physician for quality and attitude reasons

$R_k =$ total available time for provider type k

$T_j =$ number of cases of visit type j that must be assigned to the teaching team.

And the decision variables

$X_{ij} =$ the number of cases of type j assigned to team i.

Then the model's objective is to

$$\text{Minimize} \quad \sum_{i=j}^{\bar{I}} \quad \sum_{j=1}^{\bar{J}} \quad C_{ij} X_{ij}$$

subject to

(1) Demand Constraints

$$\sum_{i=1}^{\bar{I}} X_{ij} = D_{ij} \quad \text{for } j = 1, \ldots, J$$

(2) Quality and Attitude Constraints

$$\sum_{i=1}^{I_p} X_{ij} \geq Q_{ij} \quad \text{for } j = 1, \ldots, J$$

(3) Teaching Constraints

$$X_{tj} \geq T_j \quad \text{for } j = 1, \ldots, J$$

(4) Resource Availability Constraints

$$\sum_{i=1}^{\bar{I}} \sum_{j=1}^{\bar{J}} a_{ijk} X_{ij} = R_k$$

We use the activity analysis to identify alternative staffing patterns that can be used to treat the same caseload. These patterns are determined by how providers are organized to deliver care and what care is needed. For example, a physician may handle one type of case in 10 minutes yet require 20 for a more complicated diagnosis; a PA might need 12 minutes for the simple case and 25 for the more complex. A physician working with a corpsman may only need 8 minutes, with five minutes of corpsmen time for the simple case and somewhat longer for the more complex one.

To estimate production functions, we had to assume that primary care clinic outpatient visits were fairly homogeneous and could thus be lumped together as one type of output. Here we relax this assumption, recognizing that different types of visits occur and require differing amounts of provider time. However, activity analysis cannot be performed on unlimited output categories. We therefore devised a visit classification scheme that captures some essential differences among visits.

## Data

Implementing the activity analysis model required that we classify the patient visits according to data provided by the PCR records and estimate: (1) the per visit time inputs for each team allowed in each category, (2) the number of visits in each category, (3) quality of care and patient satisfaction constraints, and (4) the cost of each provider type time. The patient contact record contains provider reported diagnostic and treatment information and provider treatment time estimates, recorded by the patient at the visit's end. The time estimates are bracketed data (e.g., 1–5 minutes, 5–10 minutes, 10–20 minutes).

**Visit Classification.** In a primary care setting, diagnostic and treatment procedures are rarely performed during the visit. Our early attempts to match the provider times with the treatment data were unsuccessful. As a result we took a somewhat more analytic approach to the problem of grouping visits. Reasoning that each visit contained a segment devoted to diagnosing the problem, another for deciding on a treatment plan, and a third for carrying out the treatment plan, we rated the difficulty of each of these stages for both first and return visits within each diagnosis. Each stage was rated as (1) easy to perform, (2) of intermediate complexity, or (3) difficult to handle. Although this scheme of three difficulty levels at three stages results in 27 potential combinations, the majority of our data fell into fewer categories. As a result we decided to collapse the categories as follows: diagnoses were labeled as simple when all three stages were easy to perform, as intermediate when at least one stage was of intermediate complexity, and complex when at least one stage was complex. We classified visits with multiple diagnoses as simple, intermediate, or complex according to the most difficult diagnosis. Although visits with multiple diagnoses were given an overall rating, they were categorized separately from visits with a single diagnosis. Visits for physical examinations and prescriptions only are also specified separately. The complete list of visit types is given in Table 15.

**Provider Teams.** We identified five provider teams: physicians alone, physicians with corpsmen, physicians with PAs and corpsmen (the "teaching" team), PAs alone, and PAs with corpsmen. An implicit assumption underlying the analysis is that team members treating

Table 15

VISIT TYPE CATEGORIES

1. Physical examinations
2. First visit, single diagnosis, simple case
3. First visit, single diagnosis, intermediate case
4. First visit, single diagnosis, complex case
5. First visit, multiple diagnoses, simple cases
6. First visit, multiple diagnoses, intermediate cases
7. First visit, multiple diagnoses, complex cases
8. Return visit, single diagnosis, simple case
9. Return visit, single diagnosis, intermediate case
10. Return visit, single diagnosis, complex case
11. Return visit, multiple diagnoses, simple cases
12. Return visit, multiple diagnoses, intermediate cases
13. Return visit, multiple diagnoses, complex cases
14. No diagnosis
15. Prescription only

patients within a visit type would allocate tasks among themselves in the same manner for each patient.

**Provider Time Inputs.** From the PCR data we calculated the contact time coefficients, $a_{ijk}$, for each provider within a team seeing each visit type. These coefficients were computed by averaging the data within each category from the 16,000 general therapy, flight medicine, and internal medicine records at the four demonstration bases, Luke AFB and Charleston AFB. The contact times for various visit types for physicians alone and PAs alone appear fairly normally distributed about the means with larger standard deviations for physicians than for PAs and larger variations for both as we move from simple to complex cases.

Table 16 displays the provider contact time coefficients. For most visit types, physicians averaged somewhat more time with patients than PAs did. As expected, the physicians and PAs generally took longer as case complexity increased. Corpsmen frequently worked well with physicians, saving physician time, but they did not usually save PA time when working with PAs. Exceptions occurred with PAs handling multiple diagnoses in intermediate and complex visits.

Reflecting variations in the populations served by the bases, the distribution of visits across the categories differed. For use in the activity analysis, we selected the distributions with the most and the fewest complex cases as prototypes. Then we could compare the resulting staffing differences.

**Number of Visits.** The six bases we observed indicate that the bases averaged between 110 and 190 patients daily, with four bases in the mid-range between 140 and 160. To scale our activity analysis, we assumed 150 cases per day over a four-week interval for a total of 3000 visits. The four-week interval corresponds to the length of the data collecting period for the demonstration bases.

**Quality of Care and Patient Satisfaction Constraints.** Overall, physicians should treat between 7 and 18 percent of the primary medicine patient-visits even if nonphysician treatment costs less. For these patients, physician treatment guarantees both quality of care and patient satisfaction. To incorporate this constraint in the activity analysis and using the same rules described earlier, we calculated the percent of visits in each category to be assigned to teams with physicians. The quality of care constraint is based on the overall diagnostic distribution within each category; we do vary the distribution of visits across categories assigned to teams with physicians. We averaged the patient preference rates across the demonstration bases. The percentages of visits in each category automatically assigned to physician teams are displayed in Table 17. At a minimum, 5 percent of each visit type are assigned to the teaching team; however, because the teaching team has a physician, the 5 percent is applied toward rather than added onto the quality and attitude constraints.

**Cost of Provider Time.** The cost ratios from Sec. III are used for the objective function cost estimates. We used the cost estimates for HPSP physicians and Air Force trained PAs, because these two programs are expected to continue as the major procurement sources for primary medicine providers. We decided on the moderate 5 percent discount rate on the grounds that future cost streams carry very little risk. Thus, we estimated the cost of a PA minute at 0.7 of a physician minute and a corpsman minute at 0.2 of a physician minute.[8] Team costs for treating a specified visit type are then calculated as the sum of the provider minutes for each provider type within the team, evaluated at their relative costs.

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[8] Had we selected a more standard 10 percent discount rate, the PA/MD cost ratio would have dropped to .6 and the CP/MD ratio remained the same. Our results would not differ noticeably.

## Table 16

### PROVIDER CONTACT TIMES WHEN TEAM I TREATS VISIT TYPE J

(Number of cases in parentheses)

| | Team 1 | Team 2 | | Team 3 | | | Team 4 | Team 5 | |
|---|---|---|---|---|---|---|---|---|---|
| | MD Only | MD and CP | | MD, PA and CP | | | PA Only | PA and CP | |
| Visit Type | MD Time | MD Time | CP Time | MD Time | PA Time | CP Time | PA Time | PA Time | CP Time |
| Physical Exam | 16.9 | 13.6 | 21.8 | 11.4 | 9.6 | 12.6 | 14.3 | 14.6 | 8.1 |
| | (88) | (343) | | | (49) | | (41) | (80) | |
| First visit, single diag., simple | 10.1 | 7.5 | 3.7 | 8.8 | 7.3 | 4.3 | 9.2 | 9.5 | 5.4 |
| | (224) | (480) | | | (119) | | (631) | (876) | |
| First visit, single diag., intermed. | 11.3 | 9.1 | 4.4 | 10.4 | 9.4 | 5.0 | 10.5 | 10.8 | 5.0 |
| | (178) | (309) | | | (107) | | (545) | (579) | |
| First visit, single diag., complex | 14.6 | 13.4 | 5.5 | 11.3 | 13.4 | 9.5 | 12.8 | 13.6 | 7.5 |
| | (23) | (51) | | | (15) | | (96) | (70) | |
| First visit, multiple diag., simple | 5.5 | 10.1 | 6.9 | 8.5 | 6.0 | 6.2 | 9.0 | 10.2 | 5.7 |
| | (11) | (36) | | | (12) | | (71) | (90) | |
| First visit, multiple diag., intermed. | 12.0 | 10.4 | 4.9 | 10.7 | 9.7 | 4.3 | 12.7 | 12.1 | 5.6 |
| | (49) | (95) | | | (26) | | (108) | (162) | |
| First visit, multiple diag., complex | 17.5 | 15.4 | 7.4 | 14.0 | 9.8 | 4.8 | 14.0 | 13.5 | 6.2 |
| | (16) | (30) | | | (11) | | (37) | (45) | |
| Return visit, single diag., simple | 9.8 | 8.6 | 4.0 | 8.5 | 7.7 | 3.7 | 8.9 | 9.8 | 4.5 |
| | (172) | (303) | | | (79) | | (413) | (525) | |
| Return visit, single diag., intermed. | 12.2 | 11.9 | 4.8 | 9.4 | 8.9 | 5.4 | 11.1 | 11.9 | 4.0 |
| | (404) | (498) | | | (110) | | (649) | (639) | |
| Return visit, single diag., complex | 13.9 | 15.4 | 8.0 | 10.6 | 12.4 | 8.5 | 12.1 | 14.0 | 3.5 |
| | (40) | (46) | | | (7) | | (22) | (12) | |
| Return visit, multiple diag., simple | 11.2 | 10.1 | 5.7 | 11.4 | 11.0 | 5.2 | 8.9 | 10.6 | 3.6 |
| | (16) | (36) | | | (9) | | (42) | (71) | |
| Return visit, multiple diag., intermed. | 14.4 | 14.8 | 5,2 | 12.1 | 8.4 | 3.8 | 13.0 | 12.9 | 4.8 |
| | (217) | (245) | | | (49) | | (181) | (179) | |
| Return visit, multiple diag., complex | 14.7 | 16.8 | 5.3 | 22.5 | 17.7 | 5.0 | 15.8 | 13.0 | 4.6 |
| | (29) | (43) | | | (3) | | (14) | (12) | |
| No diagnosis | 10.9 | 10.8 | 7.6 | 8.7 | 6.0 | 5.7 | 9.3 | 10.6 | 6.3 |
| | (209) | (306) | | | (61) | | (145) | (192) | |
| Prescription only | 6.2 | 4.1 | 2.2 | 10.0 | 6.7 | 2.2 | 6.6 | 7.1 | 3.2 |
| | (40) | (63) | | | (10) | | (91) | (43) | |

## Activity Analysis Results

For both the more and less complex caseloads, we considered several variations in the staffing problem; the solutions are displayed in Table 18. The first variation minimizes total relative costs and requires sufficient physician staffing to meet the teaching and quality and attitude constraints. This resulted in 4335 minutes of physician time, 26,656 minutes of PA time, and 1416 minutes of corpsmen time for the less complex caseload; and 5319 minutes of MD time, 27,403 minutes of PA time, and 1573 minutes of corpsmen time for the more complex caseload.

Next we identified the minimum physician staffing level that could meet the teaching, quality, and attitude constraints. For the less complex caseload a minimum of 3469 physician

### Table 17

### QUALITY AND ATTITUDE CONSTRAINT,[a] SHARE OF CASELOAD THAT MUST BE SEEN BY A PHYSICIAN

(Percent)

| Visit Type | Quality and Attitude Combined | Quality Only |
|---|---|---|
| Physical exam | 8.4 | 0.9 |
| First visit, single diagnosis, simple | 10.0 | -- |
| First visit, single diagnosis, intermediate | 13.0 | 1.1 |
| First visit, single diagnosis, complex | 25.0 | 14.6 |
| First visit, multiple diagnoses, simple | 10.0 | -- |
| First visit, multiple diagnoses, intermediate | 14.0 | 1.5 |
| First visit, multiple diagnoses, complex | 27.0 | 16.8 |
| Return visit, single diagnosis, simple | 10.0 | -- |
| Return visit, single diagnosis, intermediate | 13.0 | 1.1 |
| Return visit, single diagnosis, complex | 58.0 | 54.9 |
| Return visit, multiple diagnoses, simple | 11.0 | -- |
| Return visit, multiple diagnoses, intermediate | 15.0 | 2.2 |
| Return visit, multiple diagnoses, complex | 72.0 | 70.0 |
| No diagnosis | 10.0 | -- |
| Prescription only | 10.0 | 2.7 |

[a] David Maxwell Jolly performed this analysis. For a more complete description of his methodology, see Jolly (1982).

minutes were needed, and 4311 for the more complex, or approximately 80 percent of the optimal physician time input.

We then looked at how much physician time would be required to treat each caseload if there were no PAs. For the less complex caseload, physicians alone required 32,897 minutes; with corpsmen this figure drops to 28,888 minutes while adding 8350 minutes of corpsmen time. With the more complex caseload 34,761 minutes of physician time are needed or a combination of 31,172 physician minutes with 7433 corpsman minutes.

Table 18

ACTIVITY ANALYSIS BASELINE SOLUTIONS

| | Less Complex Caseload | | | |
|---|---|---|---|---|
| | Physician Time | PA Time | Corpsmen Time | Relative Cost |
| Minimum cost solution | 4,335 | 26,656 | 1,416 | 23,268 |
| Minimum physician time | 3,469 | 28,712 | 1,767 | 23,912 |
| All physician, no corpsmen | 32,897 | -- | -- | 32,897 |
| All physician, corpsmen allowed | 28,888 | -- | 8,350 | 30,558 |
| | More Complex Caseload | | | |
| | Physician Time | PA Time | Corpsmen Time | Relative Cost |
| Minimum cost solution | 5,319 | 27,403 | 1,573 | 24,825 |
| Minimum physician time | 4,311 | 30,065 | 2,233 | 25,812 |
| All physician, no corpsmen | 34,761 | -- | -- | 34,761 |
| All physician, corpsmen allowed | 31,172 | -- | 7,433 | 32,658 |

## The Production Isoquants

A production isoquant shows which combinations of inputs may be used to produce a given constant level of output. To explore how PAs may substitute for physicians, we constructed a production isoquant between these two providers at an output level equal to 3000 patient-visits. We approximate production isoquants for a distribution of a given visit type by repeatedly performing the activity analysis on that distribution, each time constraining physician inputs to a different level. Each repetition indicated the PA inputs needed to supplement the specified physician input and treat the entire caseload.

The isoquants for the more and the less complex caseloads are presented in Fig. 2. The isoquants in the upper portion of the figure are traced out assuming that corpsmen are staffed optimally, and those in the lower portion have corpsmen inputs constrained at less than the minimum cost levels.

The shape of a production isoquant provides information on how the providers substitute for one another. In the isoquants in the upper half of Fig. 2, optimal corpsmen inputs first increase and then begin a gradual decline as we increase physician inputs. When corpsmen inputs are constrained to be at most equal to their minimum cost solution value, the isoquants rotate upward and become more linear. This linearity implies that, above the minimum cost solutions, the substitution rate or marginal product ratio between physicians and PAs is nearly constant. These results thus reinforce our production function observations. As we approach the minimum physician staffing levels, just below the minimum cost solutions, the substitution rates change rapidly. Average substitution rates along segments of the four isoquants are presented in Table 19. At the minimum cost solutions, 4335 and 5319 physician minutes, the substitution rates equate to the cost ratio or .7.

Costs vary considerably along the isoquants, increasing 33–35 percent as physician inputs increase for the more complex caseload and 37–39 percent for the less complex caseload. (Detailed results are displayed in Appendix E.) The minimum cost staffing occurs at 5319 physician contact minutes for the more complex caseload and at 4335 physician contact minutes for the less complex caseload. We also asked how staffing changed if PAs with civilian training were available, dropping the PA/MD cost ratio to .4. For the complex caseload the minimum cost solution called for 4724 physician contact minutes, or almost 90 percent of the physician time at the .7 cost ratio, but costs were reduced by a third.

We estimated above that physicians allocate 102.4 minutes per day to outpatient care (2048 minutes during a four-week interval). PAs allocate 162.7 minutes per day (3254 minutes). Using these figures, the minimum cost staffing occurs at 2.5 physicians for the more complex caseload and at 1.9 physicians for the less complex. We conservatively assume that three physicians are necessary for both the more complex caseload and the less complex caseload. At these physician levels, nine PAs are needed for the more complex caseload and eight for the less complex one. Therefore, as we move from a simpler to a more complex caseload, a PA, but no physicians, must be added.

Although the activity analysis results suggest the demonstration project's clinics should be staffed at a somewhat higher ratio (3:1), we did not actually observe such a high ratio. These results do support the conclusion that Air Force primary medicines can be operated efficiently and effectively with two extenders for every physician. For clinics similar in size to the four participating in the project, a 2:1 ratio implies four physicians and seven or eight PAs.

We conclude from the estimated production functions and the isoquants derived from the activity analysis that PAs and physicians can be substituted one-for-one. Thus, just to replace the PA's outpatient output, we would need nine added physicians. We are assuming that, because these physicians would replace outpatient capacity and not provide any additional services, they could devote the same proportion of their time to the clinics as the PAs did. This assumption represents a large increase over the project physicians' observed outpatient care time. In these circumstances we would need 12 physicians for the more complex caseload and 11 for the less complex caseload. If PAs are 30 percent cheaper, personnel costs for the system with PAs are 19–20 percent lower at the 2:1 ratio.[9] We would expect only a negligible

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[9] This assumes that physicians or PAs can be added at prevailing procurement and compensation costs.

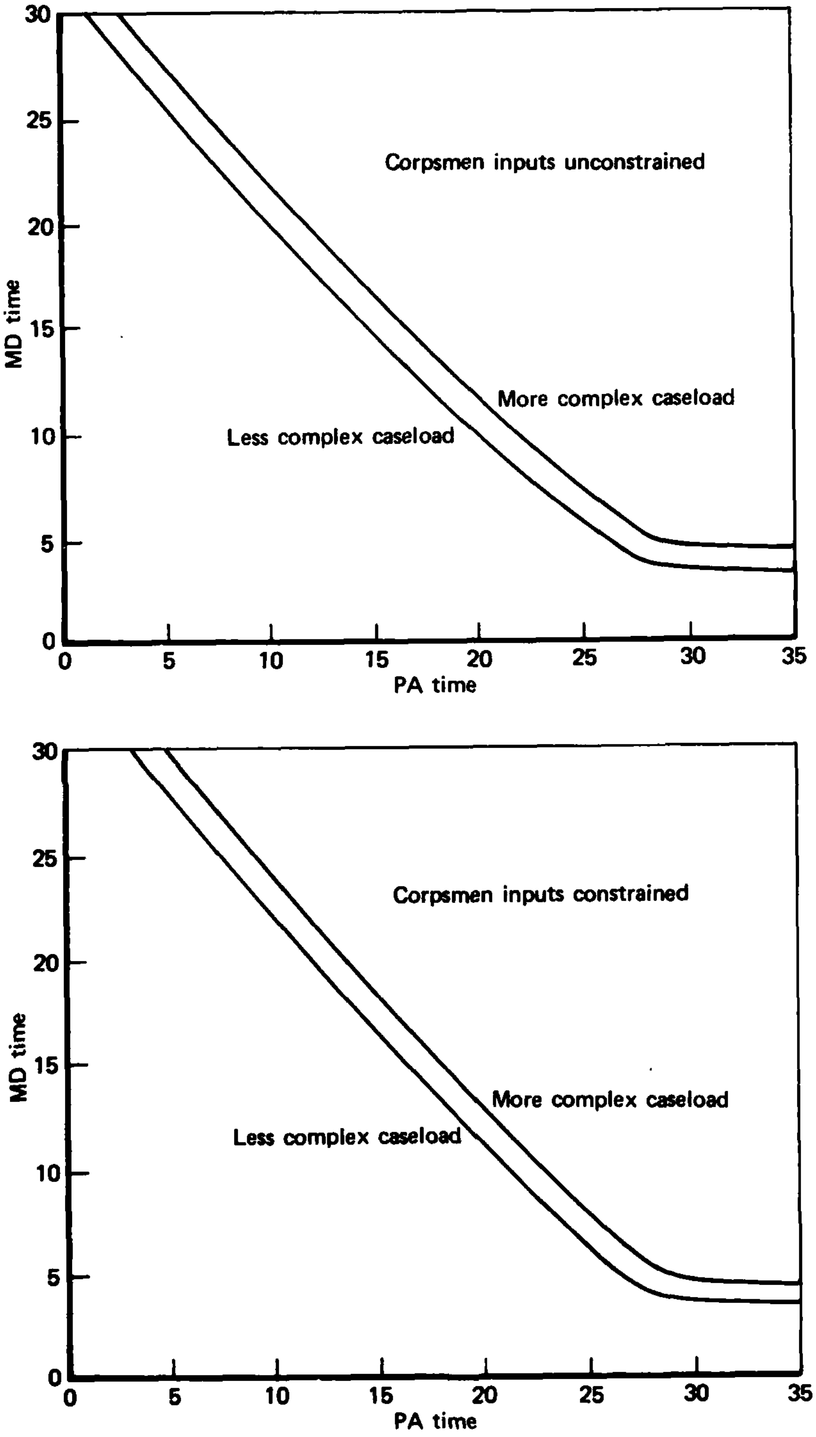

Fig. 2—Production isoquants

## Table 19

## Average Substitution Rates Along Segments of the Production Isoquants

Less Complex Caseload

| Corpsmen Unconstrained | | Corpsmen Constrained | |
|---|---|---|---|
| Physician Time Segment | ΔMD/ΔPA | Physician Time Segment | ΔMD/ΔPA |
| 3,469 - 4,335 | .4 | 3,592 - 4,335 | .4 |
| 4,335 - 5,000 | .8 | 4,335 - 5,000 | .8 |
| 5,000 - 10,000 | .8 | 5,000 - 10,000 | 1.0 |
| 10,000 - 15,000 | .9 | 10,000 - 15,000 | 1.1 |
| 15,000 - 20,000 | 1.1 | 15,000 - 20,000 | 1.1 |
| 20,000 - 25,000 | 1.2 | 20,000 - 25,000 | 1.1 |
| 25,000 - 30,000 | 1.2 | 25,000 - 30,000 | 1.1 |

More Complex Caseload

| Corpsmen Unconstrained | | Corpsmen Constrained | |
|---|---|---|---|
| Physician Time Segment | ΔMD/ΔPA | Physician Time Segment | ΔMD/ΔPA |
| 4,311 - 5,000 | .4 | 4,538 - 5,000 | .4 |
| 5,000 - 5,319 | .6 | 5,000 - 5,319 | .6 |
| 5,319 - 10,000 | .8 | 5,319 - 10,000 | 1.0 |
| 10,000 - 15,000 | .9 | 10,000 - 15,000 | 1.1 |
| 15,000 - 20,000 | 1.1 | 15,000 - 20,000 | 1.1 |
| 20,000 - 25,000 | 1.1 | 20,000 - 25,000 | 1.1 |
| 25,000 - 30,000 | 1.2 | 25,000 - 30,000 | 1.1 |

difference in the costs of ancillary services or in return visit rates (see Goldberg and Jolly, 1980).

Several other studies have evaluated extender productivity in the civilian sector, many focusing on whether private primary care practices become more efficient and more profitable with the introduction of extenders. Smith et al. (1976), Hershey and Kropp (1979), Scheffler (1979), and Zeckhauser and Eliastam (1974), and the previously cited Mendenhall, Repicky, and Neville (1980) address productivity or optimal staffing using different techniques and data. Most support the employment of extenders in civilian practices, but not for the majority of patients. However, there are numerous differences between the Air Force's institutional setting and small fee-for-service civilian practices.

Research comparable to ours has been done by Record et al., based on data from the Kaiser-Permanente Medical Care Plan of Oregon. Record (1981) applies the results, along with information from a review of the literature, to estimate physician and extender staffing for the U.S. adult primary care workload. Under conditions allowing maximum delegation to extenders (75 percent of all visits), they estimate extenders could substitute for 93 percent of a physician. However, the extent of substitution is limited by the proportion of visits that can be delegated to the PAs, by time for consultation and supervision, and by the physician time needed for more complex problems and nonoutpatient services. Therefore, the resulting staffing ratio (0.6:1) is less than the substitution ratio.

Why do our results differ? First, we find a smaller difference in the time providers spent with the most complex versus the simplest problems treated. As a result, compared with the PAs, the project physicians required little more time per patient for their complex caseload. Second, consultation was both less frequent and less time-consuming in the demonstration project clinics. Third, fewer Air Force patients presented problems requiring a physician, and the physician time required outside the clinics (for inpatient care and other services) was smaller.

These differences may stem from a simpler caseload. Although we could not directly compare the caseloads underlying these estimates, the Air Force caseload was probably simpler. Active duty personnel are screened for good health, and few military retirees are elderly. In 1975, 3.1 percent of military beneficiaries were 65 or over, compared with 9.8 percent in the U.S. population as a whole.

Other differences are institutional. Even the more similar civilian settings are limited in using extenders by state legal restrictions. Finally, the availability of outpatient care without charge undoubtedly raises the visit rate for minor complaints (Newhouse et al., 1982).

# V. CONCLUSION

This report describes the final stage in our evaluation of the Air Force's demonstration project in the use of physician's extenders. Our findings lend strong support to continued reliance on extenders in the primary medicine clinics. The first report (Goldberg and Jolly, 1980) concluded that "the Air Force can deliver the same quality of medical care when (extenders) treat a sizable proportion of the patients formerly treated by physicians, and that no quality bar exists to the continued training and employment of PAs and PCNPs in Air Force outpatient clinics." The second report (Jolly, 1980) found that "reliance on physician's extenders does not adversely affect the level of satisfaction with the care provided at the clinic." The results presented in this final report demonstrate that extenders are also cost-effective providers of care.

Here we have evaluated the cost effectiveness of intensively utilizing physician's extenders in Air Force primary medicine clinics. We have examined data on the personnel costs and outpatient care productivities of extenders, with particular emphasis on physician's assistants (PAs) and on the physicians working with them.

In performing their outpatient care duties, PAs participating in a demonstration project at four Air Force base hospitals were as productive as the physicians with whom they worked. Whether based on estimated production functions or activity analysis, we find that at current relative personnel costs the Air Force should use PAs to treat as many primary medicine patients as the PAs' training and patient acceptance allow. This conclusion also rests on the PA's documented quality of care. Excluding personnel on flying status, the four demonstration hospitals each saw approximately 150 primary medicine patients daily. Allowing for enough physicians to supervise the PAs, treat more complex problems, and satisfy patient preferences for physician treatment, we calculate that this workload is most efficiently handled with three physicians and eight or nine PAs, depending on case mix complexity. Recognizing the physician's inpatient and other non-clinic duties, a more cautious staffing pattern would add a fourth physician, retain the 2:1 ratio, and require seven or eight PAs.

For most of the sample problems seen in the primary medicine clinics, a corpsman's assistance does not conserve provider time. The cost-minimizing staffing patterns all call for less than one corpsman. However, the activity analysis considers only direct patient care activities, which constitute a small portion of corpsmen's clinic duties.

Although the Air Force PA training program is expensive, its graduates are less expensive to employ than physicians. If comparable civilian-trained PAs could be directly recruited, this cost gap would widen considerably. Not surprisingly, we find HPSP physicians to be more expensive than volunteer physicians, but the former may also be better qualified. In all cases, the cost calculations rest heavily on assumptions about future retention rates that must be highly tenuous without further evidence on post-draft era retention.

The Graduate Medical Education National Advisory Board has predicted that the physician-to-population ratio will increase from 1975 to 1990 by almost 40 percent. Nonetheless, they predict that the supply of general or family practice physicians will be inadequate in 1990. However, even with an ample supply of primary care physicians, intensive utilization of PAs will remain efficient unless physician incomes fall significantly relative to PA incomes. In addition, many Air Force primary care physicians participating in the demonstration project preferred having PAs to relieve them of some of the simpler caseload.

In interviews with the extenders and physicians participating in the demonstration project, we detected two themes that affect our conclusions. Most flight surgeons felt that supervising extenders and seeing nonflying patients were incompatible with their duties as flight surgeons. The extenders concurred, indicating that the flight surgeons' flight line duties inhibited supervision and consultation. Some flight surgeons felt uncomfortable seeing women and (older) children, patients they had not seen for many years. Therefore, we do not recommend that the Air Force follow the demonstration project's example of expanding the flight medicine clinic's primary medicine role.

The second theme was almost universally expressed by the project's extenders. They felt that the job of supervising extenders and treating the more complex problems referred by the extenders should be given only to more highly trained physicians; as much as possible, these physicians ought to be board-certified family practitioners or internists.

# Appendix A

## THE PATIENT CONTACT RECORD

Nº 307601

CARD 1
(1-7)

ARRIVED:

(TIME OF PATIENT ARRIVAL)
(8-16)

EXAMINED:

(TIME PATIENT IS CALLED TO EXAMINATION OR TREATMENT ROOM)
(17-25)

(26-27) **OUTPATIENT UNIT:**

☐ 1. AIR FORCE CLINIC (FAMILY PRACTICE OR GENERAL THERAPY)
☐ 2. FLIGHT SURGEON'S CLINIC
☐ 3. PHYSICAL EXAM SECTION
☐ 4. EMERGENCY ROOM/WALK-IN CLINIC
☐ 5. SICK CALL
☐ 6. ALLERGY
☐ 7. DERMATOLOGY
☐ 8. ENT
☐ 9. EYE CLINIC
☐ 10. MEDICINE
☐ 11. OB-GYN
☐ 12. ORTHOPEDICS
☐ 13. PODIATRY
☐ 14. PEDIATRICS
☐ 15. PSYCHIATRY
☐ 16. SURGERY
☐ 17. UROLOGY
☐ 18. PHYSICAL THERAPY
☐ 19. INHALATION THERAPY
☐ 20. OTHER: ________

## PATIENT CONTACT RECORD

APPROVED: DBMS

### PART I Patient Information

TO BE FILLED OUT BY PATIENT

**1** **(SPONSOR'S) SOCIAL SECURITY NUMBER:** (LAST 4 DIGITS)
(33-36) ________

**2** **SERVICE OF PATIENT OR PATIENT'S SPONSOR:**
(37)
☐ 1. AIR FORCE
☐ 2. ARMY
☐ 3. NAVY
☐ 4. MARINE CORPS
☐ 5. COAST GUARD
☐ 6. CADET/APPLICANT FOR MILITARY SERVICE
☐ 7. CIVILIAN EMPLOYEE
☐ 8. OTHER ________________

**3** **RANK OF PATIENT OR PATIENT'S SPONSOR**
(38)
☐ 1. ENLISTED
☐ 2. OFFICER

**4** **PATIENT'S DATE OF BIRTH:** ____ / ____ / ____
Month Day Year
(39-44)

**5** **PATIENT'S SEX:**
(45)
☐ 1. MALE
☐ 2. FEMALE

**6** **PATIENT'S MARITAL STATUS:**
(46)
☐ 1. NOT APPLICABLE (PATIENT A CHILD)
☐ 2. SINGLE
☐ 3. MARRIED
☐ 4. SEPARATED/DIVORCED
☐ 5. WIDOW/WIDOWER

**7** **PATIENT'S MILITARY STATUS:**
(47)
☐ 1. SPOUSE OR DEPENDENT OF ACTIVE MILITARY
☐ 2. SPOUSE OR DEPENDENT OF RETIRED OR DECEASED MILITARY
☐ 3. ACTIVE MILITARY
☐ 4. RETIRED MILITARY
☐ 5. CIVILIAN EMPLOYEE

**8** **PATIENT'S FLYING STATUS (ACTIVE DUTY PERSONNEL ONLY):**
(48)
☐ 1. ON FLYING STATUS
☐ 2. SUSPENDED FROM FLYING STATUS
☐ 3. NOT ON FLYING STATUS

**9** **DO YOU (THE PATIENT) LIVE ON THIS BASE?**
(49)
☐ 1. YES
☐ 2. NO

**10** **IF "NO":**
APPROXIMATELY HOW MANY MILES AWAY? ______ MILES
(50-52)

**11** **DID YOU MAKE AN APPOINTMENT FOR THIS VISIT?**
(53)
☐ 1. YES
☐ 2. NO

**12** **IF YOU HAD AN APPOINTMENT:**
(54-55)
a. ABOUT HOW MANY DAYS AGO WAS THE APPOINTMENT MADE? (ENTER 0 IF MADE TODAY)
____ DAYS
b. WHAT WAS THE TIME OF THE APPOINTMENT? ____ : ____
(56-59)

**13** **WHAT IS THE MAJOR REASON OR SYMPTOM FOR THIS VISIT?**
(60-71)
**HEAD AND CHEST AREA:**
☐ 1. COLD OR RUNNY NOSE
☐ 2. COUGH
☐ 3. SORE THROAT
☐ 4. EARACHE OR EAR DRAINAGE
☐ 5. HEADACHE
☐ 6. DIZZINESS OR LIGHTHEADEDNESS
☐ 7. EYE PROBLEM, OR CAN'T SEE WELL
☐ 8. HEART PROBLEM
☐ 9. CHEST PAIN
**STOMACH (ABDOMINAL) AREA:**
☐ 10. INDIGESTION, HEARTBURN, DISCOMFORT AFTER EATING
☐ 11. STOMACH (ABDOMINAL) PAIN
☐ 12. URINARY PROBLEM OR INFECTION
☐ 13. PROBLEM WITH SEX-AREA OF BODY
**BONE, MUSCLE, SKIN:**
☐ 14. HURT A BONE, JOINT OR MUSCLE
☐ 15. BACK ACHE OR NECK PAIN
☐ 16. JOINT PAIN (OTHER THAN INJURY) OR ARTHRITIS
☐ 17. SKIN CUT, SCRATCH OR BRUISE
☐ 18. RASH
**GENERAL:**
☐ 19. FLU
☐ 20. FEVER
☐ 21. FATIGUE
☐ 22. WEAKNESS
☐ 23. NERVOUS TENSION, ANXIETY, DEPRESSION
☐ 24. OVERWEIGHT (OR WEIGHT GAIN)
☐ 25. DIABETES
☐ 26. HIGH BLOOD PRESSURE (HYPERTENSION)
☐ 27 THYROID PROBLEM
☐ 28 CHEMOTHERAPY
☐ 29. TO REFILL A PRESCRIPTION
☐ 30 TO GET LAB TEST
☐ 31 REGULAR (ROUTINE) PHYSICAL EXAM
*SOMETHING ELSE (WRITE IN):* ________________
(72-79)

# PART II Diagnostic Information

**TO BE COMPLETED BY THE HEALTH CARE PROFESSIONAL(S) ONLY**

**19** a. STATUS OF PATIENT (CHECK ALL BOXES THAT APPLY):

CARD 2 (8) ☐ 1. NEW PATIENT TO CLINIC
(9) ☐ 2. NEW PATIENT TO PRACTITIONER

b. STATUS OF VISIT

(10) ☐ 1. FIRST VISIT (TO ANYONE) FOR MAIN PROBLEM OR PROCEDURE
☐ 2. RETURN VISIT (TO ANYONE) FOR MAIN PROBLEM OR PROCEDURE
☐ 3. PRESCRIPTION REFILL ONLY

**20** ANY PROPHYLACTIC PROCEDURES PERFORMED? IF YES, CHECK APPLICABLE BOX:

☐ 1. PERIODIC ADULT PHYSICAL EXAM
(11-12) ☐ 2. PERIODIC WELL-CHILD EXAM
☐ 3. FLIGHT PHYSICAL (CLASS 1)
☐ 4. FLIGHT PHYSICAL (CLASS 2 OR 3)
☐ 5. SEPARATION/RETIREMENT PHYSICAL
☐ 6. OTHER NON-FLYING (ADMINISTRATIVE) PHYSICAL
☐ 7. ROUTINE EYE EXAM
☐ 8. ROUTINE GYN EXAM
☐ 9. PRENATAL VISIT
☐ 10. POSTPARTUM VISIT
☐ 11. PRE-OP VISIT
☐ 12. POST-OP FOLLOW-UP
☐ 13. WEIGHT CHECK ONLY
☐ 14. HAZARDOUS NOISE EXAM
☐ 15. OTHER ____________________

**21** ID NUMBER OF PERSON(S) TREATING PATIENT (ENTER IN APPROPRIATE SPACE):

(13-27) ________ / ________ / ________ / ________ / ________
DR. PA NURSE CORPSMAN OTHER

**22** PROBLEMS/AREAS TREATED (CHECK ALL BOXES THAT APPLY):

1. COMMUNICABLE DISEASES (SEE ALSO SECTIONS 8, 10, 11, 12)

| | |
|---|---|
| (28-42) ☐ 5 | INFECTIOUS INTESTINAL (INCLUDES INFECTIOUS DIARRHEA) |
| ☐ 23 | VIRAL SYNDROME WITH GASTROENTERITIS |
| ☐ 245 | VIRAL SYNDROME WITHOUT GASTROENTERITIS |
| ☐ 11-13, 15 | MEASLES, MUMPS, CHICKEN POX |
| ☐ 16 | HEPATITIS OR EXPOSURE TO HEPATITIS |
| ☐ 17 | INFECTIOUS MONONUCLEOSIS |
| ☐ 4 | GONORRHEA (OR EXPOSURE TO GONORRHEA) |
| ☐ 901 | OTHER ____________ |

2. NEOPLASMS

| | |
|---|---|
| ☐ 50-68 | MALIGNANT NEOPLASM |
| ☐ 631 | BENIGN SKIN (INCLUDES MOLE/NEVUS) |
| ☐ 70-74 | BENIGN (OTHER THAN SKIN) |
| ☐ 902 | OTHER ____________ |

3. ALLERGIC, ENDOCRINE, METABOLIC, NUTRITIONAL

| | |
|---|---|
| ☐ 85, 96, 257 | HAY FEVER/ALLERGIES |
| ☐ 86 | ASTHMA |
| ☐ 88-90 | THYROID DISEASE |
| ☐ 91 | DIABETES MELLITUS |
| ☐ 101 | OBESITY |
| ☐ 903 | OTHER ____________ |

4. BLOOD AND IMMUNOLOGICAL ORGANS

| | |
|---|---|
| ☐ 111 | IRON-DEFICIENCY (HYPOCHROMIC) ANEMIA |
| ☐ 110, 112, 122 | OTHER ANEMIAS |
| ☐ 904 | OTHER ____________ |

5. NERVOUS SYSTEM, MENTAL ILLNESS, PERSONALITY DISORDERS

| | |
|---|---|
| ☐ 124-129 | PSYCHOSIS |
| ☐ 130, 134 | ANXIETY OR DEPRESSIVE NEUROSIS |
| ☐ 633 | SEXUAL DYSFUNCTION |
| ☐ 600 | ADULT SITUATION DISTURBANCE (E.G., MARITAL) |
| ☐ 139 | DRUG DEPENDENCE/ABUSE |
| ☐ 141 | ALCOHOL ABUSE OR ALCOHOLISM |
| ☐ 147 | TENSION HEADACHE |
| ☐ 159 | MIGRAINE HEADACHE (OR OTHER MIGRAINE MANIFESTATIONS) |
| ☐ 454 | OTHER HEADACHE |
| ☐ 155 | VASCULAR LESIONS (INCLUDES STROKE, CEREBRAL ARTERIOSCLEROSIS) |
| ☐ 158, 197 | EPILEPSY, CONVULSIONS |
| ☐ 156-157, 159-160, 165-169 | OTHER NERVOUS SYSTEM DISEASES |
| ☐ 150 | PROBLEM OF DEVELOPMENT, RETARDATION, OR BEHAVIOR |
| ☐ 905 | OTHER ____________ |

6. EYE AND EAR

| | |
|---|---|
| ☐ 170 | CONJUNCTIVITIS OR OPHTHALMIA |
| ☐ 176 | REFRACTIVE ERRORS |
| ☐ 178, 605 | STRABISMUS, TROPIA OR PHORIA |
| ☐ 171-175, 177, 179-181 | OTHER EYE DISEASES |
| ☐ 182 | OTITIS EXTERNA |
| ☐ 183, 184 | OTITIS MEDIA (EXCLUDES SEROUS) |
| ☐ 648 | SEROUS OTITIS MEDIA |
| ☐ 187 | WAX IN EAR |
| ☐ 161, 185-186, 188-190 | OTHER DISEASES OF THE EAR |
| ☐ 906 | OTHER ____________ |

7. CARDIOVASCULAR

| | |
|---|---|
| ☐ 211, 212-215 | ISCHEMIC HEART DISEASES (INCLUDING ANGINA PECTORIS, ASHD) |
| ☐ 214 | ARRHYTHMIAS OR HEART BLOCK |
| ☐ 634 | HEART MURMUR |
| ☐ 213, 216, 217 | OTHER HEART DISEASES |
| ☐ 218 | HYPERTENSION (HBP) |
| ☐ 233 | SYNCOPE |
| ☐ 225 | HEMORRHOIDS |
| ☐ 224 | VARICOSE VEINS |
| ☐ 907 | OTHER ____________ |

8. RESPIRATORY

| | |
|---|---|
| ☐ 240 | CORYZA (NON-FEBRILE COMMON COLD) |
| ☐ 241 | FEBRILE COLD |
| ☐ 245 | INFLUENZA, RESPIRATORY FLU SYNDROME |
| ☐ 242 | SORE THROAT (PHARYNGITIS OR TONSILLITIS) |
| ☐ 243 | ACUTE SINUSITIS |
| ☐ 250 | CHRONIC SINUSITIS |
| ☐ 86 | ASTHMA |
| ☐ 247, 256 | ACUTE BRONCHITIS (OR BRONCHIOLITIS) |
| ☐ 246 | PNEUMONIA, PNEUMONITIS |
| ☐ 248, 258 | CHRONIC BRONCHITIS/EMPHYSEMA/COPD |
| ☐ 257 | COUGH ONLY |
| ☐ 263 | NOSE BLEED |
| ☐ 908 | OTHER ____________ |

**9. DIGESTIVE**

| | |
|---|---|
| ☐ 273, 274, 284, 294 | ESOPHAGITIS, GASTRITIS, INDIGESTION, HIATAL HERNIA |
| ☐ 277-279 | ULCER DISEASE (STOMACH OR DUODENUM) |
| ☐ 281 | OTHER DISEASES OF ESOPHAGUS, STOMACH, DUODENUM |
| ☐ 5 | INFECTIOUS INTESTINAL (INCLUDES INFECTIOUS DIARRHEA) |
| ☐ 23 | VIRAL SYNDROME WITH GASTROENTERITIS |
| ☐ 301, 306 | ABDOMINAL PAIN (NOT OTHERWISE SPECIFIED) |
| ☐ 280 | FUNCTIONAL UPPER GI DISTRESS |
| ☐ 304 | FUNCTIONAL LARGE BOWEL DISTRESS (IRRITABLE/SPASTIC COLON) |
| ☐ 286, 287 | CHOLELITHIASIS, CHOLECYSTITIS |
| ☐ 282, 285, 309 | OTHER DISEASES OF INTESTINE AND PERITONEUM |
| ☐ 303 | DIARRHEA |
| ☐ 225 | HEMORRHOIDS |
| ☐ 283 | HERNIA–INGUINAL, FEMORAL, UMBILICAL |
| ☐ 909 | OTHER ____________________ |

**10. GENITO-URINARY SYSTEM (SEE ALSO SECTION 1)**

| | |
|---|---|
| ☐ 313, 314 | URINARY TRACT INFECTION (CYSTITIS/PYELITIS/PYELONEPHRITIS) |
| ☐ 315 | NONSPECIFIC URETHRITIS (NON-GONOCOCCAL) |
| ☐ 4 | GONOCOCCAL URETHRITIS, CERVICITIS, OR *SALPINGITIS* |
| ☐ 317 | OTHER DISEASES OF URINARY SYSTEM |
| ☐ 316, 318 | PROSTATITIS OR BENIGN PROSTATIC HYPERTROPHY |
| ☐ 319-321, 331 | OTHER DISEASES OF REPRODUCTIVE SYSTEM |
| ☐ 335 | VULVITIS, VAGINITIS AND CERVICITIS (NON-VENEREAL) |
| ☐ 327-330, 334 | DISORDERS OF MENSTRUATION, DYSFUNCTIONAL UTERINE BLEEDING |
| ☐ 329 | MENOPAUSAL SYMPTOMS |
| ☐ 585, 586 | FAMILY PLANNING/CONTRACEPTION/INFERTILITY |
| ☐ 332 | CERVICAL EROSION |
| ☐ 322 | BREAST MASS OR BREAST DISEASE (EXCLUDING MALIGNANCY) |
| ☐ 910 | OTHER ____________________ |

**12. SKIN AND SUPERFICIAL TISSUE (SEE ALSO SECTION 16)**

| | |
|---|---|
| ☐ 21 | FUNGAL SKIN INFECTION, DERMATOPHYTOSIS |
| ☐ 371, 372, 374 | CELLULITIS (INCLUDING LYMPHANGITIS) |
| ☐ 375 | IMPETIGO |
| ☐ 389 | ACNE |
| ☐ 370, 373, 377 | OTHER LOCAL INFECTIONS OF SKIN AND SUBCUTANEOUS TISSUE |
| ☐ 378-381 | DERMATITIS (INCLUDING ECZEMA) |
| ☐ 388 | PITYRIASIS ROSEA |
| ☐ 644 | DRUG RASH |
| ☐ 386 | RASH (OTHERWISE UNSPECIFIED) |
| ☐ 631 | MOLE, NEVUS |
| ☐ 25 | WARTS |
| ☐ 384, 385 | CORNS/OTHER HYPERTROPHIC/ATROPHIC SKIN CONDITIONS |
| ☐ 387 | DISEASES OF NAIL AND NAIL BED (EXCLUDING FUNGUS) |
| ☐ 390 | DISEASES OF SWEAT AND SEBACEOUS GLANDS (INCLUDING SEBACEOUS CYST) |
| ☐ 912 | OTHER ____________________ |

**13. BONES, JOINTS, MUSCLES**

| | |
|---|---|
| ☐ 406 | RHEUMATOID ARTHRITIS |
| ☐ 405 | OSTEOARTHRITIS |
| ☐ 407-409 | OTHER ARTHRITIS/RHEUMATISM, INCLUDING POST-TRAUMA |
| ☐ 420-422 | BURSITIS, TENOSYNOVITIS, SYNOVITIS |
| ☐ 424-426 | BACKACHE ALONE, BACK PAIN ALONE |
| ☐ 423 | BACKACHE WITH SCIATICA |
| ☐ 428 | PAIN IN JOINT (ARTHRALGIA) |
| ☐ 479 | DISLOCATION, UPPER EXTREMITY |
| ☐ 640 | DISLOCATION, LOWER EXTREMITY |
| ☐ 642 | TRAUMA TO HEAD |
| ☐ 473-477 | FRACTURE OF UPPER LIMB |
| ☐ 480, 481 | FRACTURE OF LOWER LIMB |
| ☐ 486 | OTHER FRACTURE |
| ☐ 607 | SPRAIN/STRAIN UPPER LIMB |
| ☐ 608 | SPRAIN/STRAIN LOWER LIMB |
| ☐ 609 | SPRAIN/STRAIN NECK/BACK |
| ☐ 643 | MUSCLE PAIN, MUSCLE CRAMPS |
| ☐ 913 | OTHER ____________________ |

**16. ACCIDENTS, POISONINGS AND VIOLENCE (SEE ALSO SECTION 13)**

| | |
|---|---|
| ☐ 465, 484 | FOREIGN BODY (DEFINITE OR POSSIBLE) |
| ☐ 483 | LACERATION.., CONTUSIONS, ABRASIONS, SUPERFICIAL INJURIES |
| ☐ 394 | INSECT BITES |
| ☐ 611 | ANIMAL BITES |
| ☐ 485-487 | BURNS |
| ☐ 488-491 | POISONING, OVERDOSE |
| ☐ 917 | OTHER ____________________ |

**17. SIGNS, SYMPTOMS AND ILL-DEFINED CONDITIONS**

| | |
|---|---|
| ☐ 455 | MALINGERING |
| ☐ 458 | FEVER OF UNKNOWN ORIGIN |
| ☐ 646 | PAIN |
| ☐ 231, 271 | CHEST PAIN (UNKNOWN ETIOLOGY) |
| ☐ 647 | NO PATHOLOGY AT THIS TIME (WELL PATIENT) |
| ☐ 916 | NO DEFINITE DIAGNOSIS AT THIS TIME |

**19. OTHER**

| | |
|---|---|
| ☐ 919 | OTHER ____________________ |

**23** SERIOUSNESS OF MAIN CONDITION TREATED (CHECK ONE):

(43)
- ☐ 1. VERY SERIOUS
- ☐ 2. SERIOUS
- ☐ 3. SLIGHTLY SERIOUS
- ☐ 4. NOT SERIOUS

**24** DISPOSITION OF VISIT:

(44-49)
- ☐ 1. NO FORMAL FOLLOW-UP PLANNED
- ☐ 2. RETURN PRN (POSSIBLE FOLLOW-UP)
- ☐ 3. *DEFINITE TELEPHONE FOLLOW-UP*
- ☐ 4. DEFINITE RETURN APPOINTMENT
- ☐ 5. REFER TO OTHER PROFESSIONAL OR CLINIC ON THIS VISIT (SPECIFY BY ID NUMBER OR NAME) ____________________
- ☐ 6. REFER TO OTHER PROFESSIONAL OR CLINIC FOR FUTURE APPOINTMENT (SPECIFY BY ID NUMBER OR NAME) ____________________
- ☐ 7. REFER TO CHAMPUS
- ☐ 8. ADMIT TO QUARTERS
- ☐ 9. ADMIT TO HOSPITAL
- ☐ 10. RETURN TO REFERRING CLINIC (SPECIFY BY NAME) ____________________
- ☐ 11. OTHER: ____________________

(50-52) ____________________

**25** a. **DID YOU SPEAK OR CONSULT WITH ANOTHER HEALTH CARE PROFESSIONAL CONCERNING THIS PATIENT ?**

(53)
- ☐ 1. YES–AND OTHER PROFESSIONAL SAW PATIENT ON THIS VISIT
- ☐ 2. YES–SPOKE, BUT OTHER PROFESSIONAL DID NOT SEE PATIENT ON THIS VISIT
- ☐ 3. YES–BUT ONLY TO HAVE A PRESCRIPTION OR ORDER COUNTERSIGNED
- ☐ 4. NO

(54-56) b. **IF YES, ENTER NAME OR ID NUMBER OF OTHER PROFESSIONAL CONSULTED:** ____________________

____________________

## PART III Treatment Information

IN THE QUESTIONS WHICH FOLLOW, EACH HEALTH PROFESSIONAL SHOULD CHECK OFF APPROPRIATE BOXES IN HIS OR HER COLUMN

**26** TESTS (CHECK ALL APPLICABLE BOXES):

| a. DIAGNOSTIC TESTS (ORDERED OR PERFORMED): | DR. 1 | PA 2 | NURSE 3 | CORPSMAN 4 | OTHER 5 |
|---|---|---|---|---|---|
| (57) AUDIOGRAM | ☐ | ☐ | ☐ | ☐ | ☐ |
| (58) CULTURE–GENITAL TRACT, OR WET PREP, SMEAR, OR GRAM STAIN | ☐ | ☐ | ☐ | ☐ | ☐ |
| (59) CULTURE–THROAT | ☐ | ☐ | ☐ | ☐ | ☐ |
| (60) CULTURE–URINE | ☐ | ☐ | ☐ | ☐ | ☐ |
| (61) CULTURE–OTHER SOURCES (SPUTUM, STOOL, ETC.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (62) EXERCISE (STRESS) TEST | ☐ | ☐ | ☐ | ☐ | ☐ |
| (63) PAP SMEAR | ☐ | ☐ | ☐ | ☐ | ☐ |
| (64) PULMONARY FUNCTION TESTS | ☐ | ☐ | ☐ | ☐ | ☐ |
| (65) SKIN TESTS (ALLERGY, TB, ETC.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (67) URINALYSIS | ☐ | ☐ | ☐ | ☐ | ☐ |
| (68) OTHER ____________ | ☐ | ☐ | ☐ | ☐ | ☐ |
| CARD 3 b. LAB TESTS ORDERED: | | | | | |
| (8) HEMOGLOBIN/HEMATOCRIT (ONLY) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (9) WBC/WHITE BLOOD COUNT (WITH OR WITHOUT DIFF.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (10) COMPLETE BLOOD COUNT/CBC | ☐ | ☐ | ☐ | ☐ | ☐ |
| (11) SYPHILIS SEROLOGY, VDRL | ☐ | ☐ | ☐ | ☐ | ☐ |
| (12) MONOSPOT OR HETEROPHILE | ☐ | ☐ | ☐ | ☐ | ☐ |
| (13) URINALYSIS | ☐ | ☐ | ☐ | ☐ | ☐ |
| (14) BLOOD SUGAR (SINGLE OR TOLERANCE TEST) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (15) CHOLESTEROL/TRIGLYCERIDES (LIPIDS) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (16) BUN/CREATININE | ☐ | ☐ | ☐ | ☐ | ☐ |
| (17) ELECTROLYTES (ONE OR MORE) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (18) LIVER FUNCTION TEST(S) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (19) THYROID (T3, T4, TSH, ETC.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (20) EKG | ☐ | ☐ | ☐ | ☐ | ☐ |
| (21) X-RAY: CHEST | ☐ | ☐ | ☐ | ☐ | ☐ |
| (22) X-RAY OTHER THAN CHEST | ☐ | ☐ | ☐ | ☐ | ☐ |
| (23) OTHER ____________ | ☐ | ☐ | ☐ | ☐ | ☐ |
| c. SELECTED EXAMINATION PROCEDURES PERFORMED: | | | | | |
| (24) BLOOD PRESSURE MEASURED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (25) LUNGS AUSCULATED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (26) HEART AUSCULATED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (27) ABDOMEN PALPATED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (28) PELVIC EXAMINATION DONE | ☐ | ☐ | ☐ | ☐ | ☐ |

**27** TREATMENT (CHECK ALL APPLICABLE ITEMS):

| a. PHYSICAL MEASURES: | DR. 1 | PA 2 | NURSE 3 | CORPSMAN 4 | OTHER 5 |
|---|---|---|---|---|---|
| (29) SUTURE PLACEMENT OR REMOVAL | ☐ | ☐ | ☐ | ☐ | ☐ |
| (30) APPLY, CHECK, CHANGE DRESSING | ☐ | ☐ | ☐ | ☐ | ☐ |
| (31) REMOVE FOREIGN BODY | ☐ | ☐ | ☐ | ☐ | ☐ |
| (32) INCISION, EXCISION OR BIOPSY | ☐ | ☐ | ☐ | ☐ | ☐ |
| (33) ORTHOPEDIC PROCEDURE | ☐ | ☐ | ☐ | ☐ | ☐ |
| (34) ORDER/GIVE PHYSICAL THERAPY | ☐ | ☐ | ☐ | ☐ | ☐ |
| (35) IMMUNIZATION OR VACCINATION (ORDERED OR DONE) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (36) INJECTION OTHER THAN IMMUN./VACC. (ORDERED OR DONE) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (37) CONTRACEPTIVE PROCEDURE (INCLUDES IUD) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (38) OTHER ____________ | ☐ | ☐ | ☐ | ☐ | ☐ |
| b. SELECTED MEDICATIONS (WHETHER STARTED OR CONTINUED): | | | | | |
| (39) ANALGESIC–NARCOTIC (OR COMBINATION NON-NARCOTIC WITH NARCOTIC) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (40) ANALGESIC–NON-NARCOTIC | ☐ | ☐ | ☐ | ☐ | ☐ |
| (41) ANTACID, ANTI-EMETIC, ANTIDIARRHEAL | ☐ | ☐ | ☐ | ☐ | ☐ |
| (42) ANTI-ANEMIA (HEMATINIC) | | | | | |
| ANTIBIOTICS: | | | | | |
| (43) ANY PENICILLIN (INCLUDING AMPICILLIN) OR ERYTHROMYCIN | ☐ | ☐ | ☐ | ☐ | ☐ |
| (44) ANY TETRACYCLINE | ☐ | ☐ | ☐ | ☐ | ☐ |
| (45) ANY SULFA DRUG | ☐ | ☐ | ☐ | ☐ | ☐ |
| (46) ANY OTHER ANTIBIOTIC | ☐ | ☐ | ☐ | ☐ | ☐ |
| (47) ANTIHISTAMINIC/DECONGESTANT/ANTITUSSIVE/ANTI-COLD | ☐ | ☐ | ☐ | ☐ | ☐ |
| (48) ANTIHYPERTENSIVE AND/OR DIURETIC | ☐ | ☐ | ☐ | ☐ | ☐ |
| (49) ANTI-INFLAMMATORY | ☐ | ☐ | ☐ | ☐ | ☐ |
| (50) BRONCHIAL DILATOR | ☐ | ☐ | ☐ | ☐ | ☐ |
| (51) CARDIOVASCULAR (DIG., ANTI-ANGINAL, ANTI-ARRHYTHMIC) | ☐ | ☐ | ☐ | ☐ | ☐ |
| (52) CONTRACEPTIVE (ORAL) OR ESTROGEN PREPARATION | ☐ | ☐ | ☐ | ☐ | ☐ |
| (53) INSULIN OR ORAL HYPOGLYCEMIC AGENT | ☐ | ☐ | ☐ | ☐ | ☐ |
| (54) SEDATIVE/SLEEP MED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (55) STEROID–ORAL OR INJECTED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (56) STEROID–TOPICAL OR INHALED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (57) THYROID-RELATED MED | ☐ | ☐ | ☐ | ☐ | ☐ |
| (58) TRANQUILIZER OR ANTI-DEPRESSANT | ☐ | ☐ | ☐ | ☐ | ☐ |
| (59) VITAMINS AND MINERALS INC. IRON | ☐ | ☐ | ☐ | ☐ | ☐ |
| (60) OTHER ____________ | ☐ | ☐ | ☐ | ☐ | ☐ |
| c. COUNSELING AND OTHER: | | | | | |
| (61) COUNSEL ABOUT DISEASE, MEDICATION, OR OTHER TREATMENT | ☐ | ☐ | ☐ | ☐ | ☐ |
| (62) ADVICE ABOUT CONTRACEPTION | ☐ | ☐ | ☐ | ☐ | ☐ |
| (63) PSYCHOLOGICAL COUNSELING | ☐ | ☐ | ☐ | ☐ | ☐ |
| (64) CHAPERONING | ☐ | ☐ | ☐ | ☐ | ☐ |
| (65) ADMINISTRATIVE ACTION | ☐ | ☐ | ☐ | ☐ | ☐ |
| (66) OTHER ____________ | ☐ | ☐ | ☐ | ☐ | ☐ |

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## PART IV Time Information

PATIENT SHOULD ANSWER THE FOLLOWING QUESTIONS AT THE END OF THE VISIT

**14** DURING YOUR VISIT, APPROXIMATELY HOW MUCH TIME WAS SPENT WITH THE DOCTOR, IF ANY?

| (67) | NONE 0 | LESS THAN A MIN 1 | 1-5 MIN 2 | 5-10 MIN 3 | 10-20 MIN 4 | 20-30 MIN 5 | MORE THAN 30 MIN 6 |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**15** HOW MUCH TIME WAS SPENT WITH THE PHYSICIAN ASSISTANT (IDENTIFIED BY THE BLUE EMBLEM "PA" ON HIS JACKET), IF ANY?

| (68) | NONE 0 | LESS THAN A MIN 1 | 1-5 MIN 2 | 5-10 MIN 3 | 10-20 MIN 4 | 20-30 MIN 5 | MORE THAN 30 MIN 6 |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**16** HOW MUCH TIME WAS SPENT WITH THE NURSE, OR NURSE PRACTITIONER, IF ANY?

| (69) | NONE 0 | LESS THAN A MIN 1 | 1-5 MIN 2 | 5-10 MIN 3 | 10-20 MIN 4 | 20-30 MIN 5 | MORE THAN 30 MIN 6 |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**17** HOW MUCH TIME WAS SPENT WITH THE CORPSMAN, IF ANY?

| (70) | NONE 0 | LESS THAN A MIN 1 | 1-5 MIN 2 | 5-10 MIN 3 | 10-20 MIN 4 | 20-30 MIN 5 | MORE THAN 30 MIN 6 |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**18** HOW MUCH TIME WAS SPENT WITH OTHER HEALTH CARE PROFESSIONALS, IF ANY?

| (71) | NONE 0 | LESS THAN A MIN 1 | 1-5 MIN 2 | 5-10 MIN 3 | 10-20 MIN 4 | 20-30 MIN 5 | MORE THAN 30 MIN 6 |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

# Appendix B

# GUIDELINES FOR A DEMONSTRATION PROJECT ON THE ORGANIZATION OF AIR FORCE OUTPATIENT CARE[1]

## I. INTRODUCTION

Rand's analysis of the existing organization of Air Force outpatient care suggests that serious consideration be given to an increased use of physician extenders in treating patients. (By physician extenders we mean physician assistants and nurse practitioners.) Properly organized, this should allow the Air Force medical service to provide high-quality care to the beneficiary population with a smaller number of physicians. By reducing physician requirements, such a system would provide the medical service with a partial solution to one of its most difficult problems: the decline in the physician force that is occurring in response to the ending of the draft. Even after allowing for the training of additional physician extenders, it is our estimate that this system would allow the Air Force to operate its outpatient clinics for substantially less than the cost of alternative arrangements.

To test the concept of using a richer mix of physician extenders, Rand has proposed a demonstration at a limited number of bases. This also allows the Air Force to develop the details of how such a concept might work before final decisions on future Air Force medical staffing are taken. In February 1976 General Schafer, the Air Force Surgeon General, approved the proposed demonstration, selecting Chanute, Dyess, Fairchild, and Nellis Air Force Bases as sites. Rand is providing assistance and guidance to the individual hospital commanders in setting up the demonstration, and will evaluate its results. This Working Note sets out the guidelines that the demonstration hospitals are following. Because one purpose of the demonstration is to explore the details of how the concept might be implemented, the guidelines are deliberately written in general terms.

The demonstration focuses on six clinics that account for about 60 percent of all outpatient visits: the General Therapy Clinic, the Flight Surgeon's Office, the Physical Exam Section, the Internal Medicine Clinic, Sick Call, and the Emergency Room (to the extent that it is used by the patient population as a walk-in facility). These clinics treat the general medical problems of adults and older children. Therefore, for

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[1] Prepared in December 1976 by David J. Armor, David S.C. Chu, and George A. Goldberg. These guidelines were distributed widely in the demonstration base clinics.

convenience, we refer to them as the "general medical clinics." In the present system, they are treated as distinct entities and staffed on the basis of historical workloads. During the draft era, they were manned principally by general medical officers, flight surgeons, and corpsmen. It is our proposal that they be managed as a unit (even though some elements might remain physically distinct at individual bases), that they be staffed in accord with the patient population for which the base is responsible, and that this staffing employ a richer mix of physician extenders and a leaner mix of physicians than the Air Force now plans to use. These personnel would be organized in teams headed by a physician, to insure that the physician extenders receive good professional supervision. Each team would be responsible for an identified set of patients, in order to deal with one of the perennial complaints of military patients: that there is little continuity from one visit to the next, and the patient may see a different individual on each visit to the hospital.

Most of the ideas contained in this demonstration are not really new. Rather, they reflect practices now employed at a number of Air Force hospitals, practices that we evaluated in a detailed study of nine Air Force outpatient facilities. On the basis of that study (to be published shortly), we selected those practices that appeared most promising and organized them into an integrated plan for the staffing and management of the general medical clinics. In some ways, our recommendations extrapolate beyond the range of what we actually observed. It is for this reason that a demonstration or test of the proposed concepts is most important.

The guidelines for this demonstration are organized into six sections: the organization and functioning of the practitioner teams, the organization of patient panels, the interface between the general medical clinics and other clinics in the hospital, the appointment system, reporting requirements for the demonstration, and publicity arrangements.

## II. ORGANIZATION AND FUNCTIONING OF PRACTITIONER TEAMS

1. The practitioner team is expected to provide all general medical care that the adult patient population requires, some pediatric care, and a limited amount of gynecological care (See Section IV. INTERFACE WITH OTHER CLINICS). Surgical care, psychiatric care, and subspecialty care are provided by referral to the appropriate clinic or CHAMPUS physician. The degree to which "general medical care" embraces care usually provided by the board-eligible internist depends on the training of the physician member of the team.

2. A team will usually consist of one physician, two or three extenders, and one or two corpsmen. The term "extenders" includes both physician assistants (PAs) and primary care nurse practitioners (PCNPs). The two types of extenders may be mixed at the discretion of the hospital commander. Decisions on assigning particular individuals to team positions are the responsibility of the hospital commander, taking into account the relative experience of prospective team members, personality factors, etc. The hospital commander may decide to change the assignment of an individual from one team to another during the course of the demonstration.

3. The physician member of the team should usually be an internist, a family practitioner, or a flight surgeon. Under exceptional circumstances the physician member may be a general practitioner. In such cases, it is strongly preferred that the general practitioner have more than one year's in-hospital training beyond the MD or DO degree, in light of the responsibilities outlined in (5) below.

4. In the Flight Surgeon's Office a team may be enlarged to provide continuous supervision of physician extenders. For example, a team might consist of two flight surgeons, three or four extenders, and two corpsmen. In this way, it is possible to have one flight surgeon on duty with the team at all times, allowing the other flight surgeon to attend to his flight line responsibilities.

5. The physician functions as a supervisor of the other team members; provides care to those individuals needing a physician's attention; and provides care to those individuals who, for their presenting

complaint, strongly prefer to see a physician rather than a physician extender, even though this may not be medically indicated. If a physician has a special interest and expertise, patients with problems in this area may be referred from other teams. Physician responsibilities for inpatient care will depend on training, experience, and practice preferences.

6. To facilitate communication among members of the team, especially consultation with the physician by the extenders, office and examination space should be arranged so that members of the same team occupy space next to each other, insofar as that is possible. A second objective in assignment of space should be to facilitate sharing of personnel who act as chaperons.

7. From data assembled in our study of nine typical Air Force outpatient facilities, we expect that most patient problems will be simple to intermediate in difficulty of diagnosis, treatment decision, and treatment application. These are the kinds of problems that physician extenders are trained to handle, and we therefore expect that most patients will receive definitive care from extenders. Only a small fraction of patients should require a referral appointment to a physician (which might be accomplished on the same day).

8. Again, because we expect that most patient problems will be simple to intermediate in difficulty of diagnosis, treatment decision, and treatment application, the initial encounter will usually be both a screening *and* a treatment visit. Only a small fraction of patients will require return appointments for a more extended workup, although of course a significant fraction of patients will require return appointments in order to monitor the course of their problem.

9. Extenders working in the Flight Surgeon's Office may treat personnel on flying status under the flight surgeon's supervision. However, actions involving grounding, release from grounding, or a waiver of regulations will typically require participation by a physician. Moreover, extenders should not hesitate to refer promptly to a physician those patients who request such referral.

10. Corpsmen assist the physician and extenders in providing care, especially in the administration of treatment procedures. They should not typically be the source of definitive decisions on patient management.

11. The physician's schedule will be designed to allow sufficient time for interruption by the extenders for immediate consultation on patient problems. Extenders are therefore encouraged to consult their physician precepter as needed. Establishment of a formal consultation period (daily, or at less frequent intervals) is left to the discretion of the hospital commander.

12. With the exception of personnel on flying status, patients who are scheduled to see an extender, yet insist on seeing a physician, should be handled according to the judgment of the extender. If the extender decides the patient should see a physician (despite the absence of medical necessity for seeing a physician), this will typically involve a return appointment. Using return appointments in these cases will avoid overburdening the physician's schedule on any one day, and will limit use of this referral mechanism to those who feel strongly about the issue.

13. When the physician member of a team is absent, the physician member of another team may be asked to serve as the temporary supervisor and consultant. Alternatively, in hospitals with an independent internist, or general practitioner, the independent physician may play this role.

## III. ORGANIZATION OF PATIENT PANELS

1. Each team of practitioners will be responsible for a panel of patients. Panel size will be a function of team size and team member availability.

2. Initially, panels will be organized at the discretion of the hospital commander. A preferable method of organization is to assign specific units to each team, with flying units assigned to the teams headed by flight surgeons.

3. For purposes of initiating the panel organization, assignment of a military person to a panel automatically carries with it the assignment of spouse and dependents.

4. Retirees now using the base for care should be included in the initial organization of panels. It is preferred that some retirees be assigned to all panels to provide a good practice mix.

5. Under this concept, teams headed by flight surgeons will be treating--in addition to flying personnel--some spouses and dependents, some retirees, and perhaps some active-duty personnel not on flying status. Assignment of physician extenders to the Flight Surgeon's Office should give it sufficient manpower to absorb these new responsibilities.

6. After the initial organization of panels, patients may request reassignment to another panel. Management of reassignment requests is left to the discretion of the hospital commander, although a flexible policy is encouraged. Valid reasons for requesting a change could include personal incompatibility with the practitioner team, specialized training of another team's physician, etc.

## IV. INTERFACE WITH OTHER CLINICS

1. Most ob/gyn care will be provided by the Ob/Gyn Clinic. Depending on the adequacy of ob/gyn staffing, the general medical teams may be encouraged to handle minor gynecological problems (e.g., vaginitis). However, routine gyn exams, including pap smears, should continue to be handled by the Ob/Gyn Clinic, since these exams represent an important opportunity for the patient to discuss other gynecological problems with the trained gynecological practitioner.

2. Much of the pediatric care will be provided by the Pediatric Clinic. Depending on the adequacy of pediatric staffing, the general medical teams may be encouraged to handle common problems of children seven years of age and older. However, well-baby care and care for children six years of age and younger should continue to be handled by the Pediatric Clinic.

3. If the team physician is a family practitioner, the above guidelines may be modified to expand the scope of ob/gyn and pediatric care provided by the general medical teams.

4. To prepare them for any gynecological and pediatric responsibilities they may have, physician assistants who are not recent graduates of the Sheppard Air Force Base training program should be offered refresher training as decided on and defined by the hospital commander.

5. When the team physician is a family practitioner, the hospital commander should decide the limits of ob/gyn and pediatric care that the team provides, taking into account the training and preferences of the team members, and the hospital's overall staffing.

## V. APPOINTMENT SYSTEM

1. The practitioner resources provided at the hospital under the demonstration concept should be sufficient to allow the hospital to move to a fully-appointed system for all patients, eliminating unappointed sick call and use of the Emergency Room as a source of care for non-urgent problems.

2. The goal is to provide same-day or next-day appointments with a member of the patient's team for all acute conditions.

3. Appointments should be handled by a central appointment desk according to schedules established by the hospital commander in consultation with the hospital's professional staff. The Rand Corporation will provide advice on the expected numbers of various kinds of appointments that will be required.

4. If necessary to demonstrate to the patient population that the new system can provide responsive appointed service, and that it is unnecessary and improper to use the Emergency Room for non-urgent problems, an abnormally large number of acute appointment slots may be established at the start of this demonstration (with a corresponding reduction of routine appointments).

5. As noted earlier, for both acute and routine appointments, we expect that most patients can be handled definitively by extenders. The central appointment desk should assign to physicians only those patients who are *directed* to a physician by a practitioner, those patients who (based on criteria developed by the hospital staff) *should* be seen by a physician, and those patients who *strongly insist* on seeing a physician even though such an assignment does not appear to be medically indicated. For this last group of patients, routine appointments should be offered with a greater delay than routine appointments with an extender.

6. Personnel on flying status will also be offered appointments under this system. However, it should be made clear to them that the appointment is a convenience to their seeking medical care, not a roadblock. Such personnel should be treated in a courteous and responsive manner if they arrive at the Flight Surgeon's Office without an appointment.

7. Personnel arriving in the Emergency Room should be evaluated and their condition treated if urgent. If not urgent, they should be assisted in making a regular appointment.

# VI. REPORTING REQUIREMENTS

1. The demonstration described in these guidelines is scheduled to last at least one year. At the end of a year, the Office of the Surgeon General will decide if the experiment should be continued or modified. The following reporting requirements therefore apply to the first year of the demonstration.

2. Each hospital administrator will be requested to prepare a quarterly "Lessons Learned" report to be forwarded to The Rand Corporation. Rand, in turn, will circulate a consolidated report to the test hospitals, as a basis for exchanging ideas and comments.

3. At six-month intervals, each hospital commander will be asked to note changes and adjustments in extender and corpsmen training that he would recommend. These will be forwarded to Rand, which again will prepare a consolidated report.

4. Early in 1977 the hospital will administer a patient contact record for a sample period. The sample period will be chosen in consultation with the hospital commander. The patient contact record will be a revised version of the contact record which Rand used in nine Air Force hospitals in 1974. It will be used as the basis for a detailed analysis and evaluation of the functioning of the demonstration system.

5. In addition, Rand will provide a productivity reporting system for use by the hospital on a continuing basis during the demonstration. This system will reflect both inpatient and outpatient activity, and will attempt to differentiate the various types of outpatient visits. Copies of these reports will be forwarded to Rand monthly.

6. When the demonstration begins, and again after the demonstration has been in progress for at least six months, Rand will administer to a sample of active-duty and retired households a mail survey soliciting baseline data and opinions on the military medical care system. This will be used to assess patient reactions to the demonstration.

7. During the course of the demonstration, Rand will conduct a series of interviews with the health care practitioners to solicit their description and assessment of the demonstration.

## VII. PUBLICITY

1. Rand will provide briefings to the unit and base commanders, as required.

2. Not later than two weeks before the start of the experiment, the hospital commander should provide base and local newspapers with press releases explaining the experiment. Rand will assist in the preparation of these releases.

3. The hospital administrator and other hospital personnel are encouraged to explain the test concept in talks to base organizations, and to undertake such other publicity as the hospital commander may think advisable.

# Appendix C

# THE EFFORT REPORT

## EFFORT REPORT

(01) 3. Fairchild AFB Hospital

(02-04) ID#________________________________________

(05-10) Report for (date--month/day/year):____________________

HOURS

(11-14) Inpatient (ward) care (hours):

(15-18) Outpatient care (hours):

(19-22) Telephone care (hours):

(23-26) Record keeping/review (hours):

(27-30) Other (administration, additional duties, etc.) (hours):

(31) On duty (incl. *MOD* previous night *1. Yes 2. No*

(32-35) Hours worked previous night as a result of being on duty/MOD/on call:

# Appendix D

# CONTINUATION CURVES

A continuation curve depicts the proportion of some group remaining in the service t years after entry. A point on the curve may also be interpreted as the probability that an individual from the group remains in the service at least t years.

The expected continuation rates published in the Health Policy and Programs Report "Physician Retention and Outlook Within Analysis by Specialty" (June 1981), by John Bircher, form the basis for our continuation curve approximation. Bircher's numbers are the most comprehensive and up-to-date figures available. However, the newness of the HPSP, Volunteer Recruiting, and PA programs limits reliability of such projections as these, which are based on historical data. In our efforts at developing reasonable smooth curve approximations to Bircher's estimates, we omitted formal curve fitting techniques because his estimates were tentative, and because we are more concerned with relative magnitudes than absolute numbers.

Our curves are divided into three segments: an obligated service phase, a regular service phase, and a retirement eligible phase. During the obligated service phase, most if not all of the group are in their initial period of obligation and terminations are rare. Let a denote the length of this segment. Then we use the functional form

$$e^{-\alpha t^2} \text{ on } [0,a].$$

This form may be used to represent a gradual but progressive decline as expected during this phase. The endpoint a and the parameter $\alpha$ are chosen to approximate Bircher's continuation rates.

In the regular service phase, from a to b, where b is the first time retirement eligibility is attained, continuation is estimated by

$$c_1(1 + \beta_1(t - a))^{\delta_1}$$

where

$$C_1 = e^{-\alpha a^2}$$

and $\beta_1$ $\delta_1$ are again selected so the curve approaches Bircher's continuation rates. This form drops off sharply from a with a much more gradual decline as b is neared. This corresponds to our intuitive understanding of the decisions through time to stay or leave. Many people leave at the end of their obligated service, but very few will separate just before retirement eligibility.

The last segment from b to mandatory retirement is similar to the regular service phase in that most who plan to leave early leave as early as possible, so we see a sharp drop off at b with a much more gradual decline thereafter. This is estimated as

$$c_2(1 + \beta_2(t - b))^{-\delta_2}$$

where

$$c_2 = c_1(1 + \beta_1(b - a))^{-\delta_1}$$

and $\beta_2$, $\delta_2$ are selected as above.

Continuation curves for HPSP physicians and for volunteers beginning from initial clinical service are displayed in Fig. D.1. The continuation rates for volunteer physicians decline much more rapidly than those for HPSP program participants. Although the rate difference narrows as retirement eligibility is approached, there is still almost a 10 percent difference at 20 years. Bircher's estimates of HPSP retention appear optimistic in light of the much lower retention of draft-era Berry Plan physicians. The dashed curve represents the lower HPSP continuation rates used in the sensitivity analysis.

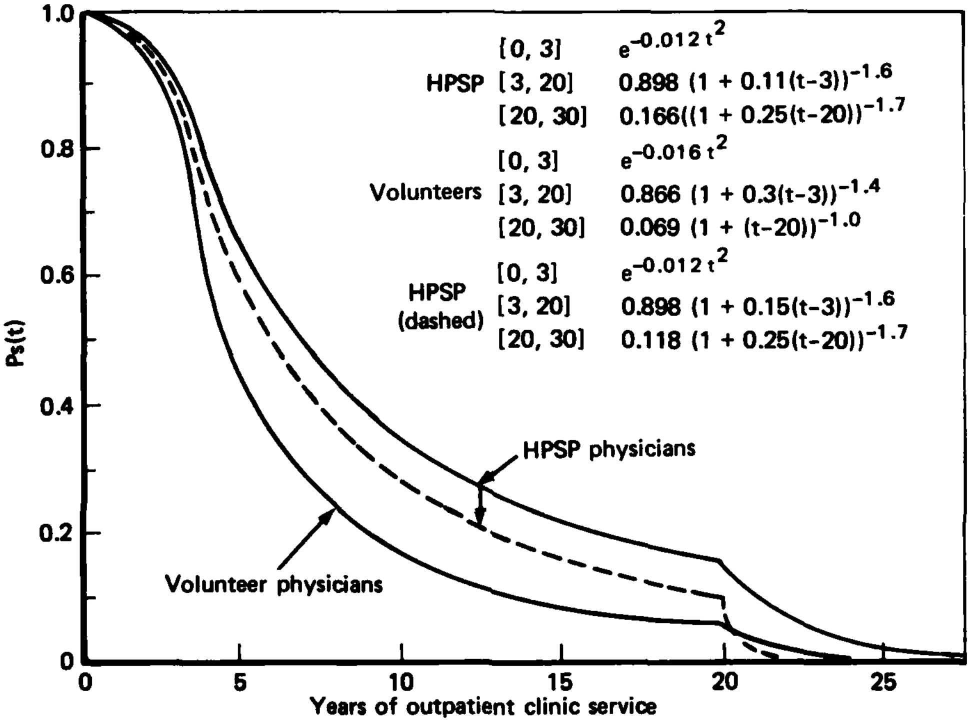

Fig. D.1—Physician continuation curves

Among HPSP physicians, we can only hypothesize the effect played by the military residency on continuation rates. We know these individuals become eligible for retirement after three less years of clinical service and expect that as a result more will stay until retirement. In the absence of better information we assume that the same parameters hold on each segment for both military and civilian residencies and that only the segment endpoints change. As depicted in Fig. D.2, this affects the retirement eligibility phase because $c_2$ changes.

The curve for PAs, presented in Fig. D.3, is strictly a construct. The retirement eligible segment is dashed because current policy dictates that PAs will not be promoted beyond major.

Because PAs will average 12 years of service upon completion of their obligation, it is believed that nearly all will stay to retirement. In our calculations we assume 80 percent reach retirement. Figure D.3 also shows the nurse continuation curve; we use this curve in our sensitivity analysis.

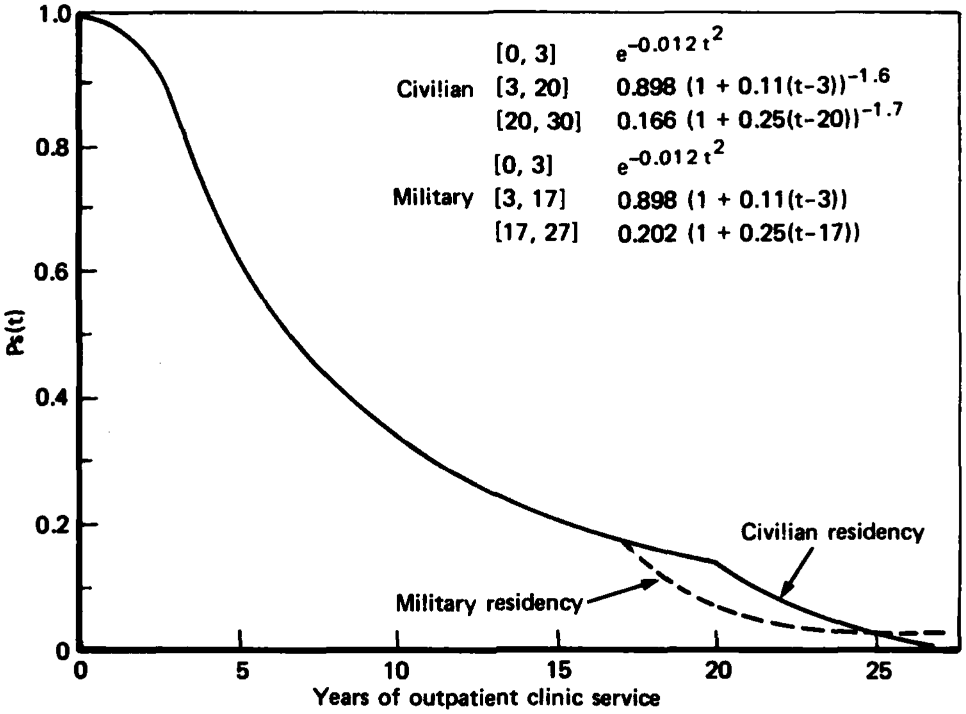

Fig. D.2—Physician continuation curves; military and civilian residency

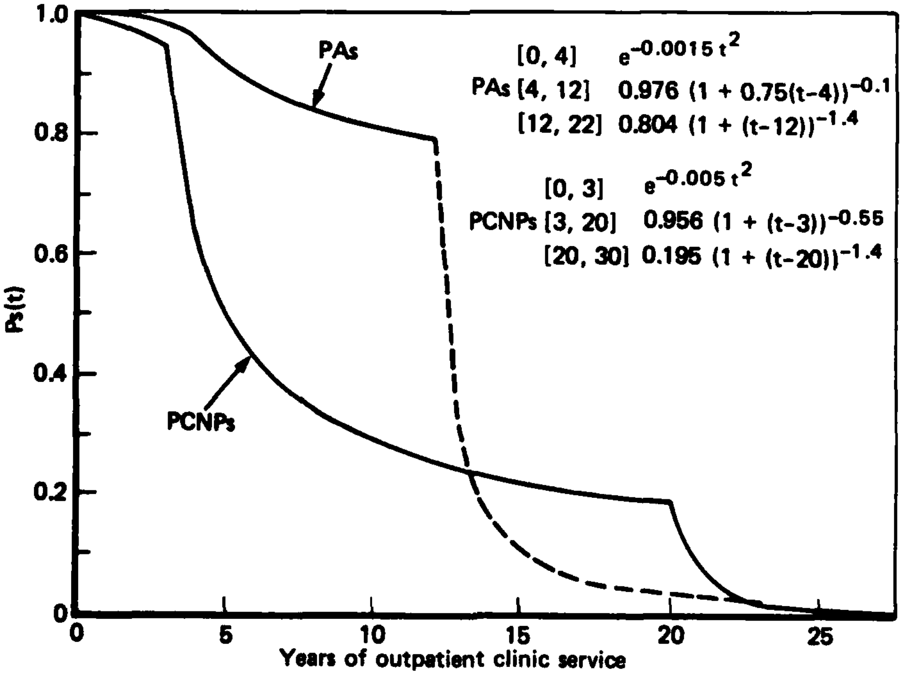

Fig. D.3—PA and PCNP continuation curves

The corpsmen retention curve we developed is given in Fig. D.4. The FY 80 retention data we obtained for corpsmen differed in form from Bircher's yearly continuation estimates for other health professionals. The data show the actual proportion reenlisting for first-term airmen, second termers, and careerists, corresponding to decisions at the four-year, eight-year, and 12-year points. In addition, we assumed 20 percent attrition for first termers and none for subsequent enlistments.

We compared the total discounted cost figures we obtained with Bircher's numbers with those we obtained using the continuous curve estimates for the case of HPSP physicians. We used 2, 5, and 10 percent real discount rates and found the continuous curve estimates differed from estimates with Bircher's numbers by at most six tenths of one percent. As a result we report on estimates using the continuous curves within the body of the report. These facilitated the sensitivity analysis.

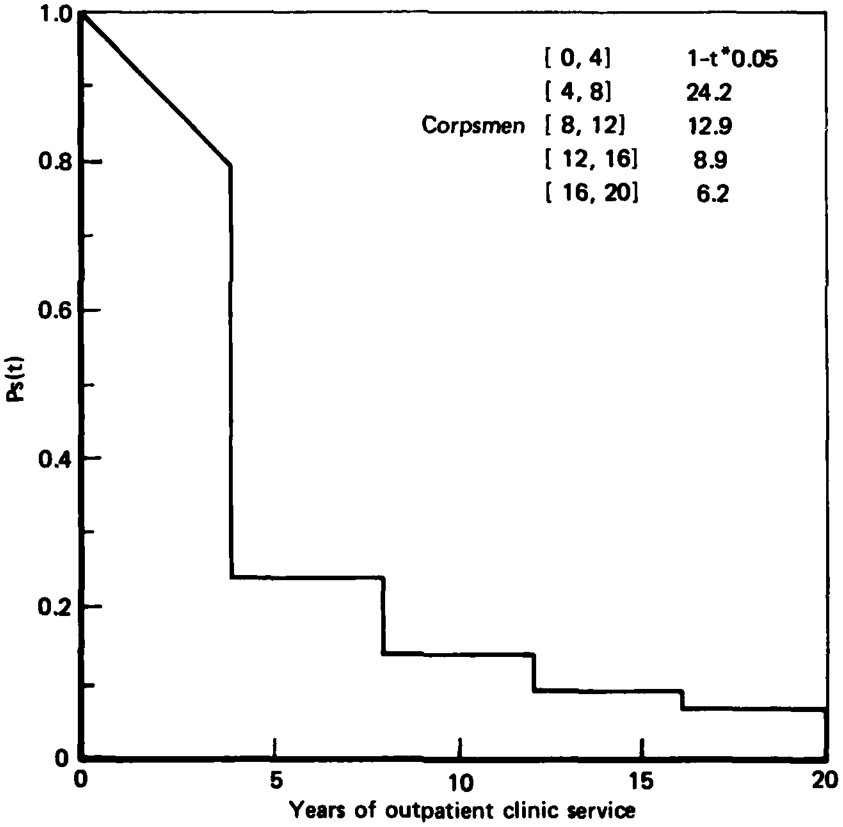

Fig. D.4—Corpsmen continuation curve

# Appendix E

# ACTIVITY ANALYSIS SOLUTIONS

| Less Complex Caseloads | | | | | | |
|---|---|---|---|---|---|---|
| Physician Time Constrained | Corpsmen Unconstrained | | | Corpsmen Constrained | | |
| | PA time | Corpsmen time | Relative cost | PA time | Corpsmen time | Relative cost |
| 3,469 (3,592) | 28,748 | 1,767 | 23,946 | 28,317 | 1,416 | 23,697 |
| 5,000 | 25,851 | 1,703 | 23,426 | 25,941 | 1,416 | 23,433 |
| 10,000 | 19,724 | 4,142 | 24,627 | 21,081 | 1,416 | 25,014 |
| 15,000 | 14,172 | 6,022 | 26,101 | 16,488 | 1,416 | 26,783 |
| 20,000 | 9,626 | 6,022 | 27,918 | 11,934 | 1,416 | 28,610 |
| 25,000 | 5,309 | 5,380 | 29,771 | 7,392 | 1,416 | 30,446 |
| 30,000 | 1,222 | 5,081 | 31,854 | 3,031 | 1,416 | 32,395 |
| More Complex Caseloads | | | | | | |
| 5,000 | 27,914 | 1,448 | 24,840 | 27,914 | 1,448 | 24,840 |
| 10,000 | 21,736 | 3,613 | 25,948 | 22,766 | 1,573 | 26,248 |
| 15,000 | 16,176 | 5,553 | 27,428 | 18,158 | 1,573 | 28,004 |
| 20,000 | 11,627 | 5,553 | 29,232 | 13,608 | 1,573 | 29,813 |
| 25,000 | 7,094 | 5,553 | 31,067 | 9,060 | 1,573 | 31,648 |
| 30,000 | 2,848 | 5,107 | 33,000 | 4,585 | 1,573 | 33,513 |
| More Complex Caseload - Civilian Trained PAs | | | | | | |
| Minimum Cost Solution | | | | | | |
| 4,724 | 28,370 | 1,437 | 16,354 | - | - | - |
| 5,000 | - | - | - | 28,043 | 1,146 | 16,441 |
| 10,000 | - | - | - | 22,848 | 1,437 | 19,412 |
| 15,000 | - | - | - | 18,249 | 1,437 | 22,563 |
| 20,000 | - | - | - | 13,700 | 1,437 | 25,733 |
| 25,000 | - | - | - | 9,169 | 1,437 | 28,928 |
| 30,000 | - | - | - | 4,668 | 1,437 | 32,112 |

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