A COST EFFECTIVENESS COMPARISON OF A PHARMACIST USING
THREE METHODS FOR IDENTIFYING POSSIBLE
DRUG-RELATED PROBLEMS

by

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A Thesis Submitted to the Faculty of the
DEPARTMENT OF PHARMACEUTICAL SCIENCES
In Partial Fulfillment of the Requirements
For the Degree of
MASTER OF SCIENCE
WITH A MAJOR IN PHARMACY
In the Graduate College
THE UNIVERSITY OF ARIZONA

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ACKNOWLEDGMENTS

I would like to acknowledge the personal guidance and scholastic leadership given to me by Dr. Henry W. Winship III. His high ideals have been a beacon to follow and his courage has been an inspiration. His efforts on my behalf have been numerous.

I would also like to express my gratitude to Dr. George Wood for his time and assistance in conducting this research.

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ABSTRACT

A study was carried out to determine the cost effectiveness of a pharmacist in identifying possible drug-related problems (PDRP's) using three methods: chart review, rounding with physicians, and patient drug profiles.

The type of drug-related problem being sought was defined. An expert panel consisting of the investigator, college professor, and teaching physician was set up to identify the majority of possible drug-related problems on the medical ward. The number of PDRP's and the time needed to identify the PDRP's by the investigator was recorded using the three methods. The results of the investigator were then compared to the finding of the expert panel to determine the effectiveness of the investigator and the cost (time) per PDRP using each of the three methods.

It was found that the patient drug profile system was the most productive and the least expensive method for screening for PDRP's. However, the rounding with physicians method of identifying PDRP's had many advantages the patient drug profile system lacked.

INTRODUCTION

In recent years, the federal government and health professionals have recognized that drug-related problems are a major health problem. The Task Force on Prescription Drugs: Final Report estimated that approximately three billion dollars are spent annually on the treatment of drug-related problems (U. S. Department of Health, Education and Welfare 1969). Several controlled studies have shown that many hospitalized patients suffer adverse reactions to drugs. Schimmel (1964) found in his study that 10 percent of the patients at the Grace New Haven Hospital developed reactions to drugs. Seidl et al. (1966) at the Johns Hopkins Hospital reported that 13.6 percent of the general medical patients experienced adverse reactions to drugs. However, another investigator has found less than 1 percent adverse drug reaction in his population (McDonald and MacKay 1964). Adverse drug reactions are becoming recognized as a major health problem.

Pharmacists receive more training than physicians and nurses concerning drug-related problems. Carr's (1970) study shows that the average medical student in his four years of training receives an average of only 31 hours' training in clinical pharmacology and applied therapeutics. The nursing education programs usually have only one formal pharmacology course in their curriculum (McCord 1973). In contrast, the colleges of pharmacy curriculum have included several courses concerned

with drug-related problems. The intent of these drug-related courses is to educate an individual who is better trained to identify and solve drug-related problems. The accrediting body for colleges of pharmacy (The American Council on Pharmaceutical Education) has formulated guidelines for colleges which include strong recommendations for these institutions to educate individuals knowledgeable in the clinical aspects of drug therapy. The federal government has further added emphasis to their movement by providing capitation grants to colleges of pharmacy with specific recommendations to develop a clinical component of pharmacy practice.

Purpose

The first purpose of this research was to determine the relative effectiveness of a pharmacist and the cost involved in identifying possible drug-related problems (PDRP's) using three methods: rounding with physicians; reviewing patient charts; and monitoring patient drug profiles. The second purpose was to develop a methodology for the practicing hospital pharmacist in identifying PDRP's to improve patient care.

The following general hypothesis was tested: there is a difference in cost and effectiveness of a pharmacist in identifying PDRP's by rounding with physicians, reviewing patient charts, and monitoring patient drug profiles.

Assumptions

1. During rounding with physicians, contamination of ideas between the investigator and other members of the expert panel was minimized.
2. The patient population disease states did not vary significantly during the experiment from method to method and were representative of common disease states in other similar institutions.
3. The expert panel identified the majority of PDRP's in the patient population during testing by any of the three methods.

Limitations

1. The data are more applicable to institutions employing the problem oriented patient chart system. It is a superior system of organizing and presenting medical information about a patient and therefore requires less time to read and study the patient charts (Weed 1968). Time factors affect two of the three methods of identifying PDRP's. Because patient chart review and rounding with physicians use the patient charts, the time needed to read a chart organized by the problem oriented medical record system would be less than the time needed to study a patient chart organized in the traditional manner.
2. The possible drug-related problems detected in this study were not related to actual patient drug reactions.
3. The patient drug profile system did not include the effects of drugs on laboratory tests or the clinically demonstrable signs

and symptoms or abnormal diagnostic laboratory tests showing malfunction of a body process.

4. This research used only one investigator in comparison with the expert panel. If more than one investigator were compared to the expert panel, the results could vary from the data collected in this study.

Definitions

The word possible is defined as "that which may be true or a fact, or may perhaps be the case, as something concerning that which one has no knowledge to the contrary" (Webster's Seventh New Collegiate Dictionary 1963). Since the clinically significant reactions to drug-related problems identified in this study were not established, the word possible was used to describe the drug-related problems detected in this study. The phrase possible drug-related problem will hereafter be abbreviated PDRP. Drug-related situations can reasonably be expected to be identified on the basis of available evidence, although not proven to eventually develop into a problem. Each PDRP will be documented by using Drug Interaction by Phillip Hansten (1971), Evaluations of Drug Interactions by the American Pharmaceutical Association (1973), or the clinical literature. A PDRP was defined for this study as any possible drug-food interaction, any possible drug-disease interaction, any possible drug-drug interaction, any possible drug-hypersensitivity (allergic) reaction, any possible dosage regimen error, or any possible drug toxicity.

A possible drug-disease interaction occurred when an order for a drug which was contraindicated in a patient with a certain disease state

was written, e.g., an order for a cold remedy which contains sympathomimetic amines for a diabetic patient.

A possible drug-drug interaction was any therapeutic incompatibility caused by taking two drugs at the same time which have potentiating, inhibiting, or opposing effect, e.g., the potentiating effect of phenylbutazone in a patient currently on coumadin therapy.

A possible drug-food interaction was considered to be caused by taking a drug and food into the body at the same time and was manifested by an altered effect of the drug in the patient, e.g., the decreased effectiveness of tetracycline when given with meals.

A possible drug-hypersensitivity (allergic) reaction was any adverse reaction of a patient to a drug whose symptoms were related to the individual's increased immunologic response to the drug, e.g., an anaphylatic reaction to a dose of penicillin.

A possible dosage regimen error occurred when the standard dosage regimen (that listed in the literature accompanying the drug) is not followed, e.g., a five-day course of therapy of ampicillin suspension instead of the recommended ten-day course of therapy.

A possible drug toxicity was any pharmacologic action of a drug that is exaggerated due to an overdose.

Usual, mild, common side effects of drugs not requiring treatment or causing undue patient discomfort or concern were not considered as PDRP's, e.g., dryness of the mouth after administration of atropine. Noncompliance to dosage regimen was not considered a PDRP.

RELATED LITERATURE

While the colleges of pharmacy and the federal government have emphasized the education of clinical pharmacists, hospital pharmacies, nursing homes, and retail pharmacies have been reluctant to hire them. Despite federal monies being spent on the development of persons to perform these professional functions, there is very little in the literature to document the cost and effectiveness of pharmacists in identifying or solving drug-related problems. A search of the literature has revealed very little with one exception concerning the cost and effectiveness of pharmacists identifying drug-related problems. A recent study done by Dixon, Skupin and Zajak (1973) addressed itself to the problems of determining the incidence of potential drug interactions and to estimate the time and cost involved in monitoring therapy. A seven percent incidence of drug interactions for the patient population was found. The cost of monitoring drug profiles per patient day was four cents and the cost per interaction detected was approximately four dollars. This study did not address itself to the problem of determining effectiveness of a pharmacist in detecting drug interactions or determining the superiority of one method of identifying drug interaction over another.

There is a need for a study to show not only the cost of using patient drug profiles for detecting drug interactions, but also the cost

and effectiveness of a pharmacist in identifying drug-related problems using the commonly available methods of rounding with physicians, patient chart review, and monitoring patient drug profiles.

DESIGN OF STUDY

Introduction

A sophisticated computer assisted identification system could possibly identify most PDRP's within an institution. Such a system would consume large amounts of time and money and utilize specialized personnel and equipment. Most small general hospitals do not have such systems currently available to them. Consequently, it is impossible to determine the absolute number of PDRP's in an institution for a given period of time. Therefore, the number of PDRP's occurring in an institution for a given period of time was estimated by an expert panel of judges.

The institution used in this study was Pima County General Hospital (PCGH). This hospital was a 140-bed hospital that treated approximately 60,000 patients in 1972. Fifty-six thousand patients were treated in outpatient specialty clinics, and 4,000 were admitted for inpatient treatment. The average patient stay at Pima County General Hospital for 1973 was 10.2 days. The population is made up of Mexican-Americans, Indians, Blacks, and Caucasians. The main hospital structure was constructed in 1936 and was somewhat outdated and crowded. However, the equipment was adequate and up to date. The outpatient clinics were internal medicine, neurology, diabetes, chest disease, ear, nose and throat, gynecology, obesity, arthritis, cardiology, endocrine,

hematology, and dermatology. The inpatient services were divided into medical and surgical and included a neuropsychiatric service, urology, orthopedics, chest, gynecology, neurosurgery, ear, nose and throat, ophthalmology, and radiotherapy. Therefore, Pima County General Hospital was considered to be representative of a small general hospital.

This study was conducted on the medical wards at Pima County General Hospital which has 34 beds. The population of patients on this ward were adult males and females who were usually ill both acutely and subacutely. Most had multiple disease states. There were few elective admissions on this ward.

An expert panel consisting of a professor from the College of Pharmacy, a teaching physician, and the investigator was formed to identify PDRP's. The college professor graduated from the University of Illinois College of Pharmacy with a Ph. D. He teaches biopharmaceutics, pathology, and clinical pharmacy at The University of Arizona. The teaching physician member of the panel is a board-certified endocrinologist and is currently Chief of Medicine, Pima County General Hospital. The investigator is a graduate of a five-year Bachelor of Science degree program and has three years of hospital experience.

The expert panel was expected to identify a majority of the PDRP's of the patient population because it used all three methods of identification simultaneously. The three members of the panel were more thorough in identifying problems than one person, and the members of the panel possessed a varied combination of educational backgrounds and

clinical experience. The patients used in the study were the patients of the adult medical wards.

Methodology

The experiment was conducted at Pima County General Hospital from July 28, 1973, to January 15, 1974. First, patient chart review was conducted and took about two months. Rounding with physicians was the second method used in the research and was conducted in two parts: the first part being conducted from September 15, 1973, to December 1, 1973, and the second part running from January 1, 1974, to January 15, 1974. Monitoring patient profiles was the last method used, and it also was performed in two parts. The first part was from December 10, 1973, to December 17, 1973, and the second part was run at the same time as the last part of rounding with physicians--January 1, 1974, to January 15, 1974.

In reviewing patient charts, the investigator examined one-half of the patient medical charts on the medical ward while the other members of the expert panel monitored the same patients. The charts were examined every day at approximately the same time, and the time spent reading the charts and looking for PDRP's in texts on hand was recorded in minutes for each patient. The charts examined were for the patients in even-numbered beds so a cross section of the male and female patients were obtained. The time spent looking for charts and the time lost due to interruptions while reviewing patient charts was not included. The PDRP's found were not brought to the attention of the physicians and interns as the purpose of the study was to identify, not solve, PDRP's.

Also, if all the PDRP's were discussed with physicians when detected, this would have altered the prescribing techniques and skills of the physicians.

The second method used in the study was the rounding with physicians. Here the investigator attended work rounds with the attending physician, the resident physician, the medical intern, the nurse, and (during the first part of this method) the pharmacy intern. It was explained to the physicians that the investigator was collecting data for experimental purposes which necessitated his keeping a time card. The investigator assumed a passive observing role and did not initiate any discussion concerning patient therapy. The other members of the expert panel rounded with physicians on the same day and followed the same patients, but did not round with the investigator. This was able to be accomplished because the patients being followed had two physician teams treating them. The investigator rounded with one-half of the patients being followed with one physician team; the other members of the expert panel rounded with the other half of the patients being followed. By alternating physician teams, all the patients were followed and the investigator and members of the expert panel did not have to be together on rounds, thus minimizing crossover contamination. If either the investigator or the other members of the expert panel received information concerning a PDRP from another panel member, the results of that patient were dropped from the study. The investigator was free to converse with the patients and consult the chart at bedside as a reference. The

investigator did not study the chart for extended periods of time as he might during reviewing patient charts.

The last method used in detecting PDRP's was the monitoring of patient drug profiles. A patient drug profile system was already in use at Pima County General Hospital. The system was adequate except that it lacked an active problem list for the patient. Therefore, an active problem list was added to the profile system and this modified patient drug profile system was used. The patient drug profile included allergies, diagnosis, height, weight, medication and strength, route of administration dosage schedule, and doctor (Figure 1). The patient drug profiles were used at the same time each day. The time spent using this method was recorded only while monitoring the patient drug profile and did not include the time spent in preparation or maintenance of profiles.

The time spent identifying PDRP's using the three methods described was recorded in minutes on a time card. The time card was designed to include the date, time in and out, and the patient's name and was used to record the time spent with each patient while rounding, reviewing patient charts, and monitoring drug profiles (Figure 2).

Patients were followed using a problem-oriented approach. A card designed for this purpose was termed a SOAP card. This patient information card included subjective patient information (e.g., signs and symptoms), objective patient information (e.g., diagnostic examination results), assessment of the patient's condition, plan for treatment (medications or other therapy), and a list of the patient's active problems (Figure 3). Each PDRP identified by the investigator was

Allergies:

Height:

Patient Demographics:

Diagnosis:

Weight:

Discharge Date:

Medication & Strength	Form	Dosage Schedule	Total Dose	MD	D 8/4 I	8/5	8/6	8/7	8/8	8/9		
Iron 300 mg	po	1 TID	3	Smith	8/4/74 MLD	0 MLD	8/5/74 0 MLD	8/6/74 0 MLD	8/7/74 0 MLD	8/7/74 0 MLD	8/8/74 0 MLD	0
Valium 5 mg	po	1 TID	3	Smith	8/4/74 MLD	0 MLD	8/5/74 0 MLD	8/6/74 0 MLD	8/6/74 1 D.C.			0
Tylenol 5 gr	po	11 QID	4	Smith	8/4/74 MLD	0 MLD	8/5/74 0 MLD	8/6/74 0 MLD	8/7/74 0 MLD	8/8/74 0 MLD	8/9/74 0 MLD	0
MOM	po	30 cc HS	30 cc	Smith	8/4/74 MLD	0 MLD	8/5/74 0 MLD	8/6/74 0 MLD	8/7/74 0 MLD	8/8/74 0 MLD	8/9/74 0 MLD	0
Dalmane 30 mg	po	1 HS	1	Smith	8/4/74 MLD	0 MLD	8/5/74 0 MLD	8/6/74 0 MLD	8/7/74 0 MLD	8/8/74 0 MLD	8/9/74 0 MLD	0
Dymelor 500 mg	po	1 QD	1	Doe	8/4/74 MLD	0 MLD	8/5/74 0 MLD	8/6/74 0 MLD	8/7/74 0 MLD	8/8/74 0 MLD	8/9/74 0 MLD	0

Active Problem List

1. Anemia
2. Agitation
3. Adult On-
4. Obesity

Figure 1. A Sample Patient Drug Profile.

TIME CARD

DATE: 8/4/74			Patient's Name & Room No.	
in	out	Total		
5:07	5:09	2 min	Fort, John	214-1
5:10	5:13	3 min	Hurd, John	216-3
5:13	5:14	1 min	Cole, John	217-1
5:15	5:16	1 min	Sith, John	219-2
5:16	5:17	1 min	Dick, John	220-1
5:18	5:20	2 min	Bell, John	221-2
5:20	5:22	2 min	Mink, John	221-3
5:23	5:24	1 min	Mole, John	224-2
5:25	5:28	3 min	Mill, John	227-1
5:30	5:31	1 min	Gate, John	227-2
5:32	5:34	2 min	Redd, John	228-1

Figure 2. A Sample Card Used to Record Patient Contact Time.

Act. Prob.	Subject	Obj.	Asses.	Plan
<u>Date:</u>				
1. H.T.	Headaches	B.P. 200/150	Malig.	Esidrix 50 mg B.I.D. Aldomet 250 mg Q.I.D.
2. Diabetes	Polyuria	F.B.S. 300	Uncon- trolled	Diet Control Dymelor 1.5 gm Q.D.
3. U.T.I.	Dysuria	C.& S. E. Coli 100,000		Gantrisin 500 mg Q.I.D.
4. Obesity			Resolved	

Figure 3. A Sample Card Used to Record the Active Problems, Subjective and Objective Information, Assessment, and Plan of Therapy for Patient Studied (Front).

recorded on the reverse side of the SOAP card. It contained the date, PDRP and evidence and references (Figure 4).

SOAP CARD

Pt. Doe, John

DATE
8/1/73

PDRP
Antacid used concurrently with
tetracycline

EVIDENCE
Hansen Page 133

Figure 4. A Sample Card of a Possible Drug-Related Problem, Date, and Evidence (Back).

RESULTS AND DISCUSSION OF DATA

A total of 243 possible drug-related problems was detected utilizing patient chart review, rounding with physicians, and monitoring patient drug profiles. Of 224 patients studied, 124 (62.5 percent) were found to have PDRP's. The PDRP's were subdivided into six categories: drug-drug interaction, drug-food interaction, drug-disease interaction, drug toxicity, drug allergy, and dosage regimen error. The number of PDRP's screened using the three different methods is shown in Table 1.

Table 1. Total Number and Percentage of Possible Drug-Related Problems Identified in the Population by the Three Methods Studied.

Category	Number of PDRP's Detected	Percentage
Drug-drug interaction	174	71.6
Drug-food interaction	1	0.4
Drug-disease interaction	23	9.5
Drug-toxicity	29	11.9
Drug allergy	7	2.9
Dosage regimen error	9	3.7
Combined	243	100.00

The most frequent PDRP detected was the drug-drug interaction which accounted for 71.6 percent of the PDRP's found. This may be because the reference texts were more oriented toward drug-drug interactions. The least frequent PDRP identified was drug-food interaction which only accounted for 0.4 percent of the PDRP's identified. This low percentage of PDRP's was due to the small amount of drug-food interactions that are documented in the literature.

Table 2 shows the 12 most common PDRP's discovered. Of the 243 PDRP's, 13 were found to be antacid-penicillin, 12 were digitalis toxicities, and 10 were antacid-iron. Appendix A lists all 243 PDRP's according to the methods studied. The most frequently involved drug was digitalis which made up 15.6 percent of all PDRP's detected. The next most frequently involved drug was an antacid which constituted 15.2 percent of all PDRP's identified. These two drugs made up nearly 31 percent of the PDRP's found.

It can be seen from Table 3 that 55.4 percent of the patients had one or more PDRP's, and that 20.1 percent had three or more PDRP's.

Table 4 indicates that over 77 percent of the PDRP's detected were found in female patients showing that in this study, females accounted for a greater percentage of PDRP's than did males. Of the 224 patients studied, 130 (58.0 percent) were female and 94 (42.0 percent) were male.

Table 5 shows the ten most common disease states of the patients studied. More females had heart disease than males and approximately twice as many females as males were affected by diabetes, arthritis, and

Table 2. The Frequency Distribution of the Twelve Most Common Possible Drug-Related Problems Identified in the Population by the Three Methods Studied.

PDRP's	Number
Antacid-Penicillin	13
Digitalis Toxicity	12
Antacid-Iron	10
Digitalis-Heparin	9
Antacid-Tetracycline	8
Corticosteroid-Thiazide	7
Coumarin-Heparin	5
Corticosteroid-Tetracycline	5
ASA-Corticosteroid	4
Penicillin Allergy	4
ASA-Heparin	4
Digitalis-Theophylline	4

Table 3. The Frequency and Percentage of Patients Having Possible Drug-Related Problems Identified by the Three Methods Studied.

Number of PDRP's	Number of Patients	Percentage
0	100	44.6
1	44	19.7
2	35	15.6
3	24	10.7
4	7	3.1
5	4	1.8
6	4	1.8
7	4	1.8
8	2	0.9
Combined:	224	100.0

Table 4. The Percentage of Males and Females with Possible Drug-Related Problems versus the Whole Population.

	PDRP's	Percentage
Males	55	22.6
Females	188	77.4
Total:	243	100.0

Table 5. The Ten Most Common Disease States of the Patients Studied and the Frequency (per 100) of Their Occurrence by Sex.

Disease State	Male (per 100)	Female (per 100)
Cardiovascular Disease	78.7	50.0
Kidney Disease	27.7	19.2
Liver Disease	24.5	14.6
Diabetes Mellitus	11.7	16.2
Anemia	14.9	10.0
Chronic Obstructive Pulmonary Disease	8.5	7.7
Pneumonia	9.6	6.2
Arthritis	6.4	7.7
Chronic Bronchitis	3.2	9.2
Tuberculosis	7.5	3.8

chronic bronchitis during the period of this study. The total number of disease states was 941 for the 224 patients studied for an average of 4.2 disease states per patient. The 130 females studied had 512 disease states for an average of 3.9 disease states, while the 94 males had 429 disease states for an average of 4.6 disease states.

The first method utilized to identify PDRP's was patient chart review. The investigator found 46 PDRP's of a possible 82 identified by the panel for 56.1 percent effectiveness (Table 6).

Table 6. The Percent Effectiveness of Investigator in Identifying Possible Drug-Related Problems in the Population by the Three Methods Studied.

Method Used	PDRP's Identified by Investigator	PDRP's Identified by Panel	Investigator Effectiveness
Chart Review	46	82	56.1%
Rounding with Physicians	21	58	36.2%
Patient Drug Profiles	70	103	68.0%

The investigator reviewed the charts of 89 patients. These 89 patient charts were reviewed a total of 472 times. Therefore, the investigator averaged 26.1 minutes per patient (Table 7) or 4.9 minutes per chart review (Table 8).

Table 7. The Average Time per Patient Spent by the Investigator in Identifying Possible Drug-Related Problems in the Population by the Three Methods Studied.

Method Used	Time (Minutes)	Number of Patients	Time per Patient
Chart Review	2320	89	26.1 minutes
Rounding with Physician	1709	56	30.5 minutes
Patient Drug Profiles	694	79	8.8 minutes

Table 8. The Average Time per Review Spent by the Investigator in Identifying Possible Drug-Related Problems in the Population by the Three Methods Studied.

Method Used	Time (Minutes)	Number of Reviews	Time per Review
Chart Review	2320	472	4.9 minutes
Rounding with Physician	1709	215	7.9 minutes
Patient Drug Profiles	694	536	1.3 minutes

The cost per PDRP identified by the investigator was \$5.38 utilizing \$6.40 as the average wage for a pharmacist at the hospital (Table 9). The exact method of calculating the cost per PDRP was calculated by dividing the PDRP's identified by the investigator into the time, to attain the minutes per PDRP. The minutes per PDRP for each method were divided by 60 to get hours per PDRP. The hours per PDRP were

Table 9. The Cost per Possible Drug-Related Problems Identified in Population by the Three Methods Studied.

Method Used	Time (Minutes)	PDRP Identified by Investigator	Cost per PDRP
Chart Review	2320	46	\$5.38
Rounding with Physician	1709	21	8.68
Patient Drug Profiles	694	70	1.06

were multiplied by \$6.40 which was the average pharmacist salary at Pima County General Hospital.

The statistic of interest would be to determine the significance of the difference in cost per PDRP for the three methods. However, because the sampling distribution of that statistic was unknown, a test of significance was not run.

Initially chart review appeared to be a very satisfactory method for detecting PDRP's. However, after rounding with physicians, the investigator discovered that the method of chart review had some deficiencies. First, the physician did not always include a reason in the chart notes for his prescribing habits. Second, there was an inadequate description of the patient's complaints and daily progress in the nurses' notes.

Using the rounding with physicians method, the investigator found 21 of a potential 58 PDRP's for a 36.2 percent effectiveness

(refer to Table 6). There were 215 reviews on 56 patients during this part of the study. The time involved was calculated to be 30.5 minutes per patient (Table 7) and 7.9 minutes per patient review (Table 8). Each PDRP identified by the investigator cost \$8.68 (Table 9). This represents the most expensive method used to identify PDRP's.

Although the cost per PDRP by rounding with physicians was the highest, this method was discovered to have several advantages. First, the rapport established with the members of the physician teams served as a strong motivating force. Second, rounding with the physician team was an educational experience and helped keep the investigator abreast of current trends in drug therapy. This increased the pharmacist effectiveness in monitoring drug therapy. Third, while doing chart review and patient drug profiles, PDRP's that had already occurred were detected. For the purposes of this study, the investigator while rounding with physicians did not affect drug prescribing habits. However, by rounding with physicians, the pharmacist has the chance to prevent PDRP's before they occur by discussing the drug therapy with the physician when the order was being written. As a result, this method would permit the pharmacist the most opportunity to affect physician drug prescribing habits. This team effort in prescribing drug therapy regimens maximizes the effectiveness of patient chemotherapy.

The patient profile system of detecting PDRP's was the most economical and productive method of those studied. Of the potential 103 PDRP's found by the expert panel, the investigator found 70 for 68.0 percent effectiveness (Table 6). The investigator took 8.8 minutes per

patient (Table 7) and 1.3 minutes per patient drug profile review (Table 8). The cost per PDRP identified by the investigator was \$1.06 (Table 9). This was the best screening method of the three used in the study for detecting PDRP's. The method of reviewing patient drug profiles had the drawbacks of having only a limited amount of information available on the patient profile and an absence of contact with the patient and physician. The pharmacist often must seek additional information about a PDRP before it can be confirmed, which increases the actual time involved. An example of this would be a PDRP which involved an order for antacid to be given "prn." The actual frequency of administration of the antacid would have to be checked before a PDRP could be determined to exist. Monitoring patient drug profiles was a tedious procedure and lacked the motivating force that the rounding with physicians method of identifying PDRP's had. Therefore, the patient drug profile method requires close supervision to keep it updated and productive.

The least productive and most expensive method of identifying PDRP's was found to be rounding with physicians. However, rounding with physicians placed the pharmacist in contact with both the physician and the patient. This would allow two additional channels of information to be established and utilized by the pharmacist which the previous two methods would not. It was discovered by the investigator that some PDRP's were not listed using the rounding with physicians method due to the additional information available to the pharmacist. For example, a drug dosage schedule may be altered from the dosage schedule

recommendations of the manufacturer for a patient who is either sensitive or resistant to the effects of a particular drug, i.e., pain medication, and therefore would not be recorded as a PDRP. This would decrease the number of PDRP's listed by the investigator and make him seem less effective using this method.

For the pharmacist who is considering the implementation of a method for screening for PDRP's, the findings of this research would indicate the utilization of the patient drug profile system. However, the pharmacist should be aware of the many disadvantages of the system previously mentioned. Although rounding with physicians was found to be more expensive, the pharmacist would have a greater opportunity to affect patient care. It is important that the pharmacist become an integral part of the patient care team. This cannot be done in the pharmacy simply by reviewing patient drug profiles.

Other investigators have shown that 18 to 30 percent of hospitalized patients have a drug reaction (Schimmel 1964, Hoddinott et al. 1967) and that the duration of hospitalization of these patients has increased as a consequence (Schimmel 1964, Seidl et al. 1966, Ogilvie and Ruedy 1967). During the period of this study, the average patient day stay on the medical wards at Pima County General Hospital was 10.2 days and the average cost per patient day was \$101 (Nagy 1974). If the patients in this study which had PDRP's exhibited clinically significant adverse affects and their hospital stay was extended by only two days, it would have been 12.2 patient days or \$202 expense per patient due to adverse drug reactions. This added expense due to adverse drug reactions

can be compared to the cost of identifying a PDRP by the methods used in this study by examining Table 9. This study shows the pharmacist is able to detect PDRP's at a reasonable cost and, therefore, can provide needed services as well as a product in our health care system.

SUMMARY AND RECOMMENDATIONS

Summary

This research was primarily concerned with determining the cost effectiveness of an investigator using three different commonly used methods of identifying PDRP's: rounding with physicians, patient chart review, and monitoring patient drug profiles. The results indicate that monitoring patient drug profiles was the most productive and least expensive method of identifying PDRP's within the boundaries set up for this study.

While the monitoring of patient drug profiles proved to be the best method of identifying PDRP's, the PDRP's discovered using this method require additional clarification, and therefore, additional time to be confirmed. This was because this system lacked both physician and patient contact and placed the pharmacist out of the mainstream of actual patient care. In this study the patient drug profile system evaluation did not include the time necessary for preparing or updating the profiles. This method is productive for screening for PDRP's, but it does not place the pharmacist in a position where he is aware of the total patient therapy.

Patient chart review was found to be the second most productive method of identifying PDRP's and the second least expensive. This method of identifying PDRP's gave the pharmacist much more information

concerning the total patient care, but lacked the actual patient contact and the communication between the pharmacist and other members of the health care team. Also, the charts were not always completely descriptive of the patient's condition and therapy regimen.

Recommendations

One reason the patient drug profile proved to be a productive screening method for identifying PDRP's was that the patient profile contained the patient's medical problems as well as drugs. It is therefore recommended that when the patient drug profile method of identifying PDRP's is used, it should include a daily updated active problem list.

Although reviewing patient drug profiles was the least expensive and most productive method of detecting possible drug-related problems, it is recommended that research should be done to determine the clinical significance of the identified PDRP's. It is further recommended that a study to determine cost effectiveness of identifying clinically significant PDRP's be conducted.

APPENDIX A

TOTAL NUMBER OF POSSIBLE DRUG-RELATED PROBLEMS IDENTIFIED

Chart Review

<u>PDRP's</u>	<u>Number</u>
1. Allopurinol-Iron	2
2. Aminophylline-Digitalis	1
3. Aminophylline induced hypertension	1
4. Ampicillin-Mandelamine used together in U.T.I. (Urinary Tract Infection)	1
5. Antacid-Iron	3
6. Antacid-Penicillin	1
7. Antacid-Tetracycline	2
8. Aspirin-Corticosteroid	2
9. Aspirin-Penicillin	1
10. Atropine-Propanolol	1
11. Barbiturate-Digitalis	1
12. Barbiturate-Dilantin	1
13. Benadryl dosage regimen error	1
14. Benadryl-Heparin	1
15. Benadryl-Thorazine	2
16. Cholestyramine dosage regimen error	1
17. Compazine-Dilantin	1
18. Corticosteroid-Insulin	1
19. Corticosteroid-Thiazide	3
20. Corticosteroid Toxicity	1
21. Darvon-Dilantin-Phenergan potentiation of C.N.S. (Central Nervous System) depression	1
22. Diazepam Allergy	1
23. Diazepam used in patient malaise	1
24. Diazepam-Doxipen	1
25. Diazepam drug dosage regimen error	1
26. Diazepam-Propanolol	1
27. Diazepam-Quinidine	1
28. Diazepam-Thiothixene	1
29. Diazepam-Talwin	1
30. Digitalis-Heparin	2
31. Digitalis-Propranolol	2
32. Digitalis-Ritalin	1

<u>PDRP's</u>	<u>Number</u>
33. Digitalis Toxicity	6
34. Dilantin Toxicity	1
35. Doxipen-Methyldopa	1
36. Doxipen-Thiazide	1
37. Dymelor-Furosemide	1
38. Garamycin dosage regimen error	1
39. Heparin dosage regimen error	1
40. Heparin-Tetracycline	1
41. Heparin-Thorazine	1
42. Insulin dosage regimen error	1
43. Insulin-Propranolol	2
44. Insulin-Thiazide	2
45. Isoniazid Toxicity	1
46. Levodopa Toxicity	1
47. Lidocaine-Pronestyl	1
48. Methyldopa-Procaïnamide	1
49. Methyldopa-Propranolol	1
50. Methyldopa-Quinidine	1
51. Methyldopa-Thiazide	2
52. Nitrofurantoin Toxicity	1
53. Normal Saline overhydration	1
54. Penicillin Allergy	2
55. Peritrate inappropriately used in cardiac dysarrhythmia disease	1
56. Phenothiazine-Quinidine	1
57. Potassium Chloride dosage regimen error	1
58. Reserpine-Thiazide	1
59. Sulfonamide-Tolbutamide	1
60. Tetracycline dosage regimen error	2
61. Thorazine dosage regimen error	2
Total:	<u>82</u>

Rounding with Physicians

<u>PDRP's</u>	<u>Number</u>
1. Acetaminophen used in F.U.O. (Fever of Unknown Origin)	1
2. Actifed used in diabetic patient	1
3. Amesec-Theophylline both used in C.O.P.D. (Chronic Obstructive Pulmonary Disease)	1
4. Antacid-Coumadin	1
5. Antacid-Iron	2
6. Antacid-Penicillin	3
7. Antacid-Tetracycline	3
8. Aspirin used in upper G.I. (Gastrointestinal) ulcer disease	1
9. Aspirin-Heparin	1

<u>PDRP's</u>	<u>Number</u>
10. Bronkosol-Theophylline potentiation of cardiac irritability	1
11. Clindamycin used for nonsusceptible pathogen	1
12. Clindamycin Toxicity	1
13. Corticosteroid-Insulin	1
14. Corticosteroid-Tetracycline	2
15. Corticosteroid-Thiazide	1
16. Coumadin-Digitalis	1
17. Coumadin-Heparin	2
18. Coumadin-M.O.M. (Milk Of Magnesia)	2
19. Dextromethorphan-Expectorant	1
20. Digitalis-Theophylline used in ischemic heart disease	1
21. Digitalis-Heparin	4
22. Digitalis Toxicity	4
23. Esidrix dosage regimen error	1
24. Furosemide Allergy	1
25. Furosemide used in diabetic patient	1
26. Furosemide used in Hyponatremia	1
27. Furosemide used in Hyperuricemia	1
28. Furosemide-Tolbutamide	1
29. Heparin dosage regimen error	1
30. Isoniazid-Meperidine	1
31. Keflin-Garamycin used together U.T.I.	1
32. Macrodantin Toxicity	1
33. Methyldopa-Quinidine	1
34. Methyldopa-Tofranil	1
35. Penicillin Allergy	1
36. Penicillin-Macrodantin used concurrently in U.T.I.	1
37. Petazocine Toxicity	1
38. Phenobarbital-Dilantin	1
39. Probanthine-Urecholine used in urinary retention	1
40. Quinidine without Digitalis used for conversion of atrial flutter	1
41. Quinidine-Thiazide	1
42. Tetracycline given with food	1
43. Tetracycline Toxicity	1
44. Thiazide Toxicity	1
Total:	<u>58</u>

Patient Drug Profiles

<u>PDRP's</u>	<u>Number</u>
1. Acetaminophen-Coumadin	1
2. Acetic Acid dosage regimen error	1
3. Actifed used in diabetes	1

PDRP'sNumber

4. Aminophylline-Digitalis potentiated ventricular irritability	1
5. Antacid-Coumadin	1
6. Antacid-Dulcolax	1
7. Antacid-Iron	6
8. Antacid-Penicillin	9
9. Antacid-Tetracycline	5
10. Aspirin used in peptic ulcer disease	1
11. Aspirin-Benemid	1
12. Aspirin-Heparin	3
13. Atropine-Propranolol	1
14. Atropine-Quinidine	1
15. Barbiturates-Corticosteroid	1
16. Bronksol-Theophylline	1
17. Chloramphenicol-Cyanacobalamine	1
18. Chloramphenicol-Penicillin	1
19. Cleocin used for inappropriate pathogen	1
20. Corticosteroid-Furosemide	1
21. Corticosteroid-Insulin	2
22. Corticosteroid-Tetracycline	4
23. Corticosteroid Toxicity	3
24. Coumadin-Diazepam	1
25. Coumadin-Digitalis	1
26. Coumadin-Heparin	3
27. Coumadin-M.O.M.	4
28. Coumadin-Penicillin	1
29. Coumadin-Theophylline	1
30. Dextromethorphan-Expectorant used for cough	1
31. Digitalis-Theophylline induced cardiac irritability	3
32. Digitalis-Dilantin	1
33. Digitalis-Heparin	7
34. Digitalis Toxicity	3
35. Dilantin-Librium	2
36. Furosemide used in diabetes	2
37. Furosemide used in Hyponatremia	2
38. Furosemide Allergy	1
39. Heparin-Quinidine	1
40. Heparin-Robitussin	1
41. Heparin-Tetracycline	1
42. Indomethacin Toxicity	1
43. Insulin-Potassium Chloride	1
44. Iron Toxicity	1
45. Isoniazid-Meperidine	2
46. Keflin-Ampicillin used concurrently in U.R.I. (Upper Respiratory Infection)	1
47. Macrochantin-Mandelamine used concurrently in U.T.I.	1
48. Macrochantin-Penicillin used concurrently in U.T.I.	1
49. Macrochantin Toxicity	1

<u>PDRP's</u>	<u>Number</u>
50. Methyldopa-Quinidine	1
51. Morphine-Codeine-Dilantin-Robaxin potentiated C.N.S. depression	1
52. Mucomyst used in asthmatic patient	2
53. Penicillin Allergy	1
54. Quinidine used without Digitalis for conversion of atrial flutter	1
55. Quinidine-Thiazide	2
56. Tetracycline Toxicity	1
57. Theophylline Toxicity	1
Total:	<u>103</u>

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