Running Head: PHARMACY WAIT TIME AND PRESCRIPTION ERRORS

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Pharmacy Wait Time and Prescription Errors at the Dwight D.

Eisenhower Army Medical Center Outpatient Pharmacy: A Study of

Manpower and Customer Service Initiatives

A Graduate Management Project Submitted to the Residency

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By

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Abstract

A retrospective study was undertaken at the Eisenhower Army Medical Center to investigate the probable cause and possible solutions to increased waiting room time for patients and prescription errors. The study examined data from a 22-month period (January 2002 through October 2003). Two multiple variant regression analyses were performed using average monthly pharmacy waiting room time and average monthly prescription errors as dependent variables and categories of personnel as independent variables.

The results of both regression analyses presented strong evidence that the decrease in pharmacy staff over the 22-month period contributed to both the increase in waiting room time for patients and the increase in prescription errors. The correlations between the dependent and independent variables in the regression analyses were statistically significant.

Finally, the paper compared and contrasted the bank teller concept, which is the current business practice used in the Eisenhower Pharmacy, and other concepts. The use of automation and a system that would mandate call-in prescription refills were the primary recommendations that resulted from the comparisons. These two methods will most likely allow the pharmacy to maintain acceptable wait time and produce acceptable levels of prescription errors despite fluctuations in personnel.

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Introduction

The wait time for refills at Dwight D. Eisenhower Army Medical Center's outpatient pharmacy waiting area has exceeded 90 minutes for some categories of patients. Overall, the wait time that patients have experienced over the past 22 months has increased noticeably and has added to patient dissatisfaction with the service.

During this same period the number of prescription errors reported by outpatient pharmacy personnel more than doubled. Prescription errors are a good measure of the quality of the pharmaceutical service at Eisenhower. The rise in errors further highlights a need for this study.

According to the pharmacy leadership, staffing was in a state of flux during the study period due to personnel shortages in authorized positions, and the inability of members of the permanent pharmacy staff to work fulltime or effectively. In the recent past, the hospital may have simply hired more pharmacy staff on the recommendation of the leadership in the pharmacy thus restoring previous staffing levels. The shortage of staff in the outpatient pharmacy was more acute due to the pharmacy's reliance on the bank teller concept to perform pharmacy functions. The bank teller concept relies on both pharmacists and technicians to work together as a team in order to deliver service to the customer (D.G. Goode, personal communication,

October 22, 2003). Any staff fluctuations have the potential to affect pharmacy operations In a positive way if the right staffing mix is achieved or negatively if not achieved.

However, there now exists a situation within the hospital of fiscal uncertainty. Simply adding staff to solve a problem is no longer fiscally possible. In addition, there was the realization that the next generation of TRICARE contracts mandates that medical treatment facilities work more efficiently. Under the next generation of TRICARE contracts, military hospitals will be more responsible, in large part, for the efficient use of funds. There will be the possibility under the new system for the hospital to lose operating cash if business decisions are not made wisely. Since the largest line of any hospital budget is personnel, any expenditure on personnel must be explored fully.

Eligible beneficiaries of the Department of Defense (DoD) Military Health System (MHS) have a number of sources from which to obtain prescription medications in the Augusta, Georgia and Fort Gordon communities. Those in need of prescription medications may receive them from any retail pharmaceutical outlet that is a member of the TRICARE network. TRICARE contains provisions for contracting with civilian pharmacies to offer prescription drugs to MHS beneficiaries at a discounted cost. Beneficiaries may also use a mail order pharmacy system that is

also a feature of TRICARE. Should patients desire to receive their prescription medications from a military treatment facility (MTF), Dwight D. Eisenhower Army Medical Center offers two options. One is the outpatient pharmacy located in the main hospital and the other is a satellite pharmacy located at the Fort Gordon Army and Air Force Exchange Service (AFFES) Mall. The focus of this study will be the outpatient pharmacy located within Dwight D. Eisenhower Army Medical Center.

The pharmacy is located in the main lobby of the hospital. Adjacent to the pharmacy is a Starbucks coffee stand. The position of the Starbucks along with the pharmacy waiting area gives the area the appearance of a social gathering. Anecdotally, some individuals have speculated that Starbucks is at the root of the pharmacy waiting area problem.

Statement of the Problem.

The pharmacy waiting room situation led to three questions upon which this research was based. First, is the number of staff available to work in the Eisenhower main pharmacy correlated to the overall rise in the wait time for prescriptions in the outpatient pharmacy? Second, has the availability of staff led to poor quality in the pharmacy as evidenced by a rise in reported prescription errors? Finally, does the use of automation and customer service strategies such as the pharmacy without walls concept, mandated call-in

prescription refills, and a pharmacy dedicated exclusively to the refilling of existing prescriptions decrease wait times in outpatient pharmacy waiting rooms?

Purpose.

The purpose of this paper is to explore reasons for the increase in wait time, and examine quality in the Eisenhower Army Medical Center Outpatient Pharmacy using prescription errors over time as a vehicle. Both variables will be analyzed in relation to fluctuations in outpatient pharmacy staffing over a 22-month period to see if there is a correlation. Also, the study will address possible solutions to the long waiting room time and the rise in reported prescription errors through the identification of best business practices related to the problem.

Hypotheses.

1. As the number of staff decreases, the wait time in the Eisenhower Outpatient Pharmacy waiting room will increase.

2. As the number of staff decreases, the reported prescription errors will increase.

Independent Variables.

The following were the independent variables used in the study:

1. Civilian Direct Care Provider FTE Available

2. Civilian Direct Care Para-Professional FTE

Available

3. Contract Direct Care Provider FTE Available

4. Enlisted Direct Care Para-Professional FTE

Available

5. Officer Direct Care Provider Available

Dependent Variables.

The following were the independent variables used in the

study:

1. Average Wait Time

2. Number of Reported Prescription Errors

Definitions.

Civilian Direct Care Provider- a pharmacist who is employed as

an employee of the federal government as a General Schedule

employee.

Civilian Direct Care Para-Professional- a pharmacy technician

who is employed by the federal government as a General Schedule

employee.

Contract Direct Care Provider- a pharmacist who is employed as a

government employee, although not a General Schedule employee or

active duty service member.

Enlisted Direct Care Para-Professional- an active duty Army

service member whose specialty is that of a pharmacy technician.

Officer Direct Care Provider- an active duty Army servicemember whose specialty is that of a pharmacist.

Average Wait Time- the average amount of time that patients spend in the outpatient pharmacy waiting room from the time they present to the pharmacy until they are called to receive their completed prescriptions.

Number of Reported Prescription Errors- the number of prescription errors reported in a single month by the outpatient pharmacy.

Literature Review

Automation.

Over the past several years the focus on automation in pharmaceutical functions in the hospital setting has increased due to increased scrutiny on medication errors and productivity, (Kimble & Chandra, 2001). Additionally, staff shortages in hospital pharmacies have resulted in the need for health system administrators to seek new solutions when dealing with problems associated with overworked pharmacy staff members (Kimble & Chandra, 2001). In October of 2003, the pharmacies within the Lackland Air Force Base Health System cited safety as the chief reason for implementing a system that used bar-coding and digital imagery to verify that the correct prescription was administered to the patient in the outpatient pharmacy setting (Campbell, 2003). According to the article written by Sue

Campbell, it was expected that the system would result in a ten-fold drop in the medication error rate.

Retail drug stores are increasingly turning to technology to automate the workflow and take the guesswork out of many tasks related to filling prescriptions in the pharmacy (Fredrick, 1998). In Georgia, state boards are looking hard at the volume of prescriptions reviewed by pharmacists per day. With an eye on safety, particularly at community pharmacies, these governing bodies see automation as a step in the right direction (Fredrick, 1998).

Several innovations associated with pharmacy automation have come to light. Chief among these innovations is the use of robotics to accomplish tasks that once required the time and effort of pharmacists and technicians (Fredrick, 1998). In addition to the ability to fill multiple prescriptions for multiple customers simultaneously, some robots actually put the cap on the bottle and presented the filled prescription to the pharmacist for review (Fredrick, 1998). Other innovations include the ability of systems to prompt the pharmacist when the use of generic or therapeutic substitution may be indicated, smoother physician interface, and faster more consistent third party insurance claims processing.

Pharmacy automation makes the job of those working in the pharmacy more efficient. With tasks such as the one mentioned

above accomplished by machines, more of the pharmacy staff's time can be devoted to producing a higher volume of products that are valuable to customers such as counseling and more accurate prescriptions.

In the rural setting, the use of automation has become invaluable in allowing pharmacists to provide services over large geographical areas. The distance issues associated with rural settings imposed challenges in staffing and, of course, effective pharmaceutical operations. One such example was Holzer Medical Centers (HMC) in Ohio (Kimble & Chandra, 2001). Among other entities, HMC operates a flagship hospital Holzer Medical Center, a 246-bed not-for profit hospital, and a 35-bed community hospital some 30 miles away called Holzer Medical Center-Jackson (Kimble & Chandra, 2001). The study was conducted to see how an automated medication management system improved several facets of pharmacy operations including safety and medication turnaround time, missing doses, and nurse time spent with pharmaceutical issues (Kimble & Chandra, 2001). Due to the current pharmacist shortage (Knapp & Livesey, 2002), it was crucial to have a pharmacy staff that was able to move freely within the medical system without having to deal with a myriad of small problems associated with a non-automated pharmacy service.

According to Kimble and Chandra, the key to pharmaceutical productivity at the Holzer Medical Centers was a "cartless" pharmaceutical system. Such a system used unit-based cabinets with profiling of medication orders so that units habitually received what they used most. The traditional pharmacy delivery system uses a cart with pill cassettes that are interchangeable. Each cassette usually holds a 24-hour supply of medications. When Holzer used the traditional system, six hours of pharmacist and technician time was required to accomplish the daily task of filling the carts (Kimble & Chandra, 2001). The automated cartless system eliminated this and eased the problem of missing doses by directly assigning medication to patients.

As a result of the efforts at Holzer Medical Centers, nurses found that the turnaround time for medications drastically improved (Kimble & Chandra, 2001). Medication became available almost instantly allowing nurses more time to focus on tasks directly related to bed-side patient care.

Similar results were observed when a study of the efficacy of an automated medication distribution system was undertaken at Mercy Hospital in Pennsylvania (Shirley, 1999). The 270-bed tertiary care facility with 11 nursing units set out to compare the percentage of medications administered on time before and after the automated system was introduced (Shirley, 1999). The study centered on the use of a system called the Medstation RX

1000. The Medstation RX 1000 was a computer controlled dispensing unit that stored and dispensed medication directly on the ward (Shirley, 1999). The unit also handled some administrative tasks associated with pharmacy such as refill levels required for each ward. After implementation of the system, Mercy noticed that medications were 2.3 times more likely to be given on time (Shirley, 1999).

Staffing.

There is a well-documented shortage of pharmacists that exists in the United States. In 1999 the Aggregate Demand Index (ADI) was implemented in an attempt to measure what the demand for pharmacists really was (Knapp & Livesey, 2002). The ADI, which had run for three years when Knapp and Livesey published their article on the topic, was really a survey that was sent to professionals in the pharmaceutical industry who were charged with hiring and addressing other human resource issues involving pharmaceutical professionals (Knapp & Livesey, 2002). The trend showed that there was a widespread, persistently unmet demand for pharmacists from 1999 through 2001 (Knapp & Livesey, 2002).

According to Knapp and Livesey, the report was further supported by the fact that dramatic increases in pharmacists' salaries were also reported within the same period. The report also contained information that suggested that at one point, 97% of the United State's population lived in a region in which

there was a demand for pharmacists, and that the level of shortage may have affected patients access to medications and information needed for health (Knapp & Livesey, 2002).

Maine,(2002) also proclaimed a pharmacist shortage in the May/June issue of the *Journal of the American Pharmaceutical Association.* In her article she said that the media focused on the for-profit pharmacy corporations that have the ability to lure pharmacists through higher pay and incentive packages. This, she said, puts not-for-profit hospitals at a disadvantage not just because of the lower salaries they offer, but also because hospitals are dealing with shortages in other areas such as nursing. However, these same institutions have the ability to offer prospective employees a diverse working environment that challenges their clinical abilities (Maine, 2002). She went on to say that services such as diabetes care programs and immunization programs are the future of the pharmacy profession.

It may not just be the physical number of graduates from schools of pharmacy that has driven an aggregate shortage of pharmacy professionals, but also the expanded demand of pharmacists to perform these diverse functions (Maine, 2002). These new patient centered functions of pharmacy professionals have become the focus of candidates at schools of pharmacy who graduate with the intention of working in a more clinical setting. Maine wrote in 2002 that most pharmacists surveyed

report that their ability to perform these other diverse functions were severely hampered by their prescription filling duties. The public's awareness of the pharmacists' new roll has grown, however the ability of the pharmacist to respond through increase and diverse pharmaceutical services has not grown at the same rate (Maine, 2002).

Finally, with regard to the shortage of pharmacy personnel, it is believed that the growth in medication use may be another factor that has contributed to the pharmacist shortage (Cooksey, Knapp, Walton & Cultice, 2002). This further exacerbates the problems associated with the changing role of the pharmacist in that there are simply more prescriptions to deal with in the midst of pharmacists' yearning to broaden their scope of practice.

Customer Service Initiatives.

The "pharmacy without walls" concept was developed at a Veterans Administration (VA) hospital in Ohio to better serve patients in the ambulatory care environment (Pierce, Rogers, Sharp, & Muslin, 1990). Pharmacists were placed in cubicles in front of the pharmacy windows, which allowed them to interact with patients one on one. Before the patient approached the prescription window, the pharmacists completed a series of activities such as patient counseling and education, and a review of the prescription for appropriateness (Pierce, Rogers,

Sharp, & Muslin, 1990). Before the pharmacy without walls, flawed prescriptions were still reviewed, but often the patient was not aware of any problem because they had simply dropped-off their prescription to be filled. The result was dissatisfied patients who returned only to find that they had to wait after being informed of a problem (Pierce, Rogers, Sharp, & Muslin, 1990). Involving the pharmacists early in the process alleviated these problems.

Williams, Shepherd, and Jowdy (1983) published a paper that compared the workload of an outpatient pharmacy before and after the implementation of a call-in prescription refill system. The study involved the outpatient pharmacy at Eisenhower Army Medical Center in Georgia (Williams, Shepherd, & Jowdy, 1983). The problem centered on the fact that for years, pharmaceutical managers searched for ways to increase the amount of output in the pharmacy associated with large numbers of patients in the pharmacy waiting rooms. It was thought that a system that could consolidate and control the flow of work associated with refill requests would help achieve this goal (Williams, Shepherd, & Jowdy, 1983). According to the authors, such a system would do two things for the outpatient pharmacy. First, patient wait time could be reduced and second, prescription volume could be planned and staffing programmed accordingly (Williams, Shepherd, & Jowdy, 1983).

The DataStat Pharmacy System was implemented in 1980. Through the use of the prescription number, the computer screened the patient's record for drug interactions and duplications, printed a label, reduced the authorized number of refills by one, and the patient's profile was updated (Williams, Shepherd, & Jowdy, 1983). A telephone-answering device was used to facilitate the call-in feature. This allowed patients to place refill requests 24-hours a day. Patients were asked to leave information concerning their prescription and a staff member checked the recorded messages periodically. As a point of policy, patients were asked to allow 24-hours before their prescriptions were ready. This workload was then consolidated and performed during non-peak hours and had the effect of leveling out hourly workload for the pharmacy service (Williams, Shepherd, & Jowdy, 1983).

As a result of the implementation of the call-in prescription refill system, overall prescription volume actually increased. However, the hospital was able to reduce the patient wait time for prescriptions in the wait room in the main hospital outpatient pharmacy and decrease the number of technicians required to run the pharmacy due to shifting the refill workload to off-peak hours. However, despite marketing efforts, only 35% of all refills were called in and worked through the newly implemented system (Williams, Shepherd, &

Jowdy, 1983). The researchers believed that further gains could have been made had a larger percentage of patients used the system.

Other organizations have used staff in different ways to improve workflow associated with prescription refills. One military organization utilized poorly used space and shifted staff to create a prescription refill pharmacy that was open 24 hours a day, seven days a week (Military Health System, 1998). As a result, beneficiaries received better, faster service, and the hospital increased parking availability during the normal workday.

The outpatient pharmacy at Eisenhower Army Medical Center uses the bank teller concept in its daily operations. Other medical treatment facilities also use this concept. The bank teller concept of pharmaceutical operations involves the use of a group of technicians working with a single pharmacist to form a single pharmacy team (Whittington, 1997). Each pharmacy team staffs a single pharmacy window. Thus, a pharmacy may have many windows with a pharmacy team staffing each.

This concept was specifically designed to allow the pharmacist to counsel the patient on the medication that was dispensed and to answer any questions that the patient may have had regarding medications while the technicians filled the requested prescriptions (Whittington, 1997). Another added value

that pharmacies were expected to realize from the use of the bank teller concept was that of reduced waiting times for prescriptions. What pharmacies were expected to avoid was filling prescriptions ahead of time for patients that may never arrive to pick up the prescriptions. In this manner time and manpower was expected to be used more efficiently. Furthermore, central to the design of the bank teller concept was the use of a queuing machine that let patients know when it was their turn at the pharmacy window (Whittington, 1997).

Subsequent to the use of the bank teller pharmacy concept, some substantial improvements were observed (Military Health System, 1998). One military medical treatment facility reported a 60 percent decrease in the waiting time for patients in its outpatient pharmacy waiting room. Subsequently, the outpatient pharmacy reduced the overall number of visits of patients to the pharmacy and quality of care in the pharmacy. Workflow in the pharmacy was also improved (Military Health System, 1998). The pharmacy was able to reduce the filled prescription storage requirement, and reduce the number of returned prescriptions by 100 percent.

Prescription Errors.

In 1999, the Institute of Medicine (IOM) released a report that pointed to research indicating that at least 44,000, and perhaps, as many as 98,000 people die each year due to avoidable

medical errors in American hospitals (Kohn, Corrigan & Donaldson, 1999). In the report, medical errors were defined as the failure of a medical plan to be completed, or the use of a medical plan that was not indicated for the clinical situation.

The IOM report classified errors into four types. The first type was diagnostic errors in which a delay in diagnosis, failure to employ indicated tests or use of outmoded therapy may occur. Second was preventive errors. Here there was the possibility that the medical system did not provide the proper prophylactic care or failed to monitor or follow-up on a course of treatment. Next there were errors associated with equipment and communication. Finally the report identified treatment errors as a major subcategory. Treatment errors are those in which actual hands-on patient care results in a failure to do what is right for the patient. Included in treatment errors are errors in the choice of drugs or the erroneous administration of drug therapies. This type of error was most germane to this study.

The results of an Australian survey of over 209 registered pharmacists showed that most agreed that dispensing errors were increasing. The reason cited for this increase were high prescription volumes, pharmacist fatigue, pharmacist overwork, interruptions to dispensing, and similar drug names or confusion over drug names (Peterson, Wu, & Bergin, 1999). The pharmacists

went onto say that the most important elements in mitigating prescription errors were having mechanisms in place for checking dispensing procedures, having a systematic dispensing workflow, checking the original prescription when dispensing repeats, improving the packaging and labeling of drug products, having drug names that are distinctive, counseling patients at the time of supply, keeping one's knowledge of drugs up-to-date, avoiding interruptions, reducing workloads on pharmacists, improving doctors' handwriting, and privacy when counseling patients (Peterson, Wu, & Bergin, 1999).

Further corroboration of the problem of prescription volume contributing to errors came from a 1983 audit that was published in *Drug Intelligence and Clinical Pharmacy* as well as a 2001 article published in *Pharmacotherapy* (Bond & Raehl, 2001). Both articles pointed out a linear relationship between the number of errors and the total number of prescriptions filled. The articles alluded to the fact that the higher the prescription volume, the higher the error rate (Guernsey et al. 1983). As a suggestion, the authors recommended that pharmacies with a high volume of prescriptions limit the number of prescriptions that their pharmacist should handle on a day-to-day basis (Guernsey et al. 1983).

The subject of pharmacist daily workload was addressed in a March 1997 statement by the North Carolina Board of Pharmacy. In

the statement, which resulted from a discussion of the board's prescription error policy, the board said that it would investigate prescription errors at various locations and issue sanctions to both pharmacists and locations where more that 150 prescriptions per day were filled by an individual pharmacist (North Carolina Board of Pharmacy, 1997). The board based its 150 prescription per day ruling on an earlier review by a panel of experts that said that a range of not more than 10 to 20 prescriptions per hour would be acceptable.

A 1993 study explored the link between distractions in the workplace and prescription errors. To accomplish the study, investigators videotaped pharmacists and technicians as they filled prescriptions over a 23-day period. Data on the number of errors that occurred throughout the trial was gathered through direct comparison of filled prescriptions to written physician orders. The videotape was used to verify interruptions and distractions that may have occurred during the trial (Flynn et al. 1999). The results of the 23-day trial identified 164 errors out of the 5072 prescriptions analyzed, an error rate of 3.23%. Investigators also determined that there was a significant correlation between distraction and the number of errors that occurred. There were a total of 2022 interruptions and 2457 distractions that were detected during the study period. The error rate for prescriptions for which an interruption occurred

during their preparation was 6.65% and 6.55% for distractions
(Flynn et al. 1999).

Methods and Procedures

Staffing to Wait Time Analysis.

Monthly staffing data from the Medical Expense Reporting
and Personnel System (MEPRS) and average wait time data in
minutes from the Eisenhower pharmacy's Q-Matic system for a 22-
month period beginning January 2002 and ending in October 2003
comprised the sample for this analysis. Overall, an increase in
the outpatient pharmacy wait time was observed during the 22-
month period.

The wait time data from the Q-Matic system were divided
into several categories. The categories were Acute III for
acutely ill patients, active duty patients, patients who have
had prescriptions submitted to the pharmacy through the
Composite Healthcare System (CHCS), and several smaller
categories with very low volumes of patients. The categorization
of patients within the Q-Matic system was used to determine the
priority of patients with regard to when prescriptions were
filled. As a result the average wait time for categories of
patients such as Acute III were markedly shorter than for other
categories. The difference in wait time was significant. Acute
III wait time ranged from a low of just over two minutes to a

high of seven minutes. In contrast, other categories had recorded wait times of up to 80 minutes.

The MEPRS system divided the personnel working in the outpatient pharmacy into several categories that were related to the types of professionals working there during each month of the study. In calculating full time equivalents (FTE) for personnel working in the outpatient pharmacy, it became apparent that an adjustment was required. When the MEPRS system compiled the number of FTE's for the pharmacy service it did not discern the personnel working in the outpatient pharmacy from personnel working for the Eisenhower pharmacy service in other areas of the hospital. As a result, an estimate of the number of FTE's working in other areas of the hospital was devised and that estimate was subtracted from the total FTE's contained in MEPRS for the pharmacy service. Table 1 depicts the results of this adjustment by personnel category along with average wait time. Generally, the staffing level in the outpatient pharmacy decreased during the 22-month period of the study.

Using the Statistical Package for the Social Sciences (SPSS) as an assessment tool, a multivariate reduced regression model was accomplished to control for extraneous variables. Using the average waiting time across all prescription categories contained in the Eisenhower pharmacy's Q-Matic system as the dependent variable, a full model was constructed using

the number of available civilian direct care providers, civilian direct care para-professionals, contracted direct care providers, enlisted direct care para-professionals, and officer direct care providers as the independent variables. Next, each variable was subsequently removed and a new regression was run to test the effect of the variable's absence on the variance (R^2). Furthermore, statistical significance for independent variables was gleaned from the student's t and Fisher's F.

Staffing to Prescription Error Analysis.

The number of prescription errors reported monthly at the Eisenhower Army Medical Center Outpatient Pharmacy for a 22-month period beginning in January 2002 and ending in October 2003 was used to conduct the study. The prescription error information was contained in the MEDMARX system that is used by Department of Defense (DoD) hospitals to self-report and track prescription errors. Although the MEDMARX system contained prescription errors from all sections of the hospital, only prescription errors associated with the outpatient pharmacy at Eisenhower were used for the study. To test the correlations between staffing fluctuations and reported prescription errors, a statistical analysis was performed using the same methodology as described above with the staffing to wait time analysis.

Table 1

Wait Time and Staffing Data

Fiscal Year	Month	Avg Wait (Minutes)	Adjusted CIV DCP	Adjusted CIV DCPP	Adjusted Contr DCP	Enl DCPP	Ofcr DCP Avail FTE
2002	1	24	8.69	9.62	0.24	22.68	3.52
2002	2	22	7.19	7.06	0.62	22.14	4.13
2002	3	23	7.82	7.72	1.58	25.34	4.76
2002	4	17	8.44	9.05	0.92	25.81	5.19
2002	5	23	4.25	4.99	0.38	20.87	5.00
2002	6	18	4.58	6.44	1.38	23.94	4.43
2002	7	22	1.57	4.60	2.15	25.54	3.95
2002	8	22	2.13	7.10	1.76	24.41	4.29
2002	9	29	1.28	4.77	0.76	19.65	3.12
2002	10	34	3.83	6.96	1.67	20.52	2.96
2002	11	40	6.08	7.96	0.67	19.84	2.79
2002	12	42	6.43	8.86	1.00	22.13	3.57
2003	1	58	6.03	10.43	1.15	23.38	4.10
2003	2	50	3.20	8.85	0.80	19.96	3.60
2003	3	48	5.00	10.25	1.00	20.97	3.73
2003	4	51	5.00	11.59	1.00	21.84	5.95
2003	5	51	2.30	8.96	0.80	15.71	4.43
2003	6	30	4.00	9.66	1.00	18.07	4.77
2003	7	55	5.90	9.02	1.10	16.37	5.10
2003	8	57	5.90	10.04	1.00	16.28	4.75
2003	9	34	6.00	10.01	1.00	16.17	4.93
2003	10	54	6.45	12.42	2.72	16.61	2.55

Using the number of reported prescription errors as the dependent variable, a multivariate reduced regression model was constructed using the same personnel categories described above as the independent variable. This data is depicted in Table 2.

Table 2

Prescription Errors and Staffing Data

Fiscal Year	Month	Presript Errors	Adjusted CIV DCP	Adjusted CIV DCPP	Adjusted Contr DCP	Adjusted Enl DCPP	Ofcr DCP Avail FTE
2002	1	3	8.69	9.62	0.24	13.68	3.52
2002	2	5	7.19	7.06	0.62	13.14	4.13
2002	3	6	7.82	7.72	1.58	16.34	4.76
2002	4	2	8.44	9.05	0.92	16.81	5.19
2002	5	4	4.25	4.99	0.38	11.87	5.00
2002	6	2	4.58	6.44	1.38	14.94	4.43
2002	7	1	1.57	4.60	2.15	16.54	3.95
2002	8	4	2.13	7.10	1.76	15.41	4.29
2002	9	7	1.28	4.77	0.76	10.65	3.12
2002	10	10	3.83	6.96	1.67	11.52	2.96
2002	11	13	6.08	7.96	0.67	10.84	2.79
2002	12	11	6.43	8.86	1.00	13.13	3.57
2003	1	13	6.03	10.43	1.15	14.38	4.10
2003	2	13	3.20	8.85	0.80	10.96	3.60
2003	3	13	5.00	10.25	1.00	11.97	3.73
2003	4	16	5.00	11.59	1.00	12.84	5.95
2003	5	11	2.30	8.96	0.80	6.71	4.43
2003	6	17	4.00	9.66	1.00	9.07	4.77
2003	7	18	5.90	9.02	1.10	7.37	5.10
2003	8	6	5.90	10.04	1.00	7.28	4.75
2003	9	19	6.00	10.01	1.00	7.17	4.93
2003	10	12	6.45	12.42	2.72	7.61	2.55

As with the analysis involving wait time, each independent variable was removed and a new regression run to test the effect of each variables absence on the R^2. The significance of each independent variable to the dependent variable was tested using the student's t and Fisher's F.

Validity.

Validity is a measure of an instrument or processes' ability to accurately measure what it is intended to measure (Soeken, 1985). In the case of this study, SPSS contains construct validity by virtue of its use for statistical analysis in many other studies. SPSS was chosen as the tool to complete the multiple regression analyses because it is best suited to perform this analysis. Furthermore, the data that was used for each study was extracted from standard sources of data commonly used throughout the Department of Defense. Although a manual adjustment was made in the MEPRS data, this adjustment was applied in a consistent manner across the whole data set. Thus, the relationships between the dependent and independent variables were not compromised in any way. Additionally, the use of regression analysis has been a valid predictor when analyzing data of this type.

The only threat to validity, in the case of this study, is that of human error. Since the preponderance of data points were entered by hand, either in SPSS or in the source databases, there was the potential that some of this data may have been entered erroneously. Furthermore, the validity of the information gleaned from Department of Defense databases was contingent on not only the data being correct in the database, but also on the way in which the information was introduced to the database. There is a feeling held by some within the

Department of Defense say that we may be measuring things

consistently wrong (R. James, personnel communication, March 4,

2004). However, in the case of the Department of Defense

databases, specific rules and regulations were applicable in all

cases to combat these types of errors. Nonetheless, the

possibility does exist.

Reliability.

Reliability is the ability to measure the same thing in the

same manner many times using the same instrument or process and

obtain similar results (Soeken, 1985). The use of SPSS

precipitated a high degree of reliability. The use of a computer

program as opposed to the use of manual mathematic calculations

virtually assured that the computations were performed in the

same manner through each iteration of the regression analyses

and thus the results were the same each time. The use of

regression has been reliable in the past.

Results

The confidence level (confidence coefficient) used to test the relationship of all

independent variables to dependent variables throughout the two independent statistical analyses

was $p<.05$. The results of this empirical data are clear. As

staffing decreases over time, the trend with regard to wait time

and prescription errors is that of an increase. The results of

the two studies follow.

Average Wait Time.

Table 3 depicts the results of the multiple regression analysis using average wait time as the dependent variable and the separate categories of personnel working in the outpatient pharmacy as the independent variables. For the analysis n=22. The full regression model resulted in an R^2 of .662 and was highly significant with F(5,16)=6.26,p<.001. All independent variables were statistically significant after controlling for all other factors. Civilian Direct Care Provider accounted for 6 percent of the full model's variance and was statistically significant with F(4,17)=6.43,p<.002. Contracted Direct Care Provider accounted for .3 percent of the full model's variance and was statistically significant with F(4,17)=8.21,p<.001. Furthermore, Enlisted Direct Care Para-Professional accounted for 4.9 percent of the full model's variance and was significant with F(4,17)=6.72,p<.001. Officer Direct Care Provider, which accounted for 1.2 of the full model's variance, was also significant with F(4,17)=7.89,p<.001. Finally, Civilian Direct Care Para-Professional was significant at the .05 level. However, analysis using Fisher's F suggested that this variable was not significant with regard to wait time with F(4,17)=2.88, compare with a test statistic of F(4,17)=2.96,p<.05.

Table 3

Hypothesis Tests of Effects on Average Wait Time Inferential

Statistics (n=22)

Effect Tested	R^2 Full	R^2 Reduced		df1	df2	F	p
Full Model	0.662	0	0.662	5	16	6.26	0.001
Civilian Direct Care Provider	0.662	0.602	0.06	4	17	6.43	0.002
Civilian Direct Care Para-Professional	0.662	0.404	0.258	4	17	2.88	0.05
Contracted Direct Care Provider	0.662	0.659	0.003	4	17	8.21	0.001
Enlisted Direct Care Para-Professional	0.662	0.613	0.049	4	17	6.72	0.001
Officer Direct Care Provider	0.662	0.65	0.012	4	17	7.89	0.001

Prescription Errors.

The results of the multiple regression model using monthly

prescription errors as the dependent variable, and categories of

pharmaceutical personnel as the independent variables are

depicted in Table 4. The Fisher's F test statistic was

$F(5,16)=2.90, p<.05$. The full model proved to be highly

significant with an R^2 of .592 and $F(5,16)=4.64, p<.008$. Civilian

Table 4

Hypothesis Tests of Effects on Prescription Errors Inferential

Statistics (n = 22)

Effect Tested	R^2 Full	R^2 Reduced	Variance Uniquely Explained	df1	df2	F	p
Full Model	0.592	0	0.592	5	16	4.64	0.008
Civilian Direct Care Provider	0.592	0.559	0.033	4	17	5.39	0.005
Civilian Direct Care Para-Professional	0.592	0.437	0.155	4	17	3.29	0.036
Contracted Direct Care Provider	0.592	0.585	0.007	4	17	5.99	0.003
Enlisted Direct Care Para-Professional	0.592	0.496	0.096	4	17	4.19	0.015
Officer Direct Care Provider	0.592	0.59	0.002	4	17	6.12	0.003

Direct Care Provider accounted for 3.3 percent of the full

model's variance. This variable proved to be significant at

$F(4,17)=5.39, p<.005$. Civilian Direct Care Para-Professional

accounted for 15.5 percent of the full model's variance and was

significant at $F(4,17)=3.29, p<.036$. Contracted Direct Care

Provider accounted for .7 percent of the full model's variance.

Furthermore, Contracted Direct Care Provider was significant at

$F(4,17)=5.99, p<.003$. Enlisted Direct Care Para-Professional accounted for the second highest portion of the full model's variance at 9.6 percent. This variable was significant at $F(4,17)=4.19, p<.015$. Finally, Officer Direct Care Provider was responsible for .2 percent of the full model's variance and was significant with at $F(4,17)=6.12, p<.003$.

Discussion

Wait Time.

The results of the multiple regression analysis involving outpatient pharmacy wait time and personnel assigned to the pharmacy support the explanations of the pharmacy staff on the problem of increased wait time. In conversations with both the chief of the pharmacy and the assistant chief, each individual made it clear that the role of the pharmacy technician (the two employee types that were called enlisted and civilian para-professionals in the study) was pivotal to the overall success of pharmacy operations. The loss of pharmacy staff in general, particularly the loss of technicians during the 22-month period, resulted in the longer wait (D.G. Goode, personal communication, October 22, 2003). This was because the outpatient pharmacy at Eisenhower Army Medical Center relied on a model of production known in the pharmaceutical industry as the bank teller model (D.G. Goode, personal communication, October 22, 2003). A key ingredient to the success of the bank teller model in outpatient

pharmacies is the use of technicians to fill and retrieve individual prescriptions that the pharmacists would then dispense to the individual patients.

Prescription Errors.

The assertions of the pharmacy chief and assistant chief that the loss of technicians profoundly affected outpatient pharmacy operations were further supported through the results of the multiple regression analysis involving outpatient pharmacy prescription errors and the personnel assigned to the outpatient pharmacy. The correlation between the change in the number of technician hours available and the increase in the number of reported prescription errors overtime was highest relative to all variables studied and was significant.

The bank teller concept that the Eisenhower outpatient pharmacy uses guaranteed that a rise in prescription errors would occur if pharmacists were forced to perform some of the functions that were normally performed by pharmacy technicians. This was the case in the outpatient pharmacy (Goode, 2003). The literature supported the fact that if pharmacists are distracted and interrupted, there will always be a noticeable rise in the number of errors (Flynn et al., 1999). Analysis of the loss of the technicians over time supported this theory. As the number of hours that technicians were available to work in the outpatient pharmacy diminished, pharmacists were forced to do

tasks such as the retrieval of prescriptions in addition to patient counseling. Thus, as the pharmacists performed more tasks overall, the number of reported prescription errors increased.

The data in Table 1 and Table 2, clearly show that both the increase in wait time and prescription errors occurred in the fall and early winter of 2002. This coincides with a marked change in the number of enlisted and civilian para-professional hours available to the outpatient pharmacy.

Customer Service Initiatives.

Throughout this section of the discussion, ideas will be presented that will predict how a change in business practice at Eisenhower Army Medical Center Outpatient Pharmacy might affect the wait time and prescription errors. Specifically, how would the introduction of pharmacy automation, the pharmacy without walls concept, a system that mandates call-in refill for prescriptions, and a separate pharmacy that would be dedicated to prescription refills contrast with the bank teller model that is now used at Eisenhower. Each option will be addressed separately.

Automation.

The literature and analysis above clearly supported the idea that the introduction of automation to the outpatient pharmacy would decrease the wait time for patients in the

waiting room and reduce prescription errors. The use of robotics for example would free technicians' time by automatically and precisely filling prescription bottles and may have the affect of lowering the number of prescriptions that have to be restocked. Technicians could then be used to support pharmacists in different ways including patient counseling and quality assurance. Pharmacists would in turn be free to perform functions that would enhance the overall pharmacy service. Furthermore, the pharmacy would avoid errors in prescriptions because the robot would fill each prescription the same way each time with computer precision. Finally with additional time, the staff would have more time to check prescriptions before they could be distributed to customers.

Pharmacy Without Walls.

The pharmacy without walls concept would do little to lessen wait time and reduce the number of reported prescription errors. The main reason for this is that the pharmacy without walls concept is similar to the bank teller concept in that a shortage of technicians would result in pharmacists having to assume technician duties. The pharmacy without walls concept works if the pharmacist is allowed to interact with patients and then allow the patients to go to the pharmacy window and complete the pharmacy transaction with the technician. If the technicians are not available to do their part, then the concept

breaks down severely which would result in increased prescription errors and longer waiting time for the patient. Call-in Prescription Refills.

In contrast to the pharmacy without walls concept, if the Eisenhower Outpatient Pharmacy were to institute a policy in which patients were mandated to call-in all prescription refills wait time and errors would decrease. Under such a system, many benefits would be realized. First, it would have the affect of decreasing distractions for the pharmacy staff due to the absence of a large number of patients waiting for a long period of time to present and then have their prescriptions refilled. The absence of distractions is key to reducing prescription errors. In addition, refills could be accomplished by the pharmacy staff at off peak hours, which would free technicians to assist pharmacists during peak hours.

A pharmacy service that specialized in the refill of prescriptions would have the advantage of specialization in one area as well as having the affect of removing the function of refills from the main pharmacy. However, this would probably require extra staff in order to effectively create the separate operation. In the end, wait time and prescription errors would rise should a loss in staff occur.

Recommendations

Use Automation.

The use of automation in the outpatient pharmacy would provide a more stable work environment from which to provide services to patients. It is said that there must be a logical connection between two events or objects in order to measure the statistical relationship between the two (Sanders & Smidt, 2000). The addition of automation to the outpatient pharmacy at Eisenhower would provide such a connection and provide for a statistically measurable improvement in the pharmacy service in the areas of waiting room time and reported prescription errors. A key outcome would be the establishment of an optimal business practice. As with any organization, the ability to attract and retain the right personnel is key to success (Collins, 2001). However, the introduction of automation would help the outpatient pharmacy stay on course even if its ability to attract and retain the right personnel was be eroded.

Automation could take many forms from robots to automated prescription quality assurance. The end result would be a service that is more efficient and capable of operating in the absence of all assigned personnel. Automation is not a panacea, however. Personnel would still be required to ensure that the services produced are what would be desired. However, the

periodic absence of personnel would not cause such a pronounced ripple effect in overall waiting time for patient.

Prescription errors were most likely a function of pharmacists' involvement in the duties of technicians. Automation has the potential to change the roles of both pharmacists and technician so that the absence of either type of personnel would not produce a situation in which quality assurance efforts, which are the responsibility of the pharmacists, would not be abandoned if personnel are not available.

Mandatory Call-In Refills.

If the outpatient pharmacy were to institute a policy under which it would no longer accept prescriptions for refill without prior telephonic coordination, the immediate affect would be fewer patients in the waiting room. This would accomplish the goal of a decreasing the wait time across all categories of patients. However, personnel would still be required to physically field phone calls and fill prescription bottles. Because this process would be just as labor intensive and labor dependent as the bank teller concept, it would carry the potential to allow prescription errors to increase if staffing levels were not optimal. For this reason, this recommendation is the second most favorable.

In contrast with the first recommendation, this would require a major shift in the culture of those who use the outpatient pharmacy. A marketing campaign aimed at informing current and potential patients of the change in business practice could be slow in taking hold. The attempted change in business practice may have the affect of alienating some patients who may perceive that the pharmacy is too dictatorial with regard to the way they received their medicines.

Conclusion

The Eisenhower Army Medical Center Outpatient Pharmacy must undergo a transformation in the way it conducts business. The introduction of automation or mandating pharmacy refills will have the affect of reducing the workload faced by the pharmacy staff during peak hours and thus reduce wait time and prescription errors.

The increased wait time and reported prescription errors are only symptoms of what can happen under a business model that depends heavily on personnel stability to run smoothly. Additionally, all medical entities, both military and civilian, must recognize that as America's Baby Boom generation reaches senior citizenship in the next few years, the problem will only increase because the demand for prescription drugs will increase (Altman & Shactman, 2002). If the outpatient pharmacy were to employ automation in daily operations, it could reduce the

institution's dependence on people accomplish them mission.
Automation would achieve the goal of optimizing services in the
face of an uncertain future in military medicine.

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