REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	MAY 1996	FINAL REPORT 07-95 to 05-96

4. TITLE AND SUBTITLE
EVALUATION OF CLINICAL PHARMACY PROGRAMS: THE D.D. EISENHOWER ARMY MEDICAL CENTER EXPERIENCE

5. FUNDING NUMBERS

6. AUTHOR(S)
KATHY H. DEXTER, DEPARTMENT OF THE ARMY CIVILIAN

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
D.D. EISENHOWER ARMY MEDICAL CENTER
ATTN: MCHF-COFS-R
FT. GORDON, GA 30905-5650

8. PERFORMING ORGANIZATION REPORT NUMBER
4b-96

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
BLDG 2841 MCCS HRA US ARMY BAYLOR PGM IN HCA
3151 SCOTT ROAD
FORT SAM HOUSTON, TEXAS 78234-6135

10. SPONSORING/MONIT AGENCY REPORT NU

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

12b. DISTRIBUTION COD

13. ABSTRACT *(Maximum 200 words)*

Although clinical pharmacy services have existed for a number of years, their cost effectiveness has not been adequately assessed. Clinical pharmacists are members of the patient care team. Besides providing direct patient counseling, clinical pharmacists serve as consultants to providers. In inpatient settings, clinical pharmacists monitor drug orders for accuracy and appropriateness for specific patient needs and diagnoses. This study analyzes over 5,000 inpatient interventions by clinical pharmacists at Dwight D. Eisenhower Army Medical Center over an eighteen-month period. Estimates of costs avoided by each intervention were compiled and analyzed for a total cost avoidance over the study period of $3,064,348. When total personnel costs were subtracted, an estimated $2,403,447 in costs were avoided for a total cost benefit ratio of 1:4.64. Types of interventions were also analyzed to identify trends. Recommendations for improvements in the data collection process were included. The methods used to evaluate the clinical pharmacy service provide a comprehensive assessment model for other clinical pharmacy services.

14. SUBJECT TERMS
CLINICAL PHARMACISTS; COST-BENEFIT ANALYSIS; COST-AVOIDANCE; PHARMACY SERVICES; INPATIENTS.

15. NUMBER OF PAGES
50

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
N/A	N/A	N/A	UL

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to ***stay within the lines*** to meet ***optical scanning requirements***.

Block 1. Agency Use Only *(Leave blank)*.

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C	- Contract	**PR**	- Project
G	- Grant	**TA**	- Task
PE	- Program Element	**WU**	- Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. *(If known)*

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

- **DOD** - See DoDD 5230.24, "Distribution Statements on Technical Documents."
- **DOE** - See authorities.
- **NASA** - See Handbook NHB 2200.2.
- **NTIS** - Leave blank.

Block 12b. Distribution Code.

- **DOD** - Leave blank.
- **DOE** - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
- **NASA** - Leave blank.
- **NTIS** - Leave blank.

Block 13. Abstract. Include a brief *(Maximum 200 words)* factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

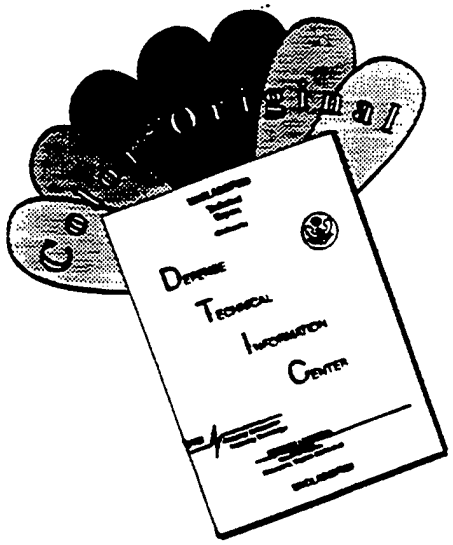
Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code *(NTIS only)*.

Blocks 17. - 19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF COLOR PAGES WHICH DO NOT REPRODUCE LEGIBLY ON BLACK AND WHITE MICROFICHE.

U.S. Army - Baylor University

Graduate Program in Health Care Administration

EVALUATION OF CLINICAL PHARMACY PROGRAMS: THE D.D. EISENHOWER ARMY MEDICAL CENTER EXPERIENCE

BY

KATHY H. DEXTER

A Graduate Management Project

Submitted in Partial Fulfillment

Of the Requirements for the

Master of Healthcare Administration

Degree

17 May 1996

ACKNOWLEDGMENTS

I wish to convey special thanks to several people who provided support and encouragement during this project. Dr. David Bookstaver, Chief of Clinical Pharmacy, and LTC Larry Estes, Chief of the Pharmacy Department at D.D. Eisenhower Army Medical Center, provided data and helpful suggestions. My preceptor, COL John Vigna, Chief of Staff at DDEAMC, provided valuable feedback and strong encouragement. Dr. Karin Zucker, my academic advisor, gave me the confidence to tackle the tough challenges. My fellow administrative resident, MAJ Michael Krukar, kept me solidly grounded in reality. I owe a great debt of gratitude to my editor and husband, Steve, who has so willingly kept the home fires burning during this long journey.

ABSTRACT

Although clinical pharmacy services have existed for a number of years, their cost effectiveness has not been adequately assessed. Clinical pharmacists are members of the patient care team. Besides providing direct patient counseling, clinical pharmacists serve as consultants to providers. In inpatient settings, clinical pharmacists monitor drug orders for accuracy and appropriateness for specific patient needs and diagnoses. This study analyzes over five thousand inpatient interventions by clinical pharmacists at Dwight D. Eisenhower Army Medical Center over an eighteen-month period. Estimates of costs avoided by each intervention were compiled and analyzed for a total cost avoidance over the study period of $3,064,348. When total personnel costs were subtracted, an estimated $2,403,447 in costs were avoided for a total cost benefit ratio of 1:4.64. Types of interventions were also analyzed to identify trends. Recommendations for improvements in the data collection process were included. The methods used to evaluate the DDEAMC clinical pharmacy service provide a comprehensive assessment model for other clinical pharmacy services.

TABLE OF CONTENTS

ACKNOWLEDGMENTS i

ABSTRACT ii

LIST OF FIGURES iv

1. **INTRODUCTION** 1

    BACKGROUND 4

    PURPOSE OF THE STUDY 7

    LITERATURE REVIEW 8

2. **METHODS AND PROCEDURES** 17

3. **RESULTS** 20

4. **DISCUSSION** 23

5. **RECOMMENDATIONS** 28

    a. Data collection 28

    b. Quality Improvement/Performance Improvement Process 28

    c. Data Coding 29

    d. Graphical Presentation of Data 29

6. **CONCLUSION** 30

GLOSSARY 31

WORKS CITED 32

LIST OF FIGURES

(Figures Follow Page 22)

Figure 1 - Costs Avoided by Month

Figure 2 - Total Cost Benefit by Pharmacist

Figure 3 - Interventions Per Month

Figure 4 - Average Costs Avoided Per Intervention - Pharmacist-Specific

Figure 5 - Number of Interventions - Pharmacist-Specific

Figure 6 - Types of Interventions I

Figure 7 - Types of Interventions II

Figure 8 - Type of Interventions - Average Percent of Total

Figure 9 - Results of Interventions ("Outcomes")

Figure 10 - Cost Avoidance Factors - Average Percent of Total

Figure 11 - Provider Acceptance - Percentage of Total Interventions

Figure 12 - Benchmarks: DDEAMC Compared with Other Studies

EVALUATION OF CLINICAL PHARMACY PROGRAMS:

THE D.D. EISENHOWER ARMY MEDICAL CENTER EXPERIENCE

1. INTRODUCTION

Pharmaceutical expenditures in the United States totalled in excess of $67 billion in 1990, comprising seven cents of every dollar spent on health care (Santell 1994). Efforts to contain pharmaceutical costs have become a significant component of managed care. The costs of the drugs themselves are only one factor; economies can be achieved by proper selection, appropriate dosage and dosage schedule, most efficacious route of administration, avoidance of allergic reactions, and avoidance of drug interactions. In addition, operating costs in academic medical centers have been shown to average 22% to 25% higher than those of community hospitals (Matuszewski and Vlasses 1995). Presumably, these increased costs include pharmaceutical prescribing by physicians in training. This combination of factors mandates a careful examination of pharmaceutical costs and the related costs of pharmaceutical utilization in order to control overall expenditures.

Over twenty-five years ago, pharmacists began to move beyond the traditional role of dispensing drugs. As the arsenal of disease-fighting drugs increased exponentially, pharmacists realized that physicians were ill-equipped to keep up with a virtual explosion of pharmaceutical information, either due to lack of time or lack of training. Clinical pharmacy programs were developed to provide assistance and oversight for physicians' prescribing patterns, from the actual choice of medication to selecting the optimal dosage. Avoidance of harmful drug interactions became a critical function as well.

The current study involves the analysis of 5,040 interventions recorded by the inpatient clinical pharmacists at DDEAMC over an eighteen-month period. "Intervention" is defined as "any information exchange and/or recommendation provided by the clinical pharmacist in relation to patients' drug regimens" (Montazeri and Cook 1994, 1045). Using this data, the study serves to identify trends, recommend improvements in data collection and analysis, and to assess the cost-benefit of the program. A first step is to identify an existing assessment methodology or, alternately, to develop a new assessment tool.

This research encompasses three questions: 1) Does the Patient-Focused Pharmacy Service confer a cost-benefit? 2) How has the Service affected the quality of care at DDEAMC, and can this be measured? and 3) What trends can be identified from the intervention data? The latter includes seasonal or periodic changes in the predominant types of interventions performed by the pharmacists, changes in provider acceptance rates and changes in pharmacist-specific productivity over time. Given the expense of providing the clinical pharmacy service in terms of compensation (salaries and benefits) alone, establishing a cost-benefit is only a first step. Larger issues involving actual patient outcomes and the organization's ability to measure those outcomes are beyond the scope of this study, but will be briefly discussed.

The American Society of Hospital Pharmacists issued a statement in 1983 entitled, "ASHP Statement of Clinical Functions in Institutional Pharmacy Practice" (ASHP 1983). The statement outlined the clinical functions that should be included in every clinical pharmacy program. Ten specific areas were outlined, including preparation of medication histories, drug therapy monitoring, patient education, participation in the management of medical emergencies, provision of written consultations, research, control of medication administration and drug distribution in

the patient-care area, detection and reporting of adverse drug reactions (ADR), education of health care providers, and participation in drug-use review (DUR) and other quality assurance programs. This statement remains current and guides clinical pharmacy activities..

Today, programs in clinical pharmacy have evolved to the point where many hospital pharmacists are no longer involved with dispensing and distributing drugs at all, but rather function as direct patient care team members. Intensive care units provide a particularly lucrative setting for clinical pharmacists, as pharmaceutical costs in ICUs average 25% of pharmacy budgets (Matuszewski and Vlasses 1995).

The current managed care environment has caused an intensive examination of all aspects of health care, to include pharmaceutical care. In response, a new discipline called pharmacoeconomics has evolved. Pharmacoeconomic analyses hold great promise in a managed care world. Controlling drug costs without adversely affecting quality of care presents an ongoing challenge for today's pharmacist. Although drug costs comprise one of the largest non-salary expenditures in a hospital, pharmacoeconomic analysis has a broader scope (Santell 1994). Instead, the entire range of possible outcomes is factored into the equation, so that it is sometimes possible to conclude that a more expensive drug alternative is the best choice because the long term outcome confers a cost savings or cost avoidance.

One author states, "Today, the issues related to drug costs are so complex that management of these costs may require senior hospital administrators to work in conjunction with pharmacy managers" (Santell 1994). In addition to the costs of the drugs themselves are the expenditures incurred when adverse reactions occur or when incorrect dosages or inappropriate drugs are prescribed. Such incidents often increase costs by lengthening hospital stays or

increasing the intensity of required services and may place the hospital at risk for litigation. This study concentrates on pharmaceutical care which may only incidentally involve direct drug costs. Such scrutiny of clinical pharmacy programs is especially important to administrators in light of shrinking budgets and payor pressures to provide efficient and cost-effective care.

BACKGROUND

The involvement of pharmacists in clinical decision making under the aegis of a clinical pharmacy program began at DDEAMC as early as 1990. The particular process under study in this paper, the Patient-Focused Pharmacy Service, began on a limited basis (two wards) in May 1994, with an expansion that included all hospital inpatient wards (except for psychiatric wards) in August 1994. From the beginning, pharmacists carried out a systematic concurrent review of inpatient records to assess aspects of pharmaceutical care, such as appropriateness, dosage, and accuracy of prescription orders written by providers. Deviations from standard practice, recommendations for alternative drugs, and errors were noted on preprinted forms, which were submitted to the Chief of Clinical Pharmacy Services. This concurrent review was prompted by an increasing emphasis on cost-effective pharmaceutical care and a perception that the overall quality of patient care could be enhanced by such a process. The stated goals of the service were: 1) Improved patient care; 2) an enhanced role of pharmacy in patient care; 3) improved pharmacists' job satisfaction; and 4) reduction of overall expenditures.

In order to measure progress towards reducing expenditures, a coding system was developed that classified each intervention into eight outcomes categories, with a corresponding cost-avoidance estimate. For example, if the intervention avoided one hospital day, the estimated total cost avoided was $1500. If a recommended drug was less expensive than another, an

average value of $50 was assigned. Cost information on hospital inpatient days was provided by the DDEAMC Resource Management Department. Other costs were estimated by the clinical pharmacy chief.

A total of seven pharmacists currently work in patient care areas. Five pharmacists are assigned to one or more inpatient wards. One additional pharmacist is assigned to the Family Practice Clinic to monitor outpatients and provide outpatient consultative support to forty-five providers. One pharmacist is assigned to the Oncology Clinic to provide outpatient services. Over the eighteen-month period under study, twelve different pharmacists participated in the inpatient program on a rotating basis. Only inpatient interventions are included in this study.

The clinical pharmacists enter orders for drugs into the Composite Health Care System (CHCS), a computerized hospital information system. In addition, they perform patient monitoring tasks, such as therapeutic drug monitoring (periodic laboratory tests done to determine serum levels of drugs). Drug prescriptions are monitored for appropriate selection of drug, appropriate dosage, and identification of possible interactions with other drugs. Adverse drug reactions (ADRs) are also identified and reported in accordance with established quality assurance procedures. The pharmacists recommend changes in drug regimens, dosage levels, etc. to providers and are available for consultation by providers and staff. The pharmacists also record whether or not their recommendations to physicians were accepted.

Although the monthly summaries prepared by the Service chief and included in the department's Quality Improvement meeting minutes seem to support the cost-benefit aspect of the Service, in-depth analysis to include all costs plus true outcomes assessment has not been done. Another cost factor involves opportunity cost; that is, what other services are not funded in order

to pay for the Patient Focused Pharmacy Service? Department of the Army medical treatment facilities are struggling with reduced manpower and reduced funds throughout the range of services. The competition for funds is fierce. In a teaching facility such as DDEAMC, demonstrating a cost benefit of a particular program is often difficult. Physicians in training tend to increase total costs by ordering more drugs and more tests for their patients. However, the presence of clinical pharmacists in patient care areas can provide an additional benefit of overseeing the residents and educating them about the cost-effective use of drugs. Measuring the benefits of such interventions in economic terms might prove to be impossible without controlled studies. From a risk management point of view, however, prevention of a potentially compensable event (PCE) may result in sizeable cost avoidance if a claim against the government is avoided.

Determining the cost benefit of the program is only one side of the picture. MacKeigan and Bootman (1988) define costs as negative consequences and define effectiveness and benefits as positive outcomes. This aspect becomes problematic in a military setting. The operating budgets of military treatment facilities (MTFs) are determined ultimately by the Congress of the United States. No additional revenues ("benefits") are realized by shortening lengths of stay, as would be the case under a prospective pay system such as Medicare, although the military health care system benefits by reducing overall expenditures. This lack of a financial incentive to become more efficient has, in the past, hindered efforts to control costs. However, budget decrements based on utilization management are projected for FY 1997, making reductions in lengths of stay a critical goal.

From the patient's point of view, an intangible benefit is derived from avoiding an adverse

drug reaction or from achieving an optimal dosage schedule. The quality of patient care is enhanced. Quality of care can be roughly approximated through continuously monitoring adverse drug reactions (ADRs) to identify trends and problem areas.

PURPOSE OF THE STUDY

In the current cost-conscious atmosphere that pervades the Army Medical Command, each program within a medical center can expect to be scrutinized and evaluated based on its cost. The purpose of this study is to provide the leadership at DDEAMC with sufficient data upon which to justify the continuance of the Patient Focused Pharmacy Service based on a fiscal assessment. The Chief of the Pharmacy Department and the Chief of the Clinical Pharmacy Service can also benefit from an outside, impartial appraisal of the reliability and validity of both the data being collected and the current analytical methods. In addition, issues of patient outcomes and the impact of the program on the quality of patient care must somehow be addressed.

The objectives of this study are as follows:

- Determine if the DDEAMC Patient-Focused Pharmacy Service confers a cost-benefit, based on cost avoidance data collected over an eighteen-month period.
- Assess current data collection and analysis procedures for reliability and validity.
- Make recommendations for the improvement of the data collection and analysis procedures.
- Make a recommendation about the continuance of the program, based on a cost analysis.

The independent variable under study is the therapeutic intervention carried out by each

clinical pharmacist. The dependent variable is the cost avoided by the intervention. An additional dependent variable that could be studied is patient outcomes, but this data is not available for study. The null hypothesis is that therapeutic interventions by clinical pharmacists do not avoid costs in excess of expenses for the program (the "no difference" model). The alternative hypothesis is that the interventions do avoid costs in excess of expenses (the "difference" model).

LITERATURE REVIEW

What methods have been utilized to assess the effectiveness of clinical pharmacy programs? A number of studies have attempted to evaluate various aspects of these programs. The impact of clinical pharmacy programs can be approached from several different directions, depending upon the particular focus. Included are the impact on quality of care, the impact on cost savings or cost avoidance, and the impact on provider behavior. Without exception, those studies which address program costs were able to show a cost-benefit. Therefore, rather than focus on the **results** of each study, the literature review will identify the methodology and any inherent flaws in that methodology. Program descriptions will also be included in order to provide a means for comparison with the DDEAMC program. The studies address different aspects of clinical pharmacy programs, including cost avoidance/cost savings, impact on quality of care, and effectiveness. Other articles provide career progression and training information and privileging requirements for clinical pharmacists. The latter are included to illustrate the required skill levels for clinical pharmacy activities and their impact on compensation for clinical pharmacists.

A 1985 conference sponsored by the American Society of Hospital Pharmacists entitled "Directions for Clinical Practice in Pharmacy" prompted the development of a number of clinical

pharmacy programs across the U.S. Two resultant programs are described in the literature, one at St. John's Regional Health Center in Springfield, Missouri, (Greene and Powell 1991) and the other at the University of California, San Francisco (Day et. al. 1991). The St. John's RHC was set up to develop clinical pharmacists and consisted of volunteers from the inpatient pharmacy service who rotated through the 6-week training. This program has evolved from primarily a training program into one that utilizes pharmacists on hospital wards for at least part of every work day. Although there are similarities between the St. John's program and the DDEAMC program, the latter has provided far more direct patient care and has increased provider contact with the clinical pharmacists.

The UCSF program functioned as a clinical program almost from its inception in 1966. The idea of including a pharmacist on the patient care team was radical indeed in 1966. The authors state, "But this was 1966, a time when physicians almost entirely controlled the care of a patient and when pharmacists were neither performing nor generally recognized as capable of performing any of the activities proposed..." (Day et.al. 1991, 310). The UCSF pharmacists combined dispensing functions with clinical functions. The consulting function grew exponentially. As a pharmacy teaching institution, UCSF tailored its teaching program towards the development of clinical pharmacists at a very early stage in the development of the concept.

If pharmacists are to perform clinical tasks, the issue of privileging arises. The Veterans Administration, recognizing the need for privileging clinical pharmacists, issued guidelines in 1985, with major revisions in 1990 (Hutchison et. al. 1992). In response, a Pharmacist Clinical Privileges Review Board (PCPRB) was created at the Veterans Administration Medical Center (VAMC) in Little Rock, Arkansas, to evaluate requests for privileges from clinical pharmacists

and similar in function to a privileging board for physicians. Hutchison et. al. (1992) described the program at the Little Rock VAMC and concluded that a privileging process is essential for the success and provider acceptance of clinical pharmacy programs. In the present study, DDEAMC does privilege its clinical pharmacists. The outpatient program in particular requires independent direct patient education and monitoring for those patients who are taking multiple medications.

The VAMC in Albuquerque, New Mexico, developed a three-tiered system to recognize the various skill levels required for clinical pharmacists (Swanson et. al. 1991). The privileging system worked in combination with the so-call "career ladder" to produce a matrix of nine options for advancement. The levels progressed from limited degrees of independent practice for the pharmacists to very high degrees of independent practice. Pharmacists could advance from one level to another by taking oral and written exams.

DDEAMC clinical pharmacists are granted privileges at one of three levels: **Approved without limitation, Approved - requires qualified supervision, or Approved with modifications**. Privileges are granted in nine areas:

1. Refill of outpatient medications (except controlled drugs)
2. Initiation of over-the-counter drug orders
3. Ordering of laboratory tests necessary for monitoring a patient's disease state or drug regimen
4. Evaluation of drug regimens for appropriateness, toxicity, and drug interactions
5. Documentation in the medical record of the assessment of #4 and recommendations for change, if applicable
6. Initiation of drug orders after consulting with a physician

7. Pharmacokinetics

8. Annotating verbal orders in the chart

9. Discharge counselling and documentation in the chart

Privileges are renewed once every two years in a procedure similar to that for other providers.

How is the effectiveness of clinical pharmacy programs measured? Hartoum et. al. (1986) prepared a bibliography of the existing literature on the evaluation of clinical pharmacy programs almost ten years ago. The literature at that time included 305 articles. Only studies of inpatient services were included. Articles were assigned codes based on patient care cost reduction, patient care quality improvement, and acceptance (by patients or providers). These categories were developed based on the ASHP's Statement on Clinical Functions in Institutional Pharmacy Practice (1983). The analyses of the articles were displayed in tabular form. The fact that this literature review has not been updated could be attributable to the sharp increase in clinical pharmacy programs, making such a literature review infeasible. The results of the various studies were by no means overwhelmingly positive. Although the authors provided no in-depth summary, the authors concluded that most programs were able to show cost avoidance. True outcomes information was missing, however.

The utilization of pharmacists in the clinical setting would not have been possible without shifts in workload within the Pharmacy Department. In keeping with current trends in the provision of pharmacy services by technicians (Miller et. al. 1993), DDEAMC trained pharmacy technicians to assume some of the routine distribution tasks formerly performed by pharmacists. State laws have been developed to further define the tasks that can be delegated to pharmacy technicians (Raehl, Pitterle, and Bond 1992). Most state laws define tasks that **must** be

performed by licensed pharmacists rather than defining tasks that **could** be performed by pharmacy technicians. The authors analyzed data collected in a 1989 survey of 1174 U.S. hospitals and concluded that "[i]ncreased use of pharmacy technicians was associated with increased involvement by pharmacists in patient-specific clinical pharmacy services" (Raehl, Pitterle, and Bond, 2185).

Efforts to meet a growing clinical and drug distribution responsibility at the Norris, a comprehensive cancer center affiliated with the University of Southern California, are described in a 1992 article by Kalman, Witkowski, and Ogawa. The expanded role for pharmacy technicians and the increasing clinical role for pharmacists were responsible for a 59% increase in the number of clinical consultations provided per month between 1985 and 1990. Henry Ford Hospital in Detroit assessed the workload of its pharmacists and discovered that two-thirds of their time was spent with data collection, patient selection and documentation, while only one third was spent in improving patient outcomes through clinical pharmacy activities (Miller et. al. 1993). The addition of two pharmacy technicians to their staff increased their pharmacists' involvement in clinical tasks to one-half of their total workload. Clearly, the efficient use of pharmacists' time in clinical activities depends to a large degree on the routine tasks that can be assumed by pharmacy technicians. All three of these studies support this cost-effective approach to streamlining pharmacy distribution systems in order to free pharmacists for more direct care activities.

Of particular relevance to this paper is a study of the clinical pharmacy program at Walter Reed Army Medical Center (Bjornson et. al. 1993). Two of five medicine teams and one of three surgery teams included a pharmacist. The patients assigned to teams without pharmacists formed the control group. Cost savings averaging $377 per inpatient admission were realized by the

teams with pharmacists, with a benefit-to-cost ratio of 6.03:1. A net annual return on investment was $150,951. Unaffected by pharmacists interventions were the numbers of radiologic and laboratory tests and the number of discharge medications. Nursing acuity scores were similar in each group. Of interest in this study is the finding that the percentage of patients documented to have experienced an adverse drug reaction (ADR) was greater in the intervention group (1.7%) than in the control group (.5%). This finding was not analyzed for statistical significance. The authors speculate that the higher propensity of pharmacists to document ADRs was responsible. Based on the literature, the authors maintain that actual ADRs were much higher than the number reported in all groups, so the higher reporting levels of the pharmacists may account for the difference; that is, pharmacists may identify ADRs that would be missed by other providers. Readmission rates were similar for all groups. Intervention groups had shorter lengths of stay and lower drug costs per admission. This study has particular implications for the present study since the institutional setting was a military teaching facility.

Hartoum et. al. (1988) conducted an in-depth study of the clinical pharmacy service at the University of Illinois Hospital. At the time of the evaluation, the program had been in existence for thirteen years. The twenty-five doctoral-level pharmacists divided their time equally between teaching responsibilities in the School of Pharmacy and the clinical pharmacy service. Only a sample of 1027 interventions selected by the pharmacists themselves was studied and evaluated by a multi-disciplinary team. A random selection of 100 interventions was evaluated for cost-avoidance potential. The average cost avoidance per intervention was $241.91. When an annual projected number of interventions with cost avoidance potential (3,671) were multiplied times this amount, a cost avoidance of $888,052 was projected. The authors suggest that recommendations

that were not accepted be studied to evaluate additional cost avoidance that could have occurred had the recommendations been accepted by the provider. It would be even more beneficial to evaluate actual patient outcomes for those interventions that were not accepted. The authors fail to substantiate the costs associated with each type of outcome, which casts some doubt upon the accuracy of their results.

Provider acceptance of recommendations made by clinical pharmacists provides one measure of program outcomes. The concept of "rational drug therapy" is dependent upon establishment of trust between provider and pharmacists. Klopfer and Einarson (1990, 830) maintain that "acceptance rates of pharmacists' suggestions should be regarded as an essential component in all evaluations of clinical pharmacy services." The authors identified 23 studies published between 1972 and 1988 which measured acceptance rates. The average rate of acceptance across studies was 84.4%, with a range of 58% to 98%. This study by Klopfer and Einarson provides benchmark data on provider acceptance rates for the present study.

In discussing methods of altering physicians' practice behaviors, Ellrodt et. al. (1995) outline six basic areas: 1) education; 2) feedback; 3) participation by physicians in efforts to bring about change; 4) administrative rules; 5) financial incentives; and 6) financial penalties. All clinical pharmacy programs must assess which of these six are the most appropriate in their institutions. Ideally, a combination of most or all approaches should provide the optimal benefit. In the DDEAMC experience, financial incentives and penalties are difficult to implement. A restriction on temporary duty (e.g travel) funds is one of the few methods of using financial penalties that has been utilized to influence physicians' behaviors, and this activity has been confined to date to reducing the number of delinquent records.

Other studies have focused on clinical pharmacy programs in particular settings. Jameson, VanNoord and Vanderwoud (1995) evaluated the impact of outpatient counseling sessions on drug utilization and costs and adverse effects, concluding that such activities reduce costs and avoid the occurrence of drug-related interactions, adverse effects, and patient compliance. Intensive care units provide optimal settings for reducing costs by the use of clinical pharmacists, according to studies by Matuszewski and Vlasses (1995) and Montazeri and Cook (1994). The very high pharmaceutical costs in intensive care units can be influenced by the participation of clinical pharmacists on the health care team. In addition, quality of care is enhanced. For purposes of this study, these articles serve to highlight the potential benefits of these programs across all patient care settings.

What is the impact of clinical pharmacy services on costs? An exhaustive analysis of the literature was published by MacKeigan and Bootman (1988). Only twenty-two studies published between 1978 and 1987 utilized true cost-benefit or cost-effectiveness methodology. All twenty-two studies purported to demonstrate that their services were cost-effective. However, the authors pointed out numerous flaws in the studies and concluded, "Not only have there been few CBA/CEAs [cost benefit analyses/cost effectiveness analyses] of clinical pharmacy services but those that have been conducted are of questionable quality" (MacKeigan and Bootman 1988, 81).

Briceland, Kane and Hamilton (1992) evaluated interventions performed by PharmD. clerkship students. Physician acceptance rate was found to be 94.8%, somewhat higher than other studies. In an interesting analysis, 50.7% of the total interventions were estimated to have resulted in cost savings, 23.7% resulted in increased cost, and 25.6% had no effect on costs. The authors estimate that savings from the program averaged $30 to $35 per intervention. Not

evaluated in this study were the increased or avoided costs resulting from changes in lengths of stay or the number of adverse drug reactions.

A cost benefit analysis of drug costs avoided by a clinical pharmacy service in a community medical center was reported in 1990 (Catania, Yee, and Catania 1990). The average number of interventions ranged from 170 to 292, comparable to the DDEAMC figures, although the interventions reported in the Catania study were carried out by only one pharmacist. The service averaged $6244 in drug cost avoidance per month. The limitation of this study, as discussed later, is that drug costs alone do not present the entire picture; rather, interventions affect other patient-related costs that are not specific to the cost of a drug.

In a more recent article, Condron and Mann (1994) evaluated a number of studies that indicate that therapeutic interventions (TI) by clinical pharmacists do pay for themselves, with cost avoidance ranging from $192 to $242 per intervention. The authors conducted a survey of 145 Canadian hospitals and included 89 (62.2%) in their study. Financial information provided by ten of those hospitals showed a combined cost savings and cost-avoidance of $1,089,410 per year with an average savings of $49.34 per TI. Pharmacist compensation was not factored into the analysis. Physician acceptance of the pharmacists' recommendations averaged 83.4% across the ten hospitals.

Keys et. al. (1995) describe a commercial clinical pharmacy company which tracks physician prescribing practices and then intervenes with individual physicians as a service to managed care and insurance companies. This company analyzes claims data for the managed care company and targets specific high-cost or high-problem drugs using an in-house computer program. Pharmacists then counsel the physicians on the particular drug. The article discusses

cost-avoidance factors, such as avoiding adverse reactions or drug-drug interactions, but these avoided costs were not factored into the final equation. Potential annual drug cost savings of over $280,000 were projected, with a cost-benefit ratio of 1:4.

Capturing workload data for clinical pharmacists is the focus of an article by Bajcar et. al. (1995). Such data capture becomes critical when justifying the cost effectiveness of clinical pharmacy programs. Measuring the impact on patient outcomes was another goal of this process. Rather than recording all interventions, this system included focused studies on high use/high cost drugs. Of particular benefit in this system was the potential for pharmacist self-assessment. Pharmacist evaluation of the system was generally positive, especially in their assessment of ease of use.

Of particular note is an article by Phillips, Williams, and May (1994) of the Medical College of Georgia (MCG), located in Augusta. The intent of the data collection system used by MCG is to support quality assessment of the medical staff, identify education needs of the house staff, and identify potential improvements in medication use. In a system similar to that in use at DDEAMC, interventions are coded using a severity code which identifies the potential impact if the intervention had not occurred. The department assesses on a monthly basis all interventions according to severity, physician, and drug. From this data, the department identifies trends and develops educational programs and focused activities when problems are identified. Identifying problem **processes** rather than problem **providers** has resulted in improved relations with the medical staff and increased willingness of the medical staff to consult the pharmacists.

2. METHODS AND PROCEDURES:

This evaluation of the DDEAMC Patient-Focused Pharmacy Service is a case study as

well as a cost analysis. An example of this methodology is the previously-mentioned article on the clinical pharmacy program at Walter Reed Army Medical Center by Bjornson et. al. (1993). Included in the present study are 5,040 interventions which occurred over a 18-month period. The data was first captured in a data base program (dBase III) by the Service chief. For purposes of this study, the entries were converted to a spreadsheet program (QuattroPro) for descriptive statistical analysis.

Interventions were manually recorded on log sheets. In addition to date and name of pharmacist, each entry contained nine data elements: Patient last name, ward, physician name, drug name, recommendations and/or comments, intervention codes (added by the Service chief), "Y" or "N" code to indicate acceptance by provider, total time spent on the intervention, and an "outcome" code (also added later by the Service chief). Eighteen intervention codes were used. These codes indicated the type of intervention or finding, such as potential drug allergy, potential drug interaction, adjustments in dosages, routes of administration, or dosage schedule, recommendation of alternative therapy, etc. So-called "outcome" codes included cost reduction or increase, hospital days avoided, medication error avoided, allergic reaction avoided, ADR avoided, and provider acceptance. Each of the eight categories was assigned a dollar amount in order to assess the estimated impact on cost. Also encoded was whether or not there was an "acceptable reason" or an "unacceptable reason" for the provider to reject the recommendation made by the clinical pharmacist. Instances in which costs were increased occurred so infrequently (less than eleven during the study period) that these dollar amounts were not subtracted from the total cost avoidance data.

Using the intervention outcomes codes, estimated costs avoided were assigned to each

intervention using the following cost assignment codes:

CODE	OUTCOME	EST. COST AVOIDANCE
A	Decrease cost	$ 50
B	Increase cost	$ 50
C1	Avoid ADR/toxicity	$1,500
C2	Avoid medication error	$1,000
C3	Improved appropriateness	$ 500
C4	Improved effectiveness	$ 500
C5	Avoid allergic reaction	$1,500
C6	Avoid delay in therapy	$1,000
D1	Recommendation not accepted with justification	$ 0
D2	Unacceptable reason	$ 0
?	Indeterminate	$ 0

These dollar amounts were based on factors such as the cost of a hospital bed day. Cost avoidance estimates were compiled and averages derived for each month of the study (April 1994 through October 1995). The average number of interventions recorded per month was computed as was the average cost avoided per intervention.

Pharmacist compensation plus the government's personnel expense (estimated to be 24% of base salary) were computed using the exact grade and step of each pharmacist who recorded interventions during the study period. Next, annual individual personnel costs were divided by 12 and multiplied by the actual number of months that the individual pharmacist recorded interventions. It is presumed that a zero intervention total for one month indicated that the pharmacist did not participate in clinical pharmacy activities for that month. Monthly and total personnel costs were then computed for the entire study period.

Pharmacist-specific productivity data was compiled by month and summarized for the entire study period. Productivity was measured by the total number of interventions recorded. Average costs avoided per intervention attributable to an individual pharmacist were compiled.

The interventions were analyzed and sorted by type of intervention. An overall average percent of total was determined for each type of intervention.

Provider acceptance rates were determined for each month and an overall acceptance rate was calculated.

3. **RESULTS:**

Based on this analysis, the Patient Focused Pharmacy Service avoided costs of $3,064,348 over the 18-month study period. Figure 1, which follows page 22, summarizes the monthly estimated costs avoided. Cost avoidance data was missing for January through June 1995, but figures on the number and type of interventions were available for analysis. To extrapolate cost avoidance for this missing data, an average cost avoidance per intervention was computed for each pharmacist. This average was then multiplied by the number of interventions recorded by each pharmacist during each of the months from January to June 1995. Finally, these amounts were totalled for an estimated cost avoidance per month during that period.

Removing personnel costs (salary, benefits, and government expenditures) from the cost avoidance gross yielded an estimated net cost avoidance of $2,403,447, with a cost benefit ratio of 1:4.64. That is, for every dollar expended in personnel costs, $4.64 in costs were avoided. Figure 2 presents a comparison of the input (total cost to the government) and the output (total costs avoided) for each pharmacist. Pharmacist personnel costs during the study period ranged from $24,806 to $97,849. The average number of interventions per month was 263.1 with an average cost avoided per intervention of $612.99 (Figure 3).

Based on the pharmacist compensation rates, the average cost of each intervention was $132.20. The average cost avoided by specific pharmacist, as depicted in Figure 4, ranged from

$512 to $970. In addition, the number of interventions performed each month by seven of the pharmacists varied from 2 to 178 (Figure 5). These seven pharmacists were selected for analysis because of their involvement in the Service throughout the study period.

Figures 6 and 7 depict the types of problems that prompted interventions by the clinical pharmacists. The percentage of the total interventions by type for each month is displayed. (Multiple codes were assigned to single interventions, making the sum of all percentages larger than 100%.) The intervention types are displayed in two different graphs for convenience; the assignment of an intervention type to one graph or the other was arbitrary. The data is displayed in these two figures in order to facilitate the identification of trends in the types of interventions. However, no specific trends are noted. In addition, the average percentage of intervention types for the entire 5,040 interventions is depicted in Figure 8. On average, overdoses represent the highest proportion of the total at 19.17%, followed by recommendations for alternate therapy (17.72%) and pharmacokinetic monitoring (13.69%). These three intervention types represent just over 50% of all interventions.

Monthly cost avoidance (outcomes) factors are displayed in Figure 9. Since multiple codes were assigned to the same intervention, totals are above 100%. Interventions that were indeterminate as to cost avoidance represent the remainder of the total percentages and are not displayed. Significant variance occurs from month to month across the various factors, with no trends identified. Figure 10 synopsizes the outcomes for the entire study period. The leading outcome was "Improved appropriateness" (22.35%), followed by "Decreased cost" (19.29%). Overall, 17.52% of the outcomes could not be assessed as to the impact on costs.

Provider acceptance, an important factor in the success of clinical pharmacy programs, is

depicted in Figure 11. Percentages of recommendations accepted by providers ranged from 82.5% the first month to a high of 96.4% the fifth month, with an average of 89.6% for the entire study period.

FIGURES BEGIN ON FOLLOWING PAGE.

FIGURE 1
COSTS AVOIDED BY MONTH

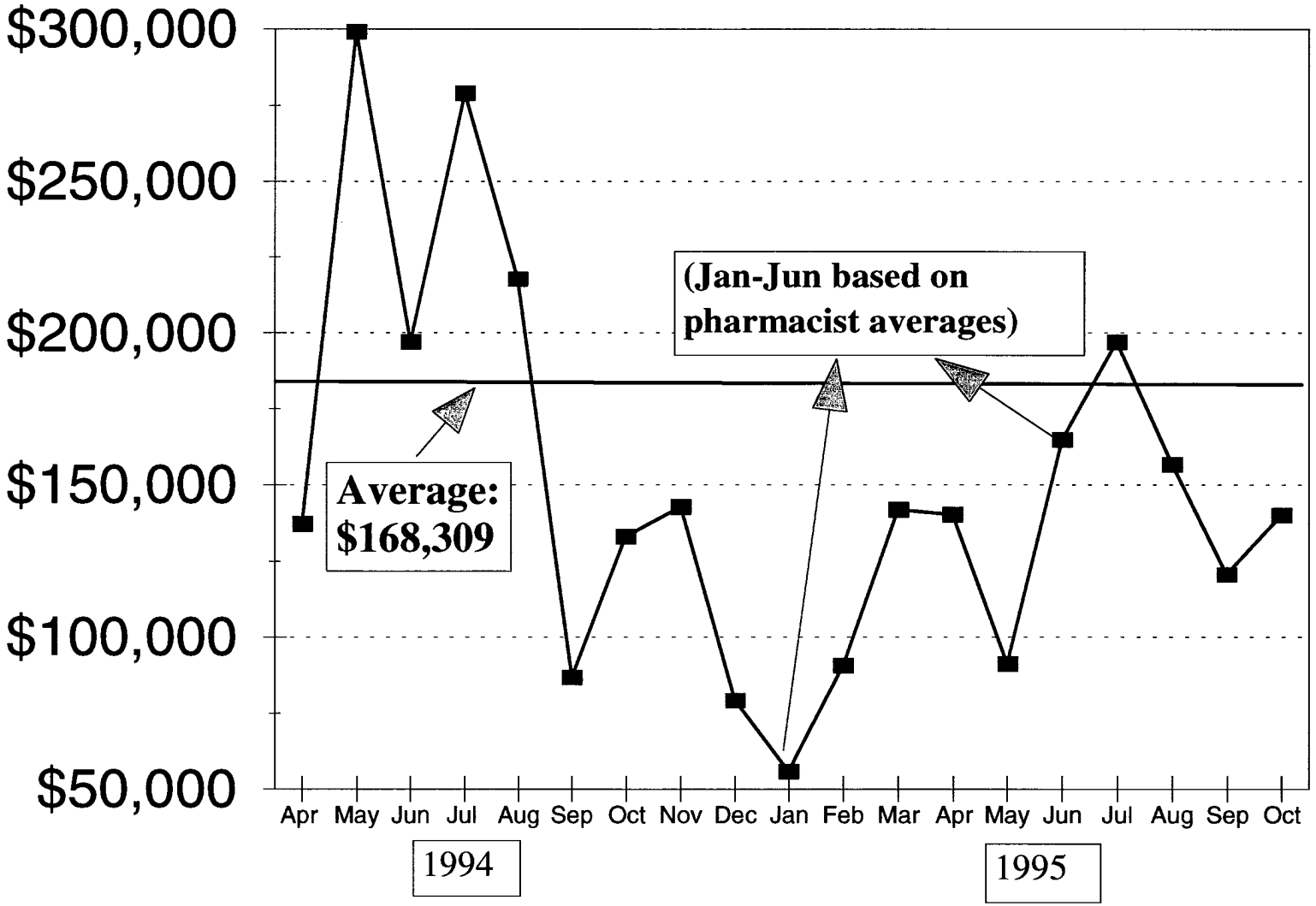
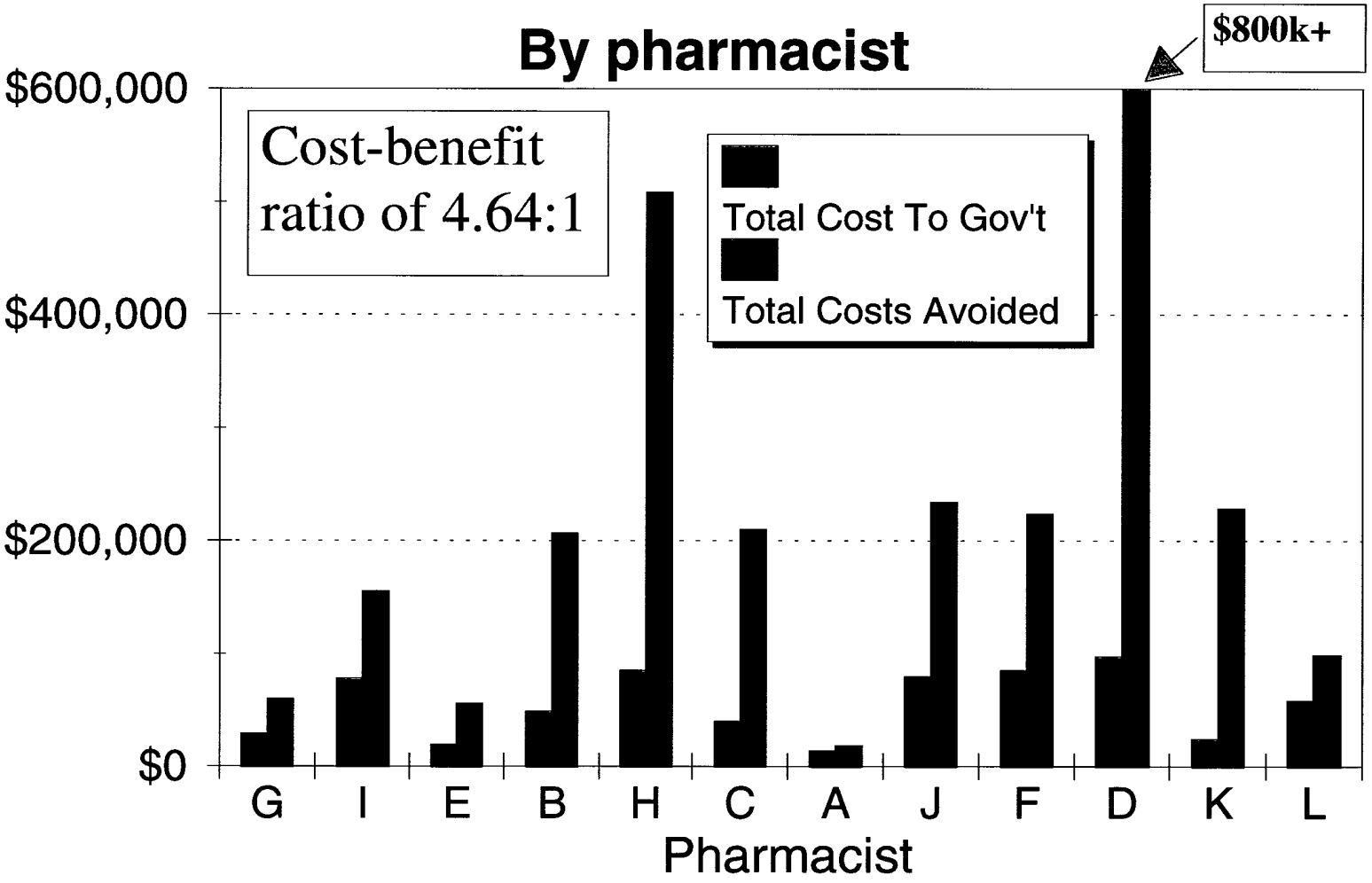


FIGURE 2

TOTAL COST BENEFIT

By pharmacist



Analysis: Without exception, every pharmacist avoided costs in excess of their total compensation.

FIGURE 3

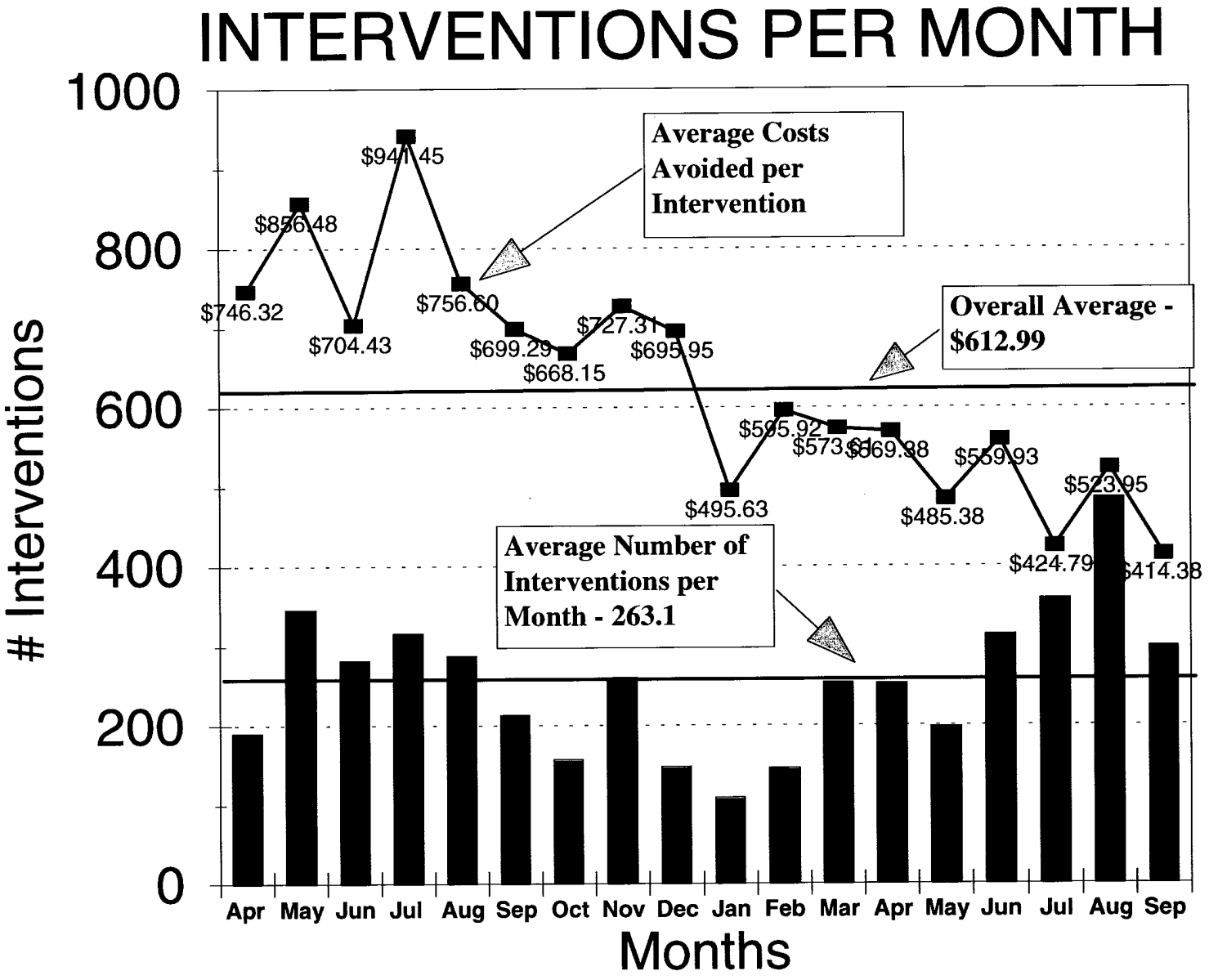

INTERVENTIONS PER MONTH
1000
800
600
400
200
0
Interventions
Average Costs Avoided per Intervention
Overall Average - $612.99
Average Number of Interventions per Month - 263.1
$746.32
$856.48
$704.43
$941.45
$756.60
$699.29
$668.15
$727.31
$695.95
$495.63
$595.92
$573.
$569.88
$485.38
$559.93
$424.79
$523.95
$414.38
Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Months

FIGURE 4

AVERAGE COSTS AVOIDED PER INTERVENTION

PHARMACIST-SPECIFIC DATA

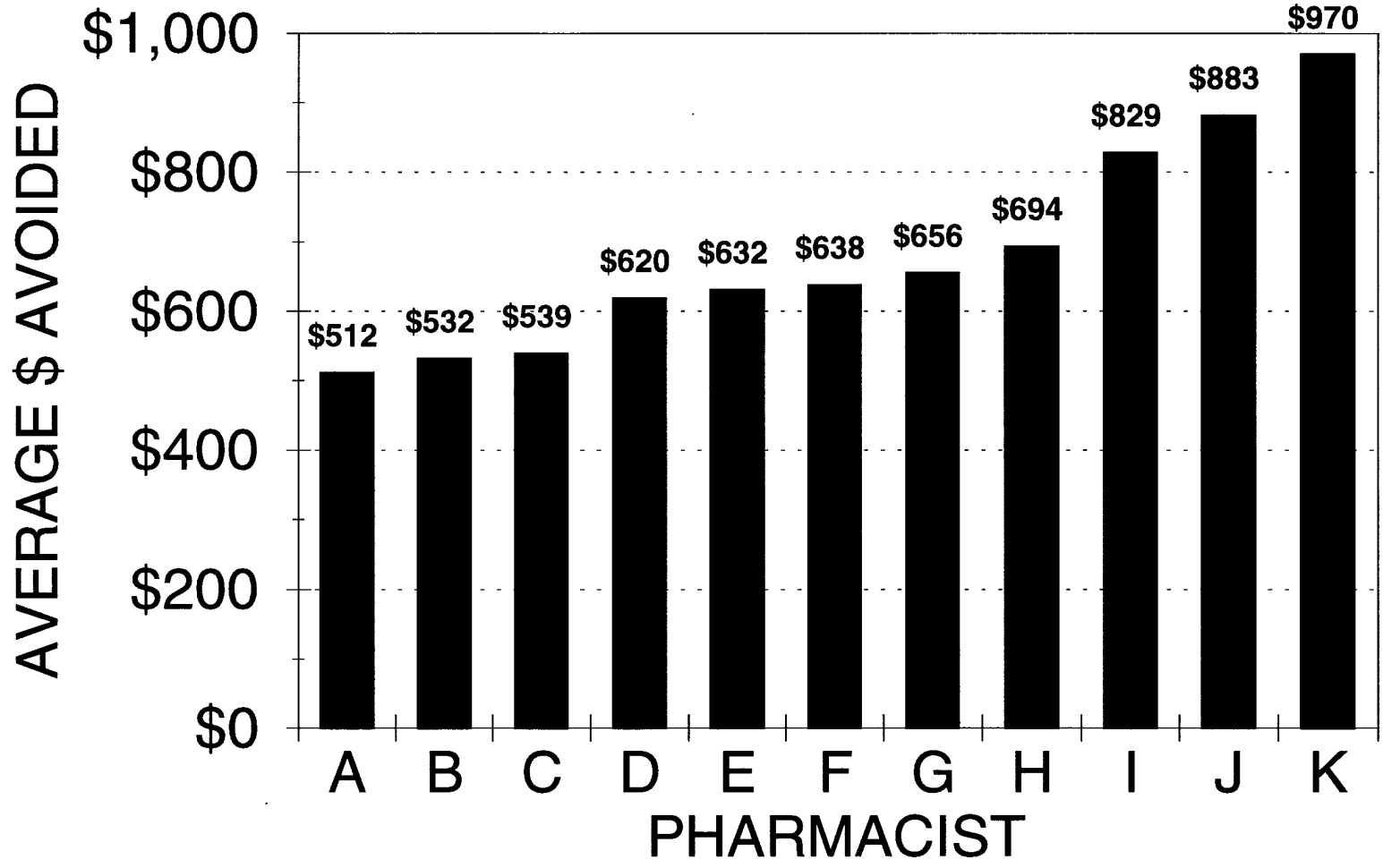


FIGURE 5
NUMBER OF INTERVENTIONS
PHARMACIST-SPECIFIC

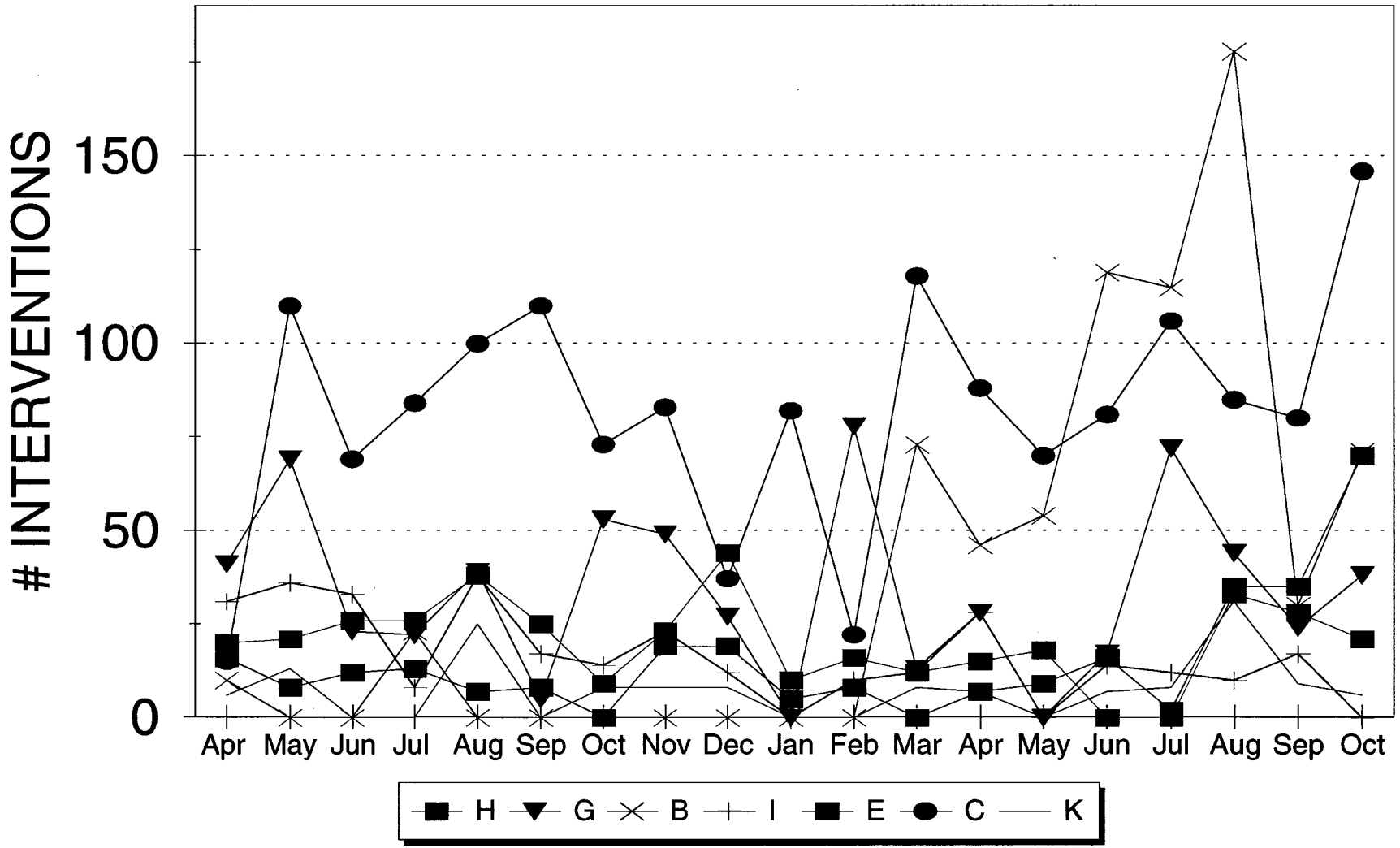


FIGURE 6
TYPES OF INTERVENTIONS I
By percentage of total interventions

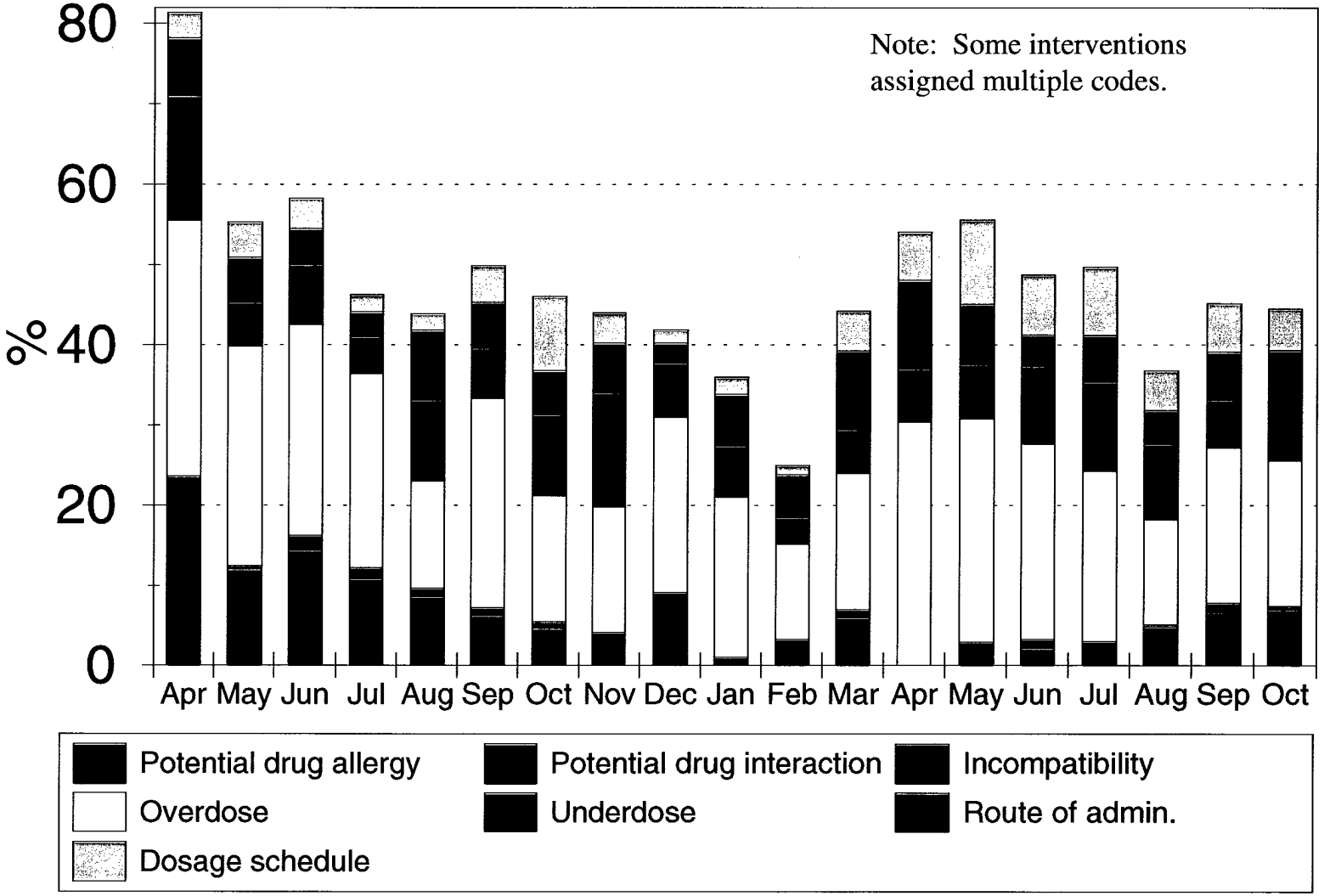


FIGURE 7
TYPES OF INTERVENTIONS II
By percentage of total interventions

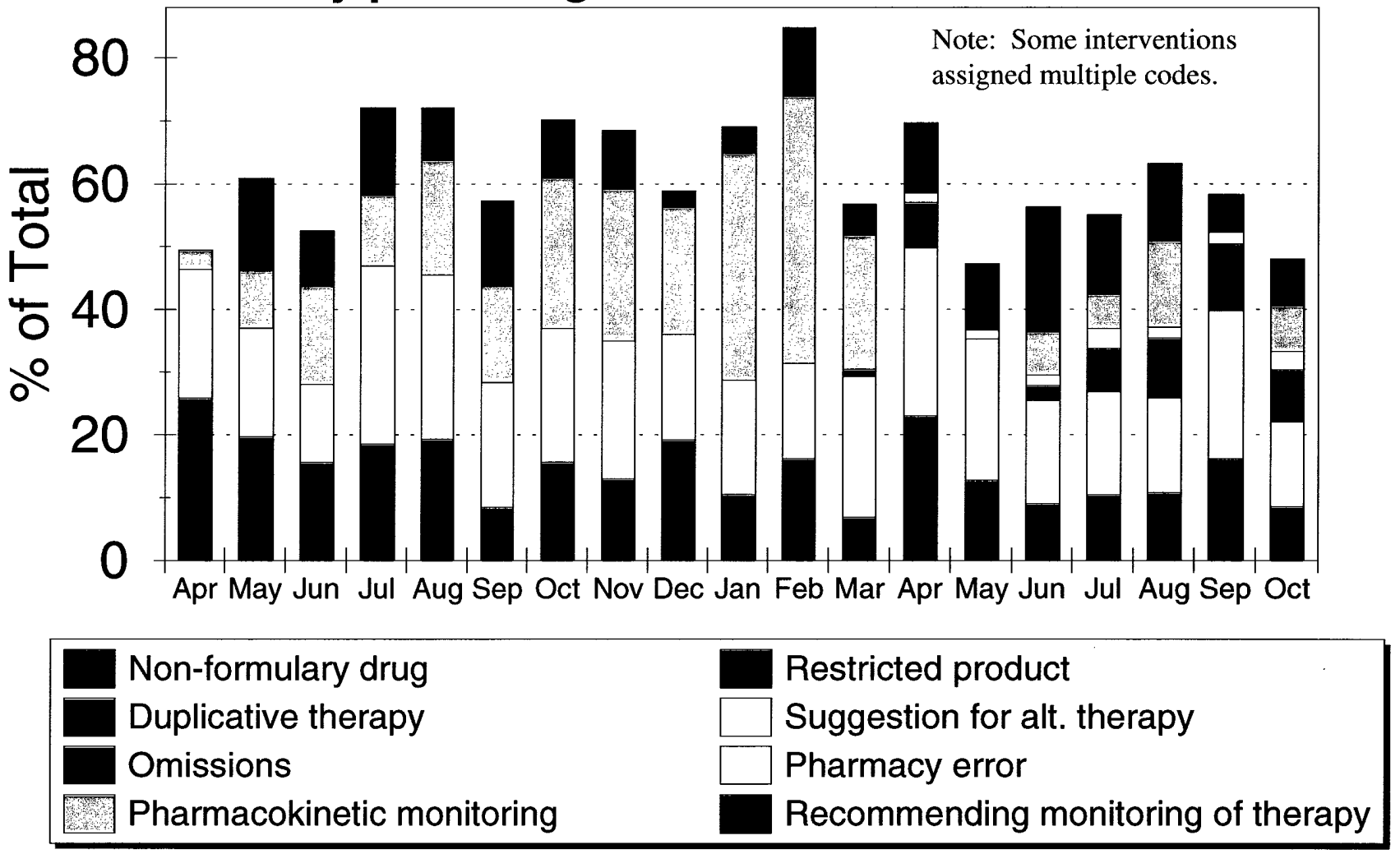


FIGURE 8
TYPE OF INTERVENTIONS
AVERAGE PERCENT OF TOTAL

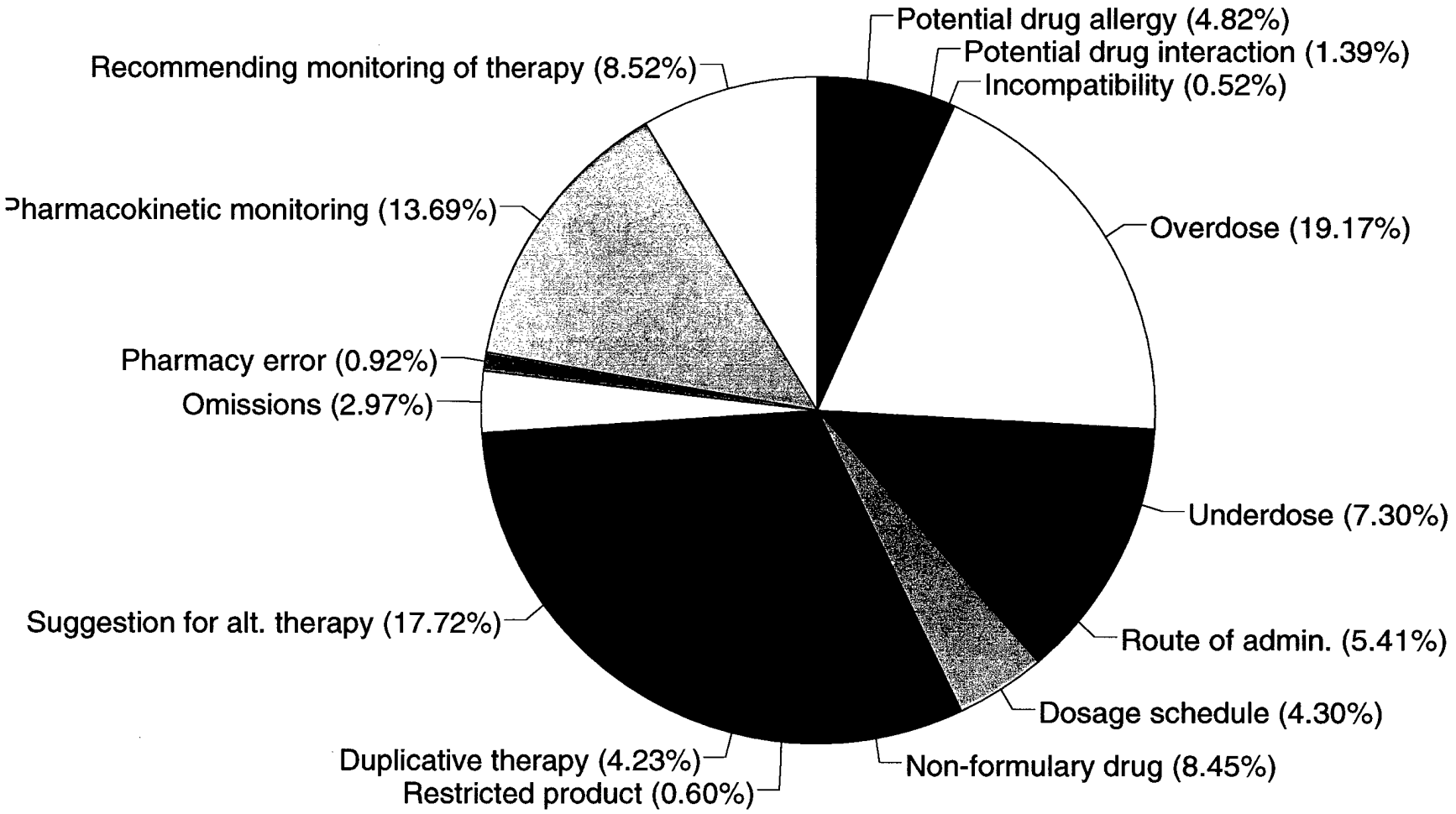


FIGURE 9
RESULTS OF INTERVENTIONS ("OUTCOMES")

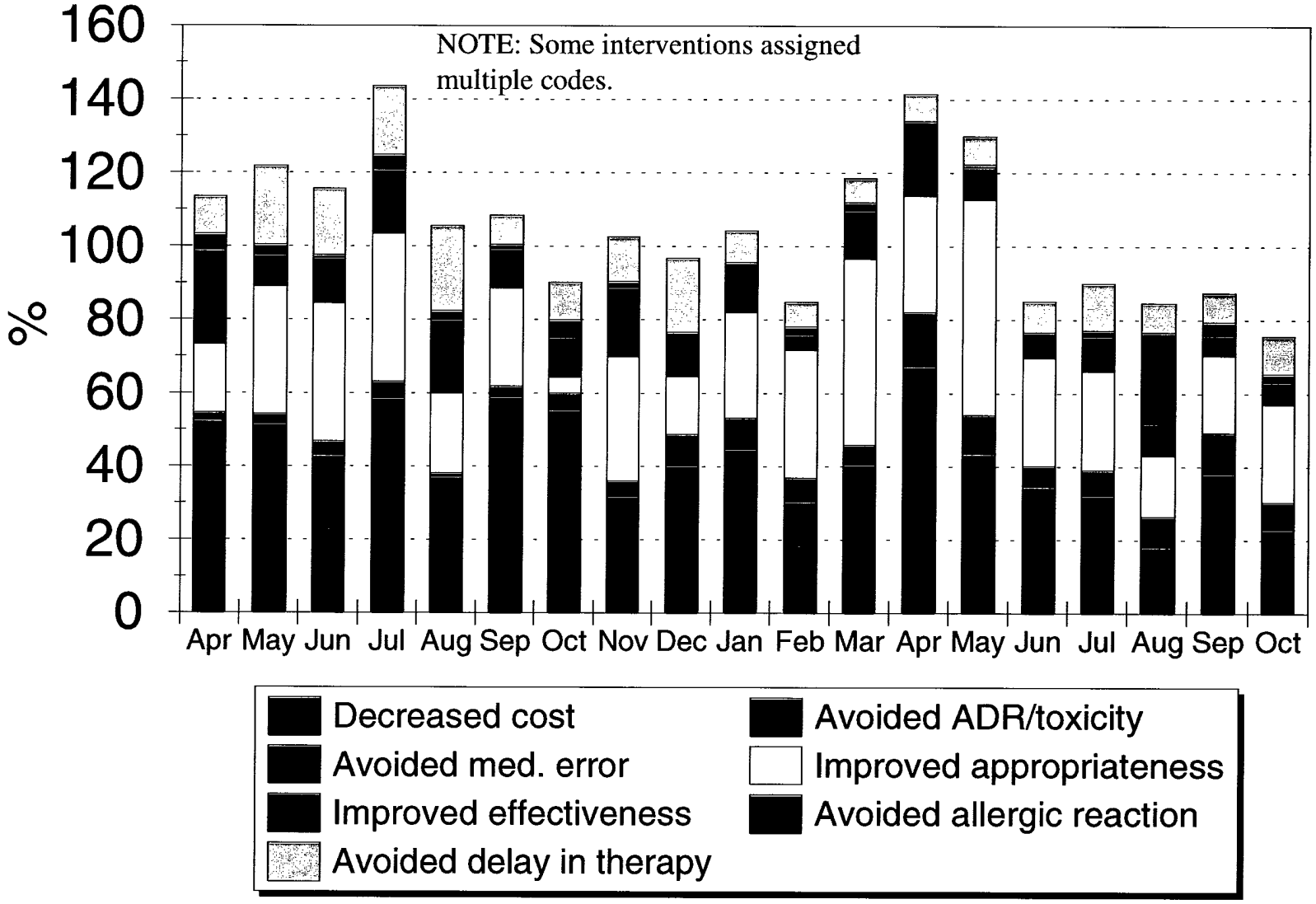


FIGURE 11

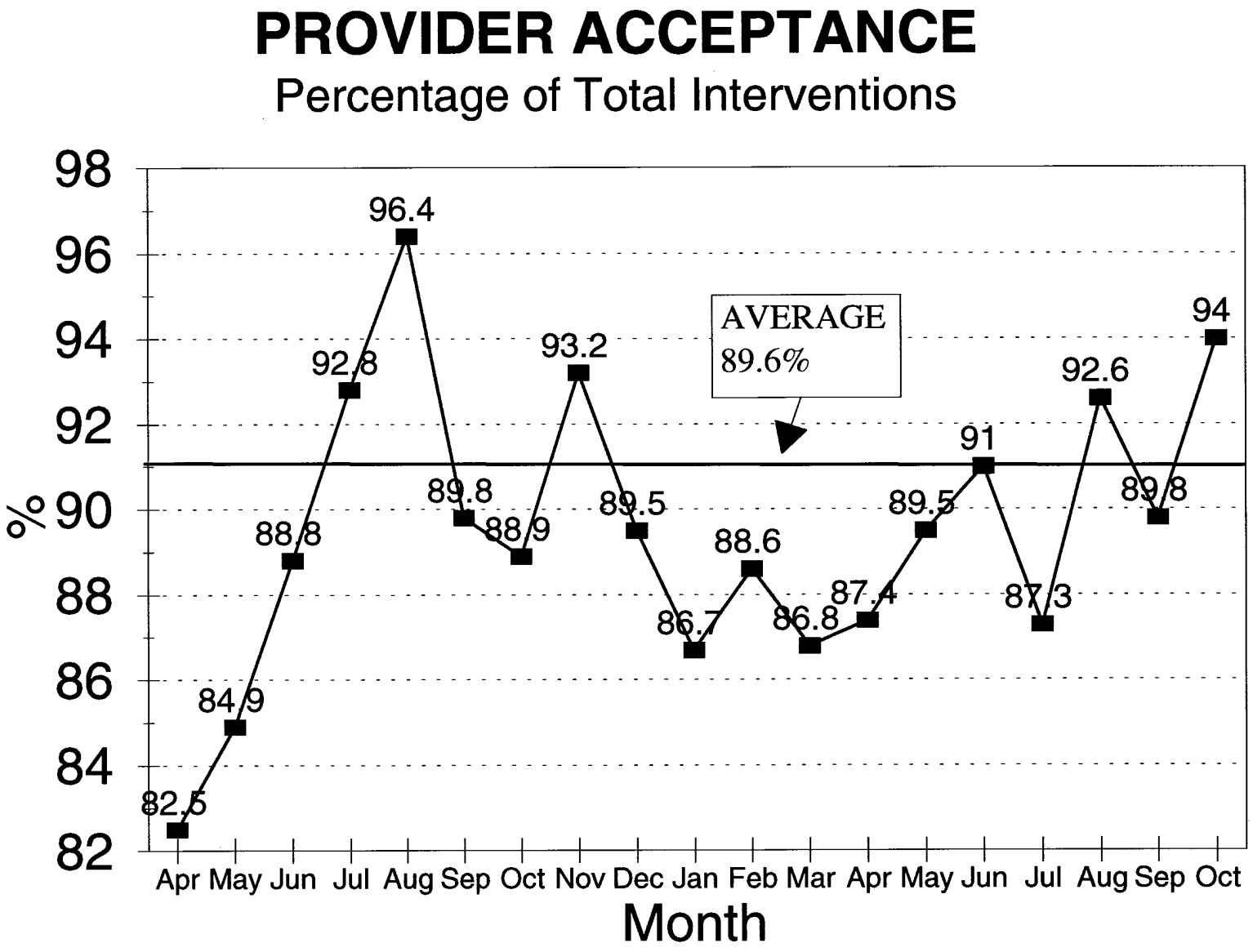

PROVIDER ACCEPTANCE
Percentage of Total Interventions
98
96
94
92
90
88
86
84
82
%
96.4
92.8
93.2
94
92.6
91
89.8
89.5
89.5
89.8
88.8
88.9
88.6
87.4
86.7
86.8
87.3
84.9
82.5
AVERAGE
89.6%
Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct
Month

FIGURE 11

PROVIDER ACCEPTANCE

Percentage of Total Interventions

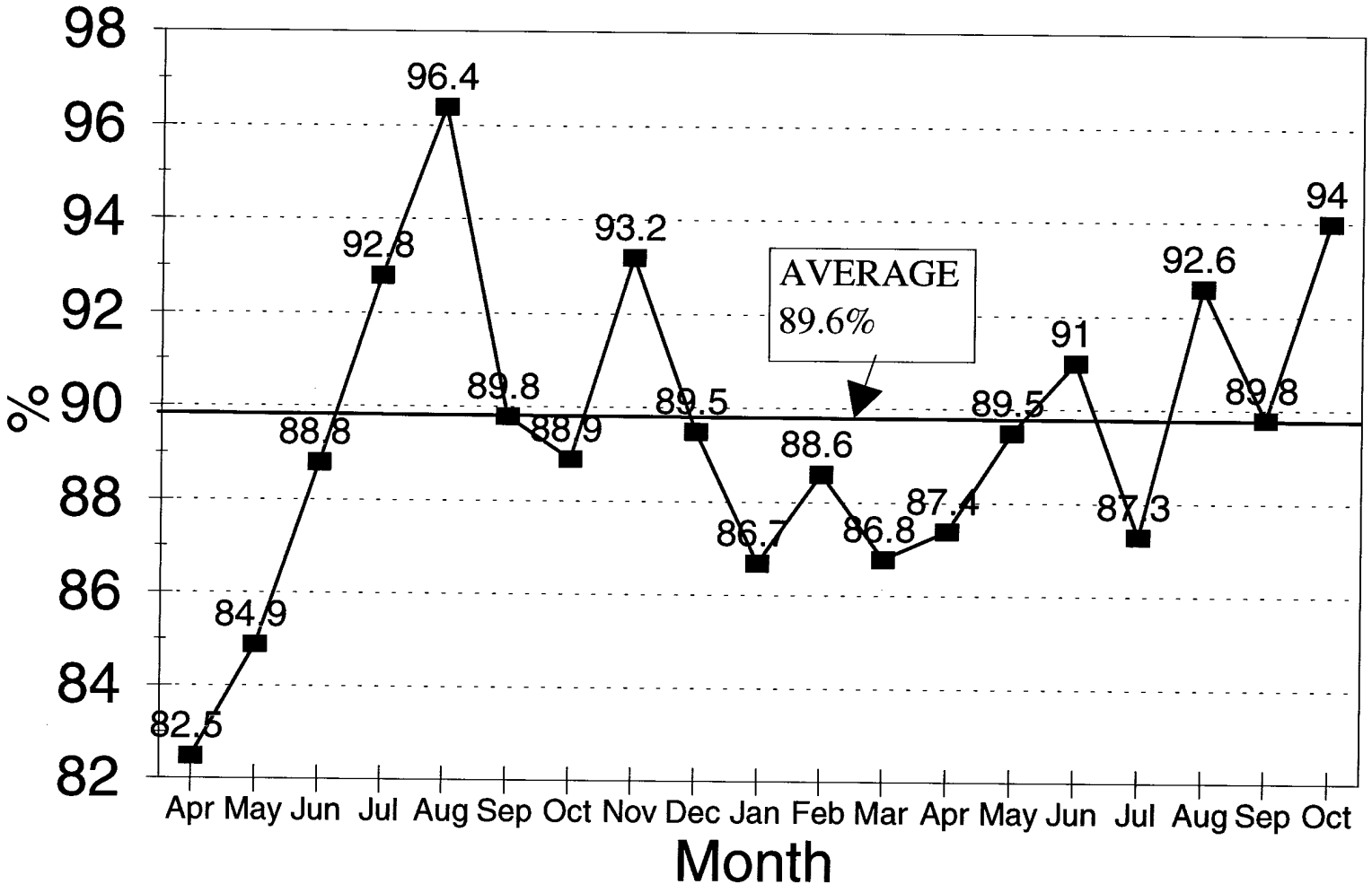


FIGURE 12

BENCHMARKS: DDEAMC STUDY COMPARED WITH OTHER STUDIES

STUDY / CONCLUSION	HARTOUM ET. AL.	KLOPFER & EINARSON	BRICELAND, KANE, & HAMILTON	CONDRON & MANN	PHILLIPS, WILLIAMS & MAY	MONTAZERI & COOK	EAMC
AVERAGE COST AVOIDED PER INTERVENTION	$241.91		$35.00	$49.34			**$612.99**
ANNUAL COST AVOIDANCE	$888,052			$1,089,410		$67,664.24*	**$2,019,708**
PROVIDER ACCEPTANCE RATE		84.4%	94.8%	83.4%	>90%	>90%	**89.6%**
COST BENEFIT RATIO						1:4	**1:4.64**

*Drug costs avoided

4. DISCUSSION:

Figure 12 presents the results of other clinical pharmacy program evaluations ("benchmarks") as described in the literature. It is interesting to note the wide disparity of cost avoidance figures per intervention, ranging from $35.00 in the Briceland study (which used pharmacy students) to the present study's estimate of $612.99. None of the studies, however, had a measurement tool that was as highly developed as the one utilized in the present study. Naturally, costs vary across institutional settings, so the disparities here are not significant. More studies from other organizations would be needed in order to validate the average cost avoidance per intervention. The same caution applies to the annual cost avoidance data. One additional study not included in the chart determined that the cost-benefit of a clinical pharmacy service was 1:6.6 (Bjornson et. al. 1993). The cost-benefit ratio of the DDEAMC Service is 1:4.65, which falls between 1:4 as reported by Montazeri and Cook and 1:6.6 as reported by Bjornson et. al. However, whatever the magnitude of the cost to benefit ratio, the conclusion that these programs are cost-effective remains valid.

The costs avoided per month (Figure 1) show a general downward trend over the study period, with an 18-month low in January 1995. This month also logged the lowest number of interventions (compare with Figure 3). However, the peak number of interventions occurred in August 1995, which does not correlate with a peak in total costs avoided. This study failed to uncover a consistent direct correlation between number of interventions and estimated costs avoided in one month.

The average cost avoided per intervention (Figure 3) showed a steady decline during the study period. The peak average of $941.45 occurred early in the study period (July 1994) and fell

to $414.38 per intervention in September 1995. Several hypotheses could explain this trend. One purpose of the data collection was to justify the Service's existence on a cost avoidance basis. As it became clear that the Service was indeed proving to be cost-effective, efforts to attain the highest possible cost avoidance figures through the encoding process may have become less intense. Secondly, as providers became familiar with the Service, the types of problems prompting interventions may have been reduced, although the data does not support such a trend. Indeed, no clear trends in types of outcomes emerged (see Figure 9).

The wide variation in the average costs avoided per intervention by individual pharmacists was an unexpected result in this study. As Figure 4 illustrates, averages ranged from $512 to $970. Experience with providing the clinical service does not explain these variances, although three of the top five have been with the Service since the beginning. One pharmacist ("C") ranked third from the bottom even though he has been on the Service since its inception..

Another unexpected finding in this study was the wide variation in pharmacist productivity. One pharmacist in particular consistently conducted more interventions than other pharmacists (Pharmacist "C" on Figure 5). The ward assignment of the pharmacist may have played a role in this high productivity. Some wards may naturally produce more problems requiring intervention. As previously discussed, high numbers of interventions were not correlated with a high cost avoidance average per intervention. It is apparent, therefore, that the key factor remains the <u>type</u> of interventions accomplished rather than the total number of interventions. Further study might reveal other factors affecting the numbers of interventions and the costs avoided.

The analysis of the types of interventions (Figures 6, 7 and 8) could be the topic of an

in-depth study of comparable size to this one. A brief examination of the graphical data fails to reveal any particular trends over the course of the study. Similarly, the outcomes data (Figures 9 and 10) provide no enlightenment.

Provider acceptance rates show a gratifying consistency across studies. Variables include academic versus non-academic hospitals, proximity and availability of the clinical pharmacist, and organizational acceptance and promotion of the program. It is postulated that DDEAMC's frequent turnover of physicians and the resultant re-education process serve to keep the acceptance rates at a lower level than that demonstrated in other organizations. Also, new residents who arrive each summer are unfamiliar with the Service and may be resistant to the pharmacists' recommendations. Provider acceptance is key to a program's cost effectiveness, since cost avoidance is predicated on the actual remediation of the drug problem. Achieving optimal provider acceptance should be a key objective of any clinical pharmacy program.

Reliability of the data across the entire study period poses a particular difficulty. The Chief of the Clinical Pharmacy Service has coded each intervention. As the months have passed, he admits that his criteria for selecting one code over another have changed. Many re-codings were done to the data, but it is impossible to know which interventions were re-coded. It is helpful that only one person, the Service chief, coded the interventions during the entire study period. Therefore, some internal consistency can be assumed.

Also in question are the cost avoidance estimates. Estimates of cost avoidance were based primarily on the cost of a hospital bed day. Other amounts were estimates developed by the Service chief based on this bed day data and other cost averages. For example, a change to a less expensive drug was assumed, on average, to save $50. In addition, interventions often received

multiple codes, with costs avoided reflecting the cumulative totals. In spite of the uncertainty which surrounds the assigned costs, the 4.64 to 1 cost-benefit ratio allows for some variance. Even if the costs are in error by a factor of three or four, the program remains cost-effective.

Validity is a factor in the final data analysis. The data measures an intermediate output or product rather than a final outcome. Are these measures appropriate? It depends on the desired goal. If the service seeks to justify its existence based on purely economic grounds, measuring avoided costs can achieve this goal. From a quality assurance point of view, the analysis currently being carried out by the service does not provide direct evidence of an enhanced quality of patient care, although such improvements can certainly be assumed. Presumably, patients do not wish to spend extra days in the hospital and do not want to suffer through adverse drug reactions. From an institutional point of view, shorter hospital stays are assumed to be desirable, although, in some cases, this may not be the case if a shortened hospital stay results in a Potentially Compensable Event (PCE).

It is apparent that true patient-focused outcomes data is missing from the Service's current measurement methodology. Although the categories of costs avoided are termed "outcomes" by the service, these results could be termed "intermediate products." An inpatient hospital day avoided is not a sufficient measure of outcome if the day was avoided because the patient expired. An example of a true outcome could be whether patients for whom interventions were recommended and accepted have better health status in terms of measurable criteria than those for whom recommendations from pharmacists were not accepted by providers. Therefore, a true cost effectiveness analysis which factors in patient outcomes was not achieved by the extant study.

Another difficulty is the lack of data on patient acuity. Although such information is

collected daily by the DDEAMC Nursing Methods Analyst, matching patient acuity scores to interventions has not been done. More seriously ill patients may generate more interventions, as might be the case in an ICU. Other patient factors, such as age, gender, and comorbidities have not been recorded. Also, the number of interventions per patient have not been recorded. These patient-specific factors may or may not affect the final analysis, but represent an area for further investigation.

Also lacking in the assembled data is information on the total number of patient charts reviewed. It would be possible to extract this data from the CHCS system based on patient census. Without this data, the ratio of interventions to total patient population cannot be determined. For example, if one pharmacist reviews only twenty-five charts and logs one intervention per day, that single intervention cost the hospital approximately $132.20, based on the previous salary and benefit figures. The ratio of interventions to total patients in this example is 1:25. Extrapolating the ratio of interventions to patient census during the period under study might yield useful data to predict future cost avoidance.

An examination of the intervention and outcomes codes reveals a lack of MECE (mutually exclusive, categorically exhaustive) categories in the data. Some categories overlap, which reduces the validity of the data. For example, is an "allergic reaction" also an "adverse drug reaction?" How vital is it to differentiate between an overdosage and an underdosage? The use of multiple codes for a single intervention, while appropriate to achieve a comprehensive analysis of that intervention, nonetheless introduced a degree of confusion into the analysis. The use of the terms "Improved appropriateness" and "Improved effectiveness" is very subjective. The recommendations section of this study presents a proposal for dealing with this problem.

5. **RECOMMENDATIONS:**

a. **Data collection:** The Clinical Pharmacy Service will be able to use these results to refine its data collection and analysis process. At some point, the time involved in collecting data on a daily basis becomes burdensome and reduces efficiency. The present manual intervention recording method introduces error into the system.

In addition, the Service chief must input each intervention into the data base program and assign codes to each. While this coding process assures a considerable degree of accuracy, delegating this task to the clinical pharmacists might be a possibility.

RECOMMENDATION: The Chief of the Patient Focused Pharmacy Service should investigate the use of the hospital Local Area Network (LAN), which becomes operational in the summer of 1996, to make available the data base program so that clinical pharmacists can enter their intervention data directly into the system and code it at the time of data entry. The installation of personal computers on each inpatient ward would be a necessary requirement for this process. This would avoid the laborious manual data entry process that is now being used. Efficiencies in time management and an increase in data accuracy would be the immediate result.

b. **Quality Improvement/Performance Improvement Process:** The Service Chief should familiarize himself with the QI/PI process currently being used at the Medical College of Georgia (Phillips, Williams, and May 1994). Implementing this process would allow tracking of problems with individual drugs and establish monitoring of individual physician performance. Also, tracking of recommendations not accepted by providers is vital. This area merits further investigation. Using the data derived from this method would satisfy Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) requirements for process improvement.

RECOMMENDATION: Introduce a quality/process improvement function into the current data collection and reporting system.

c. **Data Coding:** The coding system currently in use introduces subjectivity into the monitoring process. The MCG model uses codes A through E , defined as "Potentially Lethal or Severe", "Potentially Serious", "Potential Patient Problem", "Problem Order" and "Optimize Therapy." Although the present system allows great specificity in analysis, some of the individual categories could be modified and combined, as outlined in the discussion above, thus reducing the number of codes. Further refinement of the categories of "Improving appropriateness" and "Improving effectiveness" would further increase accuracy. Recording and coding every intervention is a necessary part of process improvement and permits a very high degree of validity and reliability into the analysis, so it is recommended that this practice continue rather than switching to a sampling methodology. The work site direct data entry system recommended above would make this process less cumbersome.

RECOMMENDATION: The data coding system should be examined so that greater specificity and less ambiguity can be achieved.

d. **Graphical Presentation of Data:** The ability to create graphical representations of data exists in the current computer programs. The graphical display of data has more impact that simple reports.

RECOMMENDATION: Use graphical representations in reporting the activities and outcomes of the Patient Focused Pharmacy Service.

e. **Further Study:** This study is only a first step in the assessment of the effectiveness of the clinical pharmacy concept and represents one medical center's experience. The proliferation of

programs across the health care industry and the cost savings/avoidance focus of managed care make it essential that these programs be carefully assessed. Benchmarking would then be possible.

RECOMMENDATION: Other clinical pharmacy programs need to be assessed using a an analysis tool similar to the one used in this study.

6. CONCLUSION:

The return on investment is sufficient to justify the continued support of the Patient-Focused Pharmacy Service at Dwight D. Eisenhower Army Medical Center. This study and others clearly demonstrate that clinical pharmacy programs are cost-effective and confer a cost benefit. Still to be addressed is the impact on true patient outcomes. Clinical pharmacy services have become an integral part of our health care delivery system. As with any patient-focused service, continual confirmation of efficacy, efficiency, and cost benefits is necessary, especially when fiscal pressures are intense. This study provides a framework for health care administrators to use when evaluating their clinical pharmacy programs.

GLOSSARY

ADR. Adverse drug reaction.

CBA. Cost benefit analysis.

CEA. Cost effectiveness analysis.

CHCS. Composite Health Care System. Computer system used by DOD health care facilities.

DDEAMC. Dwight D. Eisenhower Army Medical Center, Ft. Gordon, Georgia.

DOD. Department of Defense.

DUR. Drug Utilization Review.

GS. General Schedule. Pay grade system used for federal civilian employees who are compensated on a hourly basis.

INTERVENTION. A recommendation to remedy a single drug-related problem identifed by the clinical pharmacist.

MTF. Military Treatment Facility.

PCE. Potentially Compensable Event. Health care mishap that could result in litigation.

UCSF. University of California, San Francisco.

VAMC. Veterans Affairs Medical Center.

WORKS CITED

American Society of Hospital Pharmacists. 1983. ASHP statement on clinical functions in institutional pharmacy practice. American Journal of Hospital Pharmacy 40:1385-6.

Bajcar, Jana, Thomas Chin, Wendy Chui and Kris Wichman. 1995. Development of a comprehensive clinical pharmacy workload documentation system. Canadian Journal of Hospital Pharmacy 48:80-89.

Bjornson, Darrel C., William O. Hiner, Roger P. Potyk, Bruce A. Nelson, Fredric A. Lombardo, Tracy A. Morton, Lydia V. Larson, Brian P. Martin, Robert G. Sikora, and Frank A. Cammarata. 1993. Effect of pharmacists on health care outcomes in hospitalized patients. American Journal of Hospital Pharmacy 50:1875-84.

Condron, John H. and James L Mann. 1994. Drug utilization and therapeutic intervention programs: Pharmacy services that pay for themselves. Canadian Journal of Hospital Pharmacy 47:203-8.

Briceland, Laurie L., Michael P. Kane, and Robert A. Hamiton. 1992. Evaluation of patient-care interventions by Pharm.D. clerkship students. American Journal of Hospital Pharmacy 49:1130-2.

Day, Robert L., Jere E. Goyan, Eric T. Herfinal, and Donald L. Sorby. 1991. The origins of the clinical pharmacy program at the University of California, San Francisco. DICP: The Annals of Pharmacotherapy 25(3): 308-14.

Ellrodt, A. Gray, Laura Conner, Mary Riedinger, and Scott Weingarten. 1995. Measuring and improving physician complicance with clinical practice guidelines. Annals of Internal Medicine 122:277-82.

Hartoum, Hind T., Carmen Catizone, Richard A. Hutchinson, and Anal Purohit. 1986. An eleven-year review of the pharmacy literature: Documentation of the value and acceptance of clinical pharmacy. Drug Intelligence and Clinical Pharmacy 20:33-48.

Hartoum, Hind T., Richard A. Hutchinson, Kenneth W. Witte, and George P. Newby. 1988. Evaluation of the contribution of clinical pharmacists: Inpatient care and cost reduction. Drug Intelligence and Clinical Pharmacy 22:252-9.

Hutchison, Lisa C., Jonathan J. Wolfe, Cheryl B. Padilla, and Collie W. Forrester. 1992. Clinical privileges program for pharmacists. American Journal of Hospital Pharmacy 49:1422-4.

Jameson, John, Glenn VanNoord and Karen Vanderwoud. 1995. The impact of a pharmacotherapy consultation on the cost and outcome of medical therapy. Journal of Family Practice 41:469-72.

Kalman, Mervyn K., Dennis E. Witkowski, and Gary S. Ogawa. 1992. Increasing pharmacy productivity by expanding the role of pharmacy technicians. American Journal of Hospital Phamacy 49:84-9.

Keys, Phillip W., Carla M. Goetz, Patricia A. Keys, James A. Sterchele, Thomas M. Snedden and Bruce H. Livengood. 1995. Computer-guided academic detailing as part of a drug benefit program. American Journal of Health-System Pharmacy 52:2199-203.

Klopfer, Joanne D. and Thomas R. Einarson. 1990. Acceptance of pharmacists' suggestions by prescribers: A literature review. Hospital Pharmacy 25:830-6.

MacKeigan, Linda D. and J. Lyle Bootman. 1988. A review of cost-benefit and cost-effectiveness analyses of clinical pharmacy services. Journal of Pharmaceutical Marketing & Management 2(3):63-84.

Matuszewski, Karl and Peter H. Vlasses. 1995. Survey results from Academic Health Center intensive care units: considerations for departments of pharmacy. Clinical Therapeutics 17:517-24.

Miller, Douglas A., Barbara J. Zarowitz, Antonio Petitta, and David B. Wright. 1993. Pharmacy technicians and computer technology to support clinical pharmacy services. American Journal of Hospital Pharmacy 50(5):929-34.

Montazeri, Mitra and Deborah J. Cook. 1994. Impact of a clinical pharmacist in a multidisciplinary intensive care unit. Critical Care Medicine 22:1044-1048.

Phillips, Marjorie S., Williams, Dianne B., and May, J. Russell. 1994. Using pharmacist clinical intervention data for quality improvement or medication use and physician assessment. Joint Commission Journal on Quality Improvement 20:569-76.

Raehl, Cynthia L., Michael E. Pitterle, and C.A. Bond. 1992. Legal status and functions of hospital-based pharmacy technicians and their relationship to clinical pharmacy services. American Journal of Hospital Pharmacy 49:2179-87.

Santell, John P. Projecting future drug expenditures - 1994. 1994. American Journal of Hospital Pharmacy 51(2):177-187 .

Swanson, Kathleen M., Wesley B. Hunter, Sandra J. Trask, and Shawn M. Beck. 1991. Pharmacist career ladder with clinical privilege categories. American Journal of Hospital Pharmacy 48:1956-61.