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The purpose of this study was to determine the effectiveness of a computer simulation software package in identifying problem areas within a clinical service. A lack of treatment beds, nursing staff, and physician staff were identified as causes for decreased productivity, measured by patient throughput times. The study tested three hypotheses which included the addition of two treatment beds, three nurse FTEs, and three physician FTEs. A simulation model for the current operations was compared to a separate model for each of the hypotheses, testing for a significant mean differences in throughput times.

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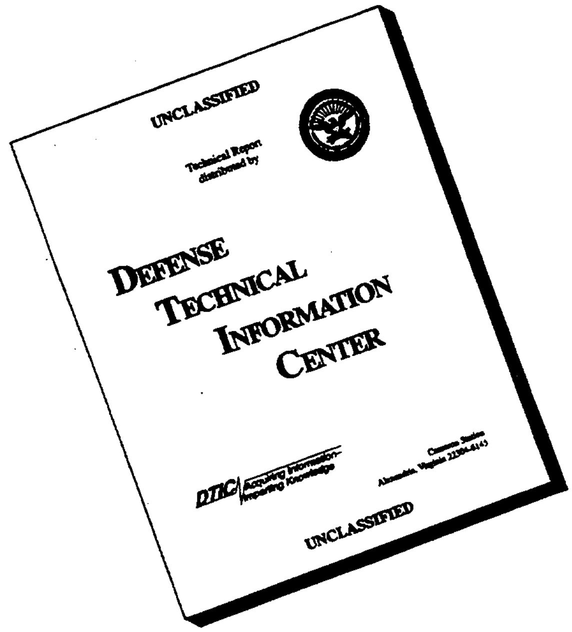

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U.S. ARMY - BAYLOR UNIVERSITY GRADUATE PROGRAM

IN HEALTH CARE ADMINISTRATION

GRADUATE MANAGEMENT PROJECT

DEVELOPMENT OF A COMPUTER SIMULATION MODEL FOR AN EMERGENCY MEDICINE SERVICE

SUBMITTED TO

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AND

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BY

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WALTER REED ARMY MEDICAL CENTER

WASHINGTON, D.C.

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This project would not have been completed without the help of Kathryn, my friend, confidant, and wife. She has made the past year the best of my life. The stress of completing this project was minimized due to her care and support.

Thank you, Kath.

ABSTRACT

The modeling of the Walter Reed Army Medical Center Emergency Medicine Service is just one example of the power of a quantitative tool. The trend in health care is to minimize costs while maintaining outputs. In order to accomplish this task, health care organizations are realizing the value of management engineering techniques such as simulation modeling.

The purpose of this study was to determine the effectiveness of a computer simulation software package in identifying problem areas within a clinical service. A lack of treatment beds, nursing staff, and physician staff were identified as causes for decreased productivity, measured by patient throughput times. The study tested three hypotheses which included the addition of two treatment beds, three nurse FTEs, and three physician FTEs. A simulation model for the current operations was compared to a separate model for each of the hypotheses, testing for a significant mean differences in throughput times.

The model's validity is key to a simulator's success. Challenges in several areas such as data collection, patient arrival modeling, and the definition of resources proved important in the final results. Through a paired t-test the results showed a significant reduction in throughput times only with the addition of physicians. This project verified the effectiveness of valid simulations. The key benefit was reinforced as the cause-and-affect analysis prevented the commitment of resources before their intended results were measured.

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CHAPTER 1

INTRODUCTION

A simulation is defined as "a model-building technique for forecasting how systems, as yet unbuilt, will behave." (Flagle 1970, 2386) The ability to create "what if" scenarios allows managers to view outputs without expending valuable resources. The benefits to simulation modeling have led to a variety of applications. The Department of Defense uses simulation (wargaming) to focus on the dynamics of war, human decisions, and their outcomes. The best designed wargames approximate reality while poor ones can exact a high price in lives. Guadalcanal is an infamous example of flawed wargaming at the Naval War College during the 1930s. (Perla 1994, 77) Computer simulations used on the battlefield can now help conserve the fighting strength. In military health care, managers benefit from a tool to help respond to the dynamic health care environment.

Conditions which Prompted the Study

My rotation through the Emergency Medicine Service (EMS) revealed several problems with patient and staff flows. EMS staff members concluded that additional staffing and treatment rooms would alleviate many patient flow problems. The Directorate of Public Works (DPW) suggested that a redesign of the emergency room is a long-term solution. For the short-term, the EMS could identify possible alternatives to improve patient flow. However, few tools exist to evaluate alternatives. A simulation of the EMS would help staff members identify problem areas and test possible solutions. This would help determine the least costly solutions with the greatest improvement. If the service staff identifies a physical plant improvement as the only efficient alternative, simulation modeling will help the investigator measure the improvement of a renovation without moving a brick. The true advantage to simulation lies in, "the ability of an investigator to examine proposed changes to an existing system without physically changing the system." (Klafehn, Rakich, and Kuzdrall 1989, 8).

Existing Conditions

Walter Reed Army Medical Center (WRAMC) is a 850-bed tertiary care medical center located in Washington, D.C. The medical center has a world wide referral base and a primary care responsibility for approximately 200,000 patients. This military treatment facility (MTF) emphasizes Graduate Medical Education (GME).

The Emergency Medicine Service (EMS) operates as a level II trauma center and limits their ambulance response to installation emergencies. There is a small demand for trauma care leaving most of the EMS visits for acute care patients. The EMS provides sick-call to all active-duty members from 8:00 A.M. to 4:00 P.M. Monday through Friday. During duty hours, the General Medicine

Clinic handles primary care for other beneficiary categories. This responsibility transfers to the EMS during non-duty hours. A minimum of one military staff physician supports this workload. A civilian staff physician helps on nights and weekends while another handles active-duty sick calls during the day shift. Residents from other programs assist during the days and evenings while the interns operate on all shifts except Friday and Saturday. Nursing operates with 1 1/2 registered nurse (RN) full-time equivalents (FTEs) and three nurse assistants during the day shift, two RNs and three nurse assistants during the evening shift, and one RN and two nurse assistants during the night shift. One Medical Record Technician (MRT) answers phones and closes records during the day and evening shifts.

The physical layout of the EMS (see figure 1) provides seven treatment rooms three of which contain two beds. Three rooms contain oxygen, and monitors including two trauma configurations. The remaining four rooms are not within view of the nurse station which hampers clinical staff observation. The nurses station and physician work desk are located within the general work area. A large adjoining anteroom contains storage, an EMS break area, and the ambulance entrance. The current gross area used by the EMS is approximately seven thousand square feet. Based on Department of Defense Medical Space Planning Criteria, an EMS with a larger trauma workload should contain approximately seventy-seven hundred square feet. (Office of the Assistant Secretary of Defense for Health Affairs, Defense Medical Facilities Office, 1987)

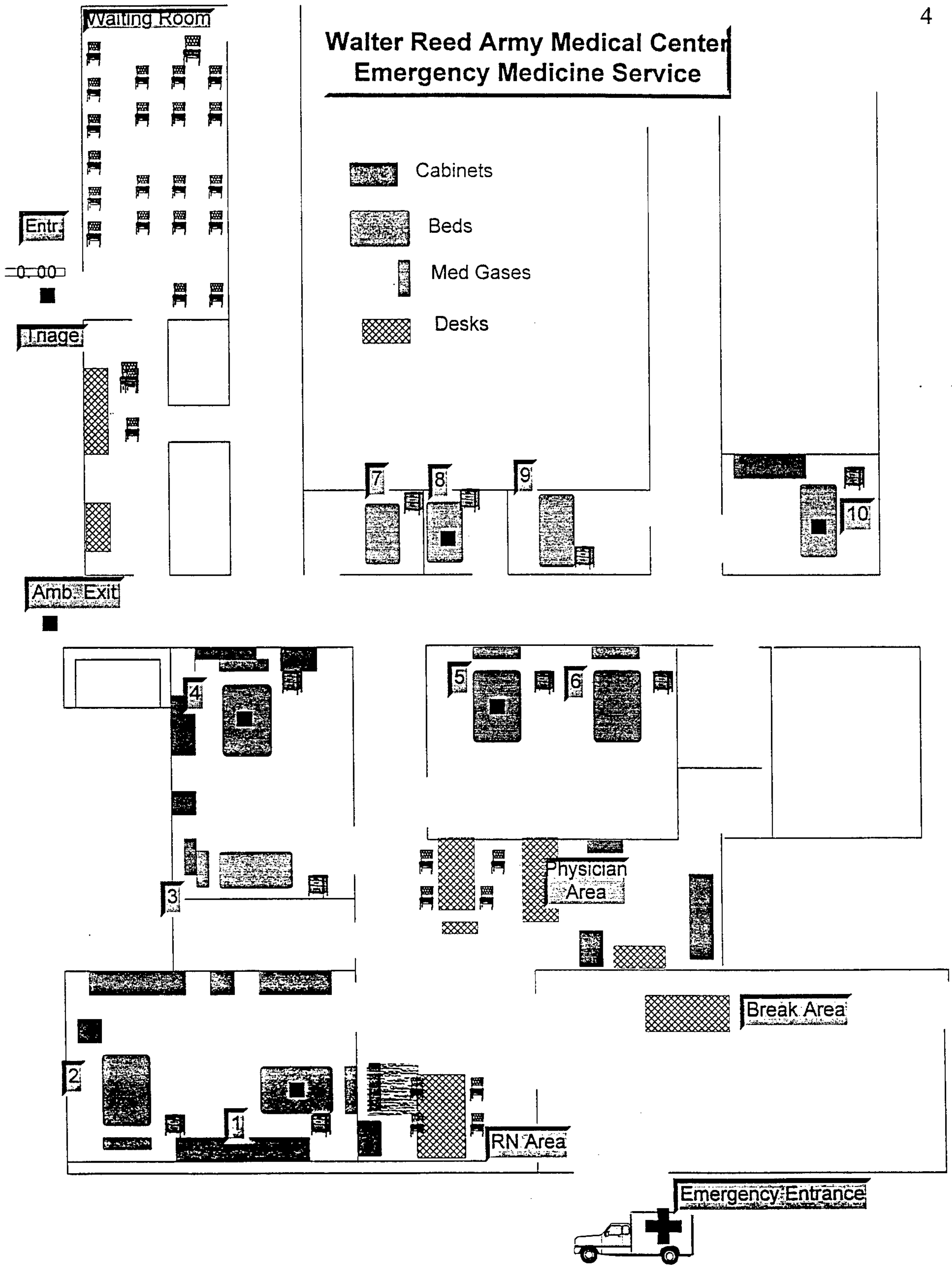

Figure 1. The physical layout of the Walter Reed Army Medical Center Emergency Medicine Service.

Historical and Environmental Factors

Over the past ten to twenty years, health care changed from an inpatient focus to outpatient care. This shift was attributed to the passage of several reimbursement laws and advances in technology. The Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982 and the Social Security Amendments of 1983 significantly changed federal reimbursement to hospitals for inpatient care for Medicare beneficiaries. The original retrospective cost-based system changed to a prospective pricing system (PPS) based on Diagnosis-Related Groups (DRGs). This change forced health care organizations to provide care for a fixed fee. The transition of health care to a managed care environment emphasizes the need for increased productivity and efficiency to provide the necessary care at costs less than the fixed price.

Several TRICARE initiatives will continue to impose change upon the military health care system. The ideal situation aligns the three Department of Defense services into a combined primary care network. The shift to a managed care setting will change the traditional use of emergency services within military treatment facilities (MTF) from general outpatient clinics to true emergency treatment.

Walter Reed Army Medical Center (WRAMC) has begun to develop a corporate managed primary care system based on the Health Maintenance Organization (HMO) model. This initiative is called the Walter Reed TRICARE Clinic (WRTC). The WRTC is expected to reduce the cost and volume of primary care that is currently being performed in the specialty and sub-specialty clinics. A potential benefit is an increase in appointments for specialty care referrals throughout the region.

The demand for primary care is estimated by historical data from the current outpatient clinic adjacent to the emergency room. Additionally, estimates from an informal study indicate that approximately 20 to 30 percent of the clinic visits in the Department of Medicine's specialty and subspecialty clinics are primary care. Currently all active-duty assigned to WRAMC receive primary care through the Emergency Medicine Service (EMS) sick-call. (Miller 1994)

The development of the WRTC would absorb all sick-call for active-duty and their beneficiaries. Ideally this would eliminate the need for EMS sick call hours. Full implementation of the WRTC would significantly impact EMS operations. A simulation model may help the EMS prepare for these "what if" scenarios in the rapidly changing military health care environment.

Limitations and Assumptions

A primary limitation to this study is the ability to collect all the necessary information required for simulation modeling. The Composite Health Care System (CHCS) provides a comprehensive information system that compiles appointments, lab work, x-ray, prescriptions, and clinic information. However, this system is limited to specific types of information. Additional sources of information are limited to a patient survey administered over a three week period. Another limitation is the time available to model the process and the abilities of the investigator. A comprehensive simulation of the emergency service and its associated ancillary services is unrealistic. This study focused on two categories of patients, urgent and non-urgent, and four patient alternatives within the EMS, physician procedure, laboratory request, x-ray request, and consultation with a specialist.

The EMS relies on other services to provide patient care. This creates a situation where the external environment may adversely affect productivity. Patient flow through the EMS relies on quick turnarounds through the lab and x-ray services. Bottlenecks in these areas may affect EMS effectiveness.

Assumptions help define the scope of the EMS simulation study. All variables were kept constant, except treatment rooms, nurses, or physician staffing. This ensures consistency in evaluating the differences between the current and alternate processes. In an effort to maintain simplicity in modeling, there were no differences between the types of physicians and nurses. Treatment beds one through five were prioritized for urgent patients who may require monitoring or medical gases. Beds six through ten were considered standard exam rooms. Although some of these assumptions do not match the actual EMS, it was necessary to keep all variables consistent between alternatives. This ensures that any significant differences in patient throughput times were attributed to the additional treatment beds. Chapter 5, Discussion, will address the impact of these limitation and assumptions.

Statement of the Problem

Is there a significant increase in productivity when treatment beds, nurses, or physicians are added to the Emergency Medicine Service (EMS)? There are several tools which help clinical services identify problem areas and quantify the effects of possible solutions. However, few match the flexibility of simulation modeling. In the past, EMS managers conducted time and motion studies to identify requirements for additional staffing. This methodology does not allow for a cause-and-effect analysis of various combinations of resources. A simulation model allows services to view the results of changes in resource distribution. The EMS has identified space and personnel constraints as a cause to operational problems. Modeling will help decide if additional space and resources result in the desired outcome.

Literature Review

Modeling, the principle of using symbolic representations, facilitates the understanding of interactions of various parts of a system. A model places components of a system into an understandable form. Once the system users validate this form, experiments help predict the behavior of the real system. (Harrell and other 1992, 1) This type of tool allows for evaluation of changes in a current system. Various models for evaluating systems and processes include time/ motion and queuing. These tools can help to define a process and suggest inefficiencies, however, "they can shed little insight into the system-wide effects of manipulating the system because they tend to ignore interactions among subsystems." (Saunders, Makens, and Leblanc 1989, 37) Modeling techniques fall into two categories: descriptive and explanatory models. Descriptive models provide basic statistical measures and relationships without attempting to explain causal factors producing the behavior. Explanatory models are more complex, but provide a more comprehensive understanding of the real system. The disadvantage is the extra time and cost. (Zilm and Hollis 1983, 83) This EMS simulation study will use a descriptive model.

Simulation Modeling

Computer advancements contributed to modeling's growth through the new user-friendly software programs. A simulation model is a "detailed description, verbal and/or mathematical, of the entities constituting the system under study along with an exhaustive set of rules that each entity follows in its interaction with the rest of the system." (Boxerman and Serota 1979, 72) Global competition forced U.S. and European organizations to improve efficiency, cut costs and enhance quality. Simulation provided a tool to measure the impact of proposed improvements. (Harrell and others 1992, 98) This type of tool found early success in the manufacturing industry, where many entities interact within a system. The improved ease-of-use and competitive pressures were the two major reasons for the increased use of simulations in manufacturing.

The increased availability of easy-to-use and flexible software brought the service industry into the simulation environment. Health care organizations form a unique subset of the service industry and face unique problems not found in other service industries. For example, "a hospital houses a collection of functional processes, each performing a different patient service. Most of these processes are subject to chance or random variation, so their usage fluctuates daily, or even hourly. Computer simulation is tailored for this type of problem since it can measure the effect of various combinations of resources to satisfy different demand levels." (de Jong 1980, 18)

The movement into the service sector led to the growth of computer simulation software. General packages such as GPSS/H requires additional programming to tailor the model to specific service requirements. The most recent software packages, such as MedModel, were designed specifically for health care. The health care industry has also realized the advantages of simulations. Changes in health care led to reimbursement changes that forced health care organizations to provide the care at costs less than the fixed price. Testing various initiatives in the real world is a costly option when operating on a trial-and-error basis. Besides the financial costs, the disruption of innovation is damaging to morale unless a beneficial change is apparent. Simulations provide an inexpensive, instructive way to test new ideas or to forecast the effects of external change. (Flagle 1970, 2388)

Simulations in Health Care

Simulation applications permeate the health care industry. Past studies ranged from modeling an entire clinical laboratory (Vogt and others 1994, 922) to studying methods to accommodate increased admissions in an emergency psychiatric service. (Johnson, Adams, Norman, and Kazetsky 1989, 52) A popular application is the scheduling of personnel, equipment, or procedures. Simulations have helped with allocating physicians to weekly shifts in an emergency department. (Vassilacopoulos, 1985) In 1987 a simulation study helped a twelve-bed medical/cardiac ICU determine their best staffing level. This model allowed for the consideration of financial concerns, quality of care issues, and staff working preferences. (Hashimoto, Bell, and Marshment 1987, 256) In 1991, White, Best and Sage used a simulation model to determine the minimum number of ambulance units required by a county emergency medical system without affecting the level of service. This tool helped the emergency medical system find an adequate level of staffing for its stations that would ensure significant cost savings without compromising the lifesaving level of service.

Other popular applications of simulation modeling include patient waiting times and patient flow. In 1987, Saunders studied the relationship between waiting times in an emergency room and the level of patient acuity. He used a time study to evaluate patient flow and resource use. Improvements in EMS efficiency can translate into improvements in the quality of care, patient satisfaction, and cost containment. Saunders concluded that patients of high acuity experienced short waiting times in all stages of emergency care, while patients of low acuity experienced frequent long waiting times. (Saunders 1987, 88)

A study in 1993 used a computer simulation to determine waiting times within different outpatient clinic structures. The simulation showed significant reductions in waiting time by changing queuing systems. (Edwards 1994, 164) In 1991, Bay Medical Center located in Bay City, Michigan, used simulation to test ideas on streamlining patient flow in ambulatory surgery to increase patient capacity. The result was a 30 percent increase in capacity. The management staff emphasized the importance of staff involvement, "the computer simulation did not streamline the department, it just tried their (staff's) ideas and proved their hypotheses correct." (Mathias 1992, 34)

Emergency Medicine Service (EMS) Simulations

Emergency departments are unique due to their complex features such as queue reneging (patients leaving rather than continuing to wait), various levels of preemptive priority among patients, multiple "servers" (physicians, nurses) with variable service times, nonstandard statistical distributions of patient arrivals, and the usually present nonequilibrium conditions. (Saunders, Makens, and Leblanc 1989, 37) Simulation studies have contributed various methods of addressing these EMS issues. In 1985, there was little information on the standards and criteria for emergency department efficiency. The University Medical Center at the Arizona Health Sciences Center (Tucson) undertook an analysis of the length of time patients spend in the emergency department. The hospital judged the average time in the treatment room, which exceeded two hours, as a major deficiency. Diagnostic testing, consultations, and inpatient admissions were the primary cause of extended waiting times. The study also found that a large category of patients required minor or major care for conditions such as laceration, strep throat, or fractures. As a corrective action, the hospital incorporated a "fast track" system for patients who do not need extensive treatment. Careful explanation of this process to other patients parlayed the concerns about preferential treatment. This system has decreased average visit length for these patients to seventy-five minutes. (Smeltzer and Curtis, 1986, 381)

A simulation of the WRAMC Emergency Medical Service (EMS) process would test the initial problem identified by the EMS staff, a lack of treatment rooms and staff. Specific entities and locations for a simulation program are duplicated from previous studies found through the literature review.

Operational Definitions

To simplify the process, the study will evaluate the effects on productivity by increasing the number of treatment beds, nurses, or physicians. The dependent variable, productivity means the patient throughput time. This time starts from the point a patient signs-in to the EMS and ends when the physician discharges the patient or admits them to a ward. The throughput time includes measurements of time from sign-in and triage to physician assessment, time for ancillary treatment (i.e. lab, x-ray, consult, or procedure), and time to admission or discharge. All treatment beds, one of the independent variables, could accept non-urgent patients. However, urgent patients could only occupy beds one through six. Based on the workload data for the EMS, patient categories were limited to non-urgent and urgent. Three additional nurse full-time equivalents (FTEs) and three physician FTEs are also defined as separate independent variables.

Purpose (Variables/ Working Hypothesis)

The purpose of this study is to determine the effectiveness of a computer simulation software package in identifying problem areas within a clinical service. The WRAMC EMS identified a lack of available treatment areas and personnel as cause for decreased productivity. This simulation will help verify this problem area by measuring the effect of adding two treatment beds, three nurse FTEs, or three physician FTEs. This study will test the following hypothesis:

1. Ho: There are no significant differences in productivity between current EMS operations and the same EMS with two additional treatment beds.

Ha: There are significant differences in productivity between current EMS operations and the same EMS with two additional treatment beds.

2. Ho: There are no significant differences in productivity between current EMS operations and the same EMS with three additional nurse FTEs.

Ha: There are significant differences in productivity between current EMS operations and the same EMS with three additional nurse FTEs.

3. Ho: There are no significant differences in productivity between current EMS operations and the same EMS with three additional physician FTEs.

Ha: There are significant differences in productivity between current EMS operations and the same EMS with three additional physician FTEs.

Results from this study will illustrate the effectiveness of a simulation to evaluate a service's current operations and help measure the effects of carrying out a change. This simulation model will test if the additional resources contribute to increased productivity.

CHAPTER 2

METHOD AND PROCEDURES

Various texts address the necessary steps in simulations. Law and Kelton (1991) and Harrell (1992), both outline several steps that will compose a sound simulations study. This study combined both processes (see figure 2) in the following modeling steps.

Identify the Problem and Objectives

The problem statement, addressed in a previous section, asks the question if an additional treatment room or staff would significantly influence the productivity of the WRAMC EMS. A model on the current operation was developed to answer this question using simulation software.

Model Formulation and Planning

A conceptual framework outlining the principal events and elements helps to focus on the areas associated with the objectives of the study. Close observation and participation by individuals who work in the system ensures development of a valid model. (Harrell 1992, 35) In this study, these individuals include physicians, nurses, medics, and medical record technicians (MRTs) working in the EMS. From the conceptual framework, I created a process flow diagram to depict the flow of current operations. (see figure 3)

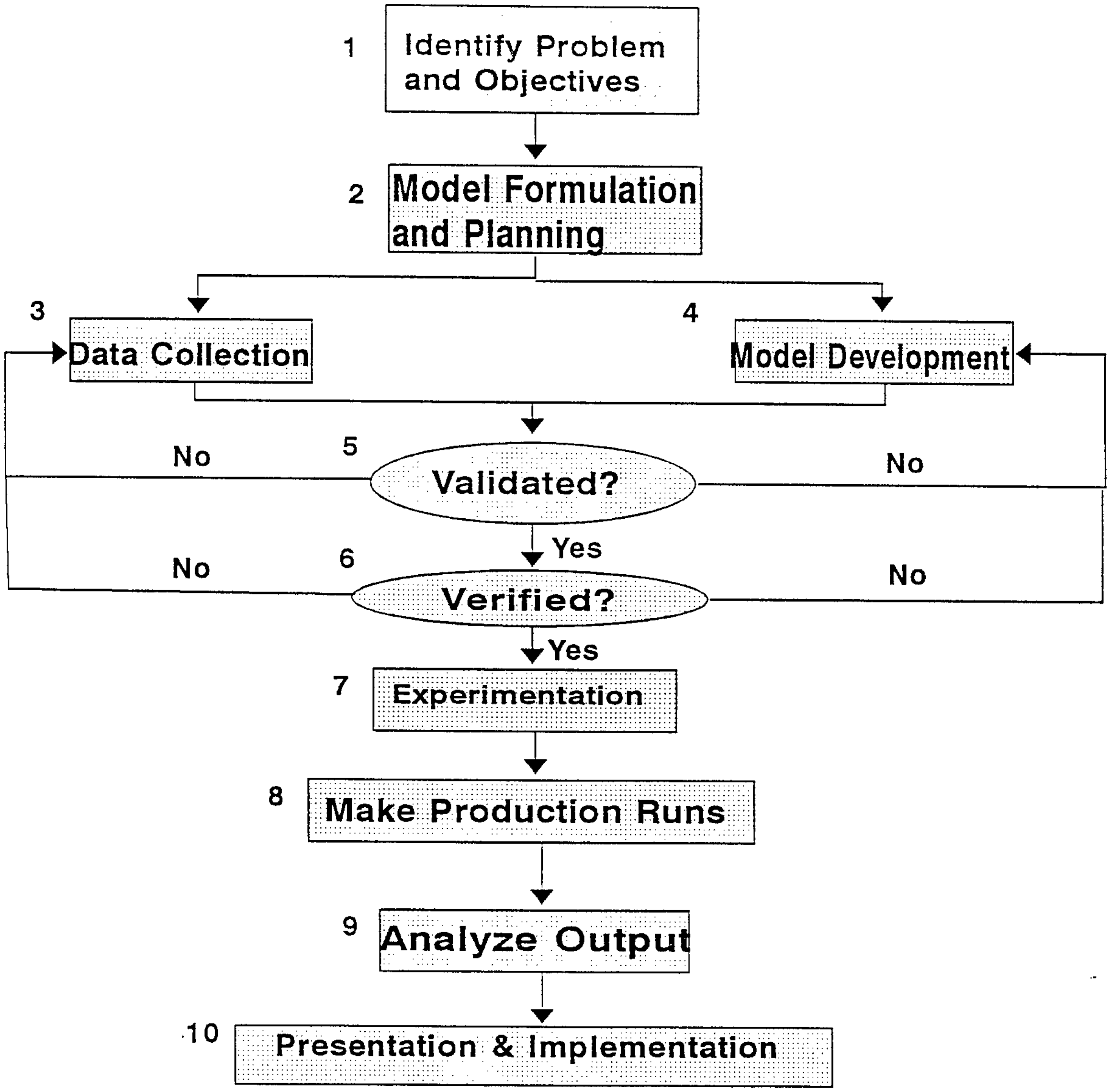

Figure 2. Steps in the simulation process.

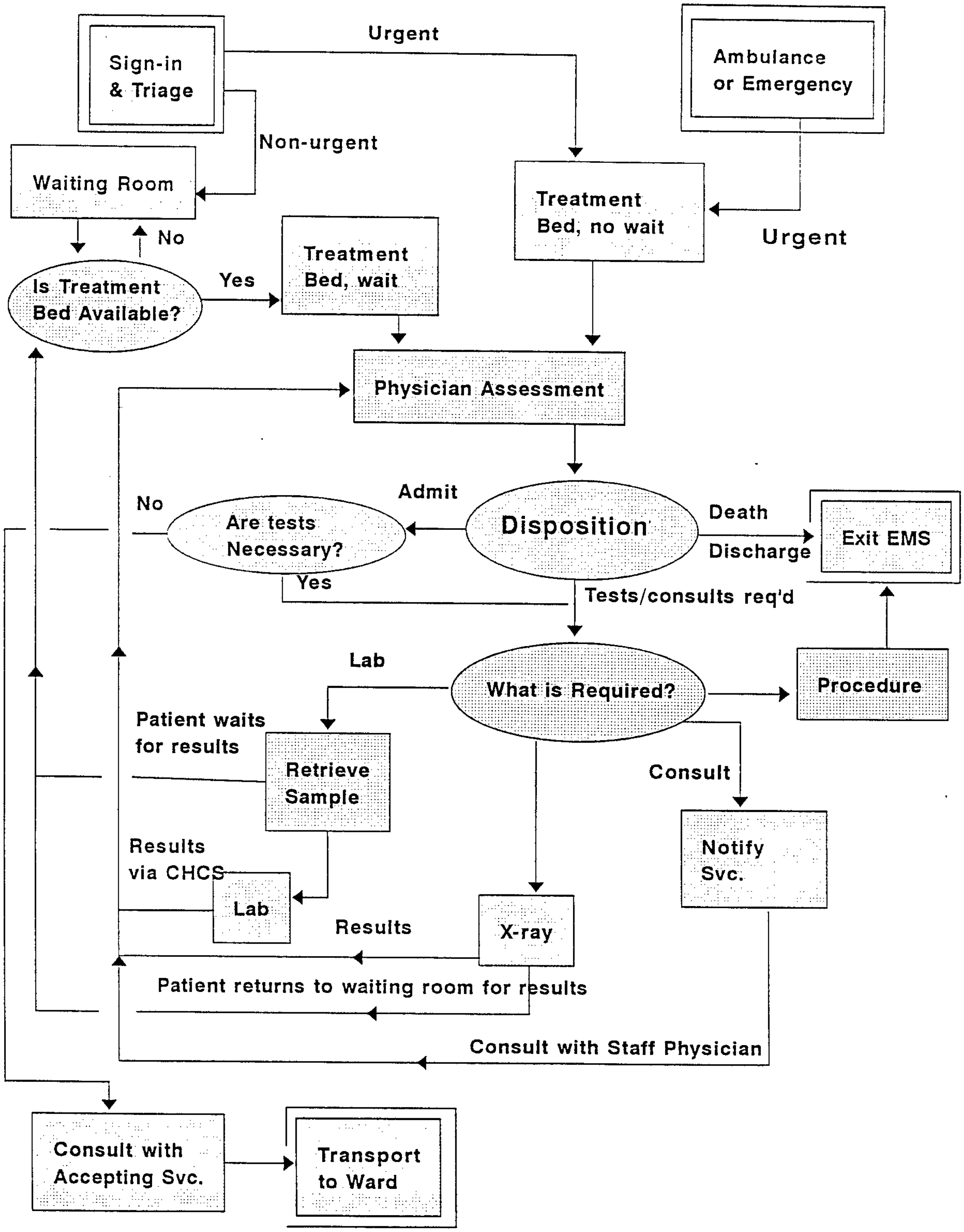

Figure 3. Process flow diagram depicting current EMS operations.

Patient Flow through the EMS

Entry into the EMS occurs either through the waiting room or through the emergency entrance. (see Figure 1) Most urgent patients arrive through the emergency entrance and occupy treatment beds one through six. Beds one and two are held exclusively for urgent patients. Ambulatory patients arrive through the waiting room and sign-in. A medic triages each patient while creating their record and determining eligibility. Based on certain parameters, the medic sends urgent patients directly to beds one through six. Non-urgent patients remain in the waiting area until called by a physician or registered nurse (RN) when a treatment bed is available. If an RN assigns the patient to a treatment bed, there is a wait for the next available physician. Each physician conducts a primary exam based on the patient's complaint. Residents and interns must seek a staff physician for approval of their diagnosis. During this disposition phase, a physician determines admission, discharge, or test/ consult requirements. The appropriate actions are loosely divided into four categories, a laboratory work-up, an x-ray, a consult with a specialty service, and performing a procedure.

If admission is required, the physician must consult with the appropriate service ensuring a positive transfer of the case. If tests are required, they may be performed in the EMS. In many instances, the actual movement of the patient is left to medics within the EMS.

If a laboratory sample is required, the medic or RN will draw the sample or provide directions to the patient . Medics take the sample to the lab for processing and the patient returns to the waiting area to await the results. The patient could remain in the treatment bed dependent on their condition and availability of treatment beds. Lab results are electronically placed on the Composite Health Care System (CHCS) for physician analysis. A second assessment and disposition occurs when a physician and treatment bed are available. The majority of cases requiring a lab work-up require some type of procedure or consult leading to an admission or discharge.

During the initial disposition, another alternate action is an x-ray. In cases other than trauma, patients traverse down the hall to Radiology and remain until a hard copy x-ray is available. In many cases, patients return to the EMS waiting area to wait for the hard copy. Similar to the laboratory process, the physician reviews the x-ray and conducts a second disposition. The majority of cases lead to a procedure or consult followed by discharge or admission.

The third alternate action during the disposition phase is consultation with a specialty service. This action incorporates a wait for coordination with the specialist. Coordination with a specialist usually allows the patient to remain in the treatment bed. Further dispositions determine the discharge or admission of the patient.

The final action by the primary physician is a procedure or diagnosis which leads to an immediate discharge. Due to the nature of the EMS, most patients fall into this category either exclusively or coupled with a lab work-up.

Data Collection

Data collection is critical to the validity and efficiency of a simulation model. Validation and verification throughout the modeling process ensures credibility of the model. This starts with gathering the right type of data and processing it into usable information. The decision to collect prospective or retrospective data is crucial to the reliability or consistency of the study. A staff that is aware of a study may bias prospective data. To prevent a bias, this study relied primarily on retrospective data collected through the Composite Health Care System (CHCS) over a one month period. This would account for any differences of data which may be dependent of the day of the week or time of day. CHCS was not designed as a means to collect data which limits its use in this capacity.

The categories of patient flow times through CHCS were limited to patient sign-in, health care provider visit, and patient departure. The difficult decision was finding the point where the collection of additional data would not lead to improvement of equal value. (Harrell and others 1992, 36) If there is not enough detail in the model, then it will probably be invalid, producing erroneous results. On the other hand, too detailed a model may result in costly data collection, missed deadlines, and excessive computer execution time or memory requirements. (Law 1993, 32) Information was gathered prospectively through a short patient survey administered over a three week period identifying several distribution patterns throughout the process (see figure 4). Based on the process flow diagram and the simulation process logic, the simulation model used the data outlined in table 1.

The collected data identified sample distributions or helped validate the accuracy of the model. Through each iteration of the validity and verification process, actual throughput and patient waiting times were compared with the simulation times.

Model Development

There are currently two major classes of simulation software: languages and simulators. Simulation language is a general computer package that may have special features for certain types of applications. The major advantage is their ability to model almost any kind of system. The drawback is the need for programming expertise and possibly a long coding and debugging time. A simulator is a computer package designed for a specific type of system such as health care. The major strength of this class is the need for little or no programming. MedModel by ProModel Corporation is an example of a simulator. This study used MedModel Version 1.10A which focuses on health care systems and has proven its effectiveness in several civilian health care organizations including Presbyterian Hospital, Dallas, Texas and Kaiser Permanente, Mid-Atlantic Region. (Smith 1994 and Cirillo 1995) One of the major constraints to

EMERGENCY MEDICINE SERVICE PATIENT TIME LOG

Please assist with the collection of Emergency Medicine Service data. This anonymous questionnaire is designed to record times required for specific actions in the Emergency Room. **Please record the time of the day (indicate AM or PM) for each task if it applies to you. After completion, deposit log at the (sign-in) front desk.** The Emergency Medicine Service appreciates your assistance in collecting this information.

Date: ____________

1. What time did you sign-in at the Front Desk? ____________________

2. What time did the medic take your blood pressure and vital signs?______________

3. What time were you assigned to a treatment room?__________________

4. Once in the room, what time did the first physician ask you questions about your condition?____________________

5. What time were blood or urine samples taken?_________________
(If none were taken, skip to question 7.)
6. What time did a physician evaluate your condition after the return of these results? ______________________

7. What time were you sent for an X-ray?_________________________
(If none were requested, skip to question 10.)
8. What time did you return to the ER? _______________________
9. What time did a physician inform you of your results after the return of your x-ray? ___________________

10. Did your ER physician request a consultation with a specialist (ie. cardiology, orthopedics, etc.)? If no, skip to question 12.
11. If yes, what time did the specialist evaluate your condition?_________

12. What time did the ER physician perform a procedure? ________________
12.a. How long did the procedure take? _______________
13. If a physician admitted you to the hospital, what time did the physician inform you of his request for admission? _______________
(if no admission was necessary, skip to question 15.
14. What time did you depart the ER for a hospital ward?
____

15. What time did you depart the ER for home? _________________________

Please leave completed log with the front desk. Thank you.

Figure 4. An example of the Emergency Medicine Service Patient Time Log.

TABLE 1

Data Required for Emergency Medicine Service Simulation

Required Data	Source	Sample Size, n=	Distribution	d.f.	Crit. Value alpha=.05	Chi Sq.
1. Percentage of urgent and non-urgent patients.	CHCS	1917				
2. Percentage of patients requiring procedures, x-rays, lab work, or consults.	Survey	109				
3. Patient arrivals per day.	CHCS	2004				
4. Interarrival times by day of week and hour of day.	CHCS	1987	E(21.2)			
5. Waiting time for first physician visit.	CHCS	1856	L(42.58,74.66)	10	18.307	53.748
6. Time required for initial physician visit when a lab work-up is requested.	Survey	17	T(0,0,49)	1	3.840	2.400
7. Waiting time for lab results.	Survey	20	W(1.21,54.67)	3	7.815	2.486
8. Waiting time for 2nd physician visit after lab request.	Survey	17	L(3.48,1.06)	3	7.815	1.941
9. Time required for initial physician visit when an x-ray is required.	Survey	21	ER(1,32.91)	3	7.815	6.834
10. Waiting time for x-ray results.	Survey	19	Geo(0.0231)	3	7.815	0.806
11. Waiting time for 2nd physician visit after x-ray request.	Survey	19	P5(.82,30.27)	3	7.815	3.656
12. Time required for a procedure.	Survey	38	P5(1.14,3.73)	4	9.488	5.969
13. Time required to receive a consultation with a specialist.	Survey	18	E(24.8)	2	5.991	0.402
14. Patient throughput times.	CHCS	1945	G(1.81,72.28)	8	15.507	45.041

L=Lognormal, T=Triangular, W=Weibull, ER=Erlang, Geo=Geometric, P5=Pearson V, E=Exponential, G=Gamma this study was the student version of MedModel which limits the number of locations, entity types, resource types, and attributes. A maximum of ten locations affecting the development of the EMS model. The following narrative will address these effects. Italicized items are identified in the simulation program in appendix A.

Modeling - Phase 1

MedModel uses a phased modeling approach that helps the model builder ensure that various elements of logic are working as desired. General Information, Locations, Entities, Arrivals, and Processing areas are basic model elements entered during phase one. The General Information area includes the creation of a floor plan through the Background Graphics module. Dimensions of all rooms and corridors were obtained through blueprints of the Emergency Medicine Service (EMS). This facilitated the development of appropriately scaled background graphics. Locations are fixed places in the system (e.g., offices, clinical areas, operating rooms, etc.) where entities are sent to receive treatment, undergo some process or simply wait while decisions are made concerning further routing (see table 2). To overcome the limitation on locations in the student version of MedModel, treatment beds were combined and assigned a capacity of two. During the simulation, patients graphically appear at beds one, four, five, eight, and ten only, however each location can hold two patients. The waiting area contained an initial waiting location and a lab/x-ray

TABLE 2

Simulation Locations

Location Name	Capacity
Enter	1
Leave	1
Waiting Room	19
Treatment 1	2
Treatment 4	2
Treatment 5	2
Treatment 8	2
Treatment 10	2
LabXray Waiting	6
Triage	1

waiting location. This allowed for the separation of patients running through the initial triage process versus those awaiting the return of lab and x-ray results.

Entities are the patients, material, and paperwork managed within the simulations. The EMS model utilized three patient entities: *Patient* (new arrival), *Lpatient* (patient awaiting lab results), and *Xpatient* (patient awaiting x-ray results). *Xpatient* was assumed to maintain a slower travelling speed due to x-ray cases limiting mobility.

An arrival is the introduction of an entity to the system. For the EMS, arrivals were recorded through CHCS over one month resulting in 1987 arrivals.

The interarrival times formed an exponential distribution pattern with a mean of 21.2 minutes providing the necessary frequency information for the Arrivals area of MedModel. The limited number of locations in the student version did not allow for an ambulance entry point and ambulatory patient entry. All patients enter the simulated EMS through the location, "Enter". The CHCS data revealed differences in arrival rates among the days of the week and the time of the day. The MedModel software provides a Cycle Table to account for the differences during various periods throughout the day based on percentages of arrivals during each period. However, this does not account for the differences in interarrival rates. This project relied on the interarrival rate distribution to define arrivals.

Processing logic is crucial to the model building process since it defines the operation and routing for each entity type at a corresponding location in the system. Once an entity has arrived at a location, processing logic specifies everything that happens to the entity until it exits the system. (ProModel Corporation 1993, 21) Despite the limitations on data collection and use of the student version, the process logic remains fairly close to the actual process within the EMS. Various levels of validation and verification will be discussed in a later section. The following narrative highlights the process logic (see appendix A) and closely follows the process flow chart at figure 2.

A patient arrives at location, *Enter*, according to the defined arrival rate. No time elapses at this location, however, upon departure from *Enter*, the patient's entry time is noted. The Routing section identifies the output from each location, *Patient*, and its corresponding destination, *Waiting_Room*. It also provides a rule for selecting the next location. In all cases (except where noted), the EMS simulation used the *First Available* rule. This routing rule selects the first location listed in a block of routings (that has available capacity).

Upon arrival to the *Waiting_Room*, the patient awaits the availability of the *Triage* location and takes a seat. This location includes one nurse and maintains the capacity of one patient. In many cases, the nurse is helping with patients in the treatment area and occupies the triage area only when a patient arrives. The length of the triage process is an exponential distribution with a mean of five minutes. After this process, the nurse is released and the patient is categorized as urgent or non-urgent.

The *Type_Distribution* is accomplished through a distribution table that identifies 20 percent of the population as urgent cases and 80 percent as non-urgent (see appendix A). An available *Doctor* retrieves the patient from the waiting area and escorts him/her to a treatment bed which is prioritized according to the patient category. If the patient category is urgent, *Type=1*, and the *Action=4*, a physician procedure. This ensures that a patient in this category receives prompt medical treatment that begins with a procedure. Assignment to a treatment bed is identified through the Routing section where urgent patients have priority for *Treatment_4, Treatment_5, and Treatment_1*, in descending order. It is assumed that urgent patients require medical gases and/or monitors which are only available at these beds. Bed number one is exclusively held for urgent patients. If the patient category is non-urgent, *Type*=2, the patient is assigned to the first available bed beginning with *Treatment_10* then descending in priority, *Treatment_8, Treatment_5, and Treatment_4.* This distribution of patients ensures that urgent patients do not wait for the appropriate room.

The next step within the process is a determination of a medical action. Based on the EMS survey, the majority of cases handled within the EMS fall into four categories; a procedure (*Action=1*), a lab test and procedure (*Action*=2), an x-ray and procedure (*Action*=3), and a consult with a specialist (*Action=4*). The distribution of patients among these various actions is defined by an *Action_Distribution* which summarizes information identified by item 2, table 1, as 30 percent requiring procedures, 40 percent requiring lab tests, 20 percent requiring x-rays, and 10 percent requiring consults. A procedure is defined as any action by a physician with nursing assistance. This could include anything from writing a prescription or outpatient consult to a hands-on procedure such as suturing. The collection of data through item 12, table 1, led to a Pearson type V distribution of procedure times. Upon completion of this action, the patient exits the system through location, *Leave*.

Lab testing (*Action*=2) includes an initial physician visit and nursing assistance with collection of the lab sample. The distribution of time required for the initial physician visit was determined through item 6, table 1. This revealed a triangular distribution. Nursing assistance with the lab sample includes drawing blood or obtaining urine samples. The survey did not address this time requirement leading to an estimated exponential distribution with a mean of ten minutes. The lab sample is sent for processing and the patient exits the treatment room as an *Lpatient* and waits for completion of the lab results at location *LabXray_Waiting*. The wait for lab results was determined through item 7, table 1, revealing a Weibull distribution of waiting times. Once the results are ready, *Lpatient* is assigned to the first available bed starting with *Treatment_10* and descending in order, *Treatment_8, Treatment_5,* and *Treatment_4.* An available physician examines the patient for the second time based on the results of the lab sample. This second exam follows the characteristics of a procedure with a similar time distribution. Upon completion of the physician visit, *Lpatient* moves to location *Leave* and departs the system.

A request for an x-ray (*Action=3*) follows a similar path to the lab request. The time distribution for an initial physician visit was determined through item 9, table 1. The resultant Erlang distribution includes the physician visit and any exams before requesting the x-ray. The patient exits the treatment location as *Xpatient* moving to the *LabXray_Waiting* to await the x-ray results. This wait time distribution through item10, table 1, formed a geometric distribution with a mean of forty-four minutes. After the defined waiting period, *Xpatient* moves to the first available treatment bed according to the same process as *Lpatient.* The physician conducts a second exam with similar characteristics to a procedure. *Lpatient* departs the treatment location and exits through *Leave.*

The final alternative action is the specialist consultation (*Action=4*). Time distributions for the initial physician visit and corresponding consultant visit were determined through item 13, table 1. Both reflected exponential distributions with means of fifteen and 24.8 minutes respectively. After the wait, a *Doctor* and *Nurse* assist with the consultation which holds the same characteristics as a procedure. This results in a Pearson type V distribution. After departure from the treatment location, the patient exits through *Leave.*

An urgent patient is assigned as an *Action=4* with assignment to either *Treatment_4, Treatment_5,* or *Treatment_1.* Their corresponding action differs from the other treatment areas. The process is similar except if the patient is urgent, *Type=1*, then a *Nurse* is retrieved to monitor the patient during the waiting period. The *Nurse* remains with the patient through an additional waiting period as coordination is made for admission to a ward. It is assumed that all urgent patients are admitted to a ward. This waiting period forms an exponential distribution with a mean of sixty minutes. Once this waiting period is over, the patient exits the EMS system through the location, *Leave*, and moves to a hospital ward.

Modeling - Phase 2

This phase adds resources and corresponding patient/ staff path networks that define entity and resource movement from location to location. A resource is a person (*Doctor* and *Nurse*), piece of equipment, or other device that is used primarily to move entities, treat entities at locations, or perform some sort of maintenance at a location. A limitation in the EMS project was the consolidation of several types of resources into two categories, *Doctors* and *Nurses*. The physician staff within the EMS consists of residents, interns, and staff physicians. Each runs separate shifts where only staff physicians provide continuous coverage. This simulation did not take into account the extra time required by residents and interns who must consult with staff physicians on diagnoses. To simplify the process logic, all physicians were treated as the same type of resource. The nursing staff was also consolidated into one resource type, *Nurse*. Currently, paraprofessional nursing staff work with registered nurses, RN, with different capabilities.

The shift assignments for physician and nursing staffs were added as external files. MedModel incorporates a Shift Editor allowing the designation of any combination of rotating shifts for each day of the week. The EMS model used six different shift files to incorporate the current staffing (see appendix A). Shift file, MDRN.SFT, accounts for three nursing staff and two physician FTEs that provide continuous coverage. Table 3 outlines the current nurse and physician staffing. MedModel also defines scheduled or unscheduled resource downtimes such as lunch breaks. This facet was not included in the model since the EMS operates as a steady-state system where breaks are taken during a lull in the operation. Movements and actions of these resources were identified through the process logic in the previous phase.

TABLE 3

EMS Staffing by FTE

	Shifts			Alternate Shifts
	Day	Eve	Night	
RN	1	2	1	(1) 1100 - 1500
Paras	3	3	2	
Staff Phys	2	1	1	
Resident				(1) 1300-2300
Intern				(2) 0700-1900 Mon.-Fri.
				(1) 1900-0700 Mon.-Fri.

The next step in phase two was defining path networks which consist of nodes where a resource may stop to perform some task or pick up and drop off entities, and path segments that connect the nodes to each other. (ProModel Corporation 1993, 127) The Path Network section within the MedModel program identifies two networks, *Clinic_Net* and *Provider_Net* (see appendix A). The *Clinic_Net* identifies pathways for patients to travel between locations. The appropriate scale of the background graphics, ensures accurate time requirements when resources and entities travel from location to location. The *Provider_Net* identifies pathways for both types of resources to travel throughout the EMS. The limit of ten locations did not allow for the simulation of all treatment beds. However, interfaces with the various nodes in the *Provider_Net* allowed each resource to graphically move to the second bed at each treatment location.

Modeling - Phase 3

The final phase defines distribution tables, attributes, system functions, statements, variables, and random number streams. The *Action_Distribution* and *Type_Distribution,* described in Phase 1, helped categorize patients and processes through distribution tables. These categories were first identified through the creation of attributes (see appendix A). Attributes are numeric token which are directly assigned to and associated with, an individual system element such as a location or entity. (ProModel Corporation 1993, 203) The *Patient Classification* attribute designated the triage category while *Patient Treatment* identified the various actions.

The third attribute, *Total_Pt_Time*, established a means to record the throughput time of each patient's visit to the EMS. Through this attribute, various system functions and statements were used to tag each patient with the time upon entry and calculated their throughput time upon exit from the EMS. System functions are built-in constructs which when called, return information (i.e. contents of a location) about the system. (ProModel Corporation 1993, 6) The system function, *Clock(),* identifies the elapsed time on the simulation clock. By equating *Total_Pt_Time* and *Clock (),* within the exit logic of the first location, *Enter,* the simulation time was attached to the entity, *Patient.* When this entity exited the model through the location, *Leave*, a LOG statement subtracted the time stored in the attribute from the current simulation clock time and sent the time to a designated file. Statements are commands which define some action or logical operation to be performed. The LOG statement was the key to identifying the throughput time, the main output.

Variables are numeric tokens defined by the user to represent numeric values. The only variable used in the EMS model was *Pt_in_ER* which kept a running tally of the number of patients within the EMS. This numeric value was shown in the animation at location, *Enter*, and helped with verifying the input and output of patients during the simulation runs.

Five random number streams with different seed values were used for all probability distributions. The five categories were based on the action served by the distribution. For example, all patient waiting distributions used the same seed. MedModel allows the modeler to reset seed values after each replication. For this study, seed values were reset between each alternative action and not after each replication.

Validation

Validation is the process of, "making sure that the model reflects the operation of the real system under study in a manner sufficient to address the stated problem." (Harrell and others 1992, 37) The modeler, potential users, and others familiar with the actual operation of the system create a team to review the validity of the model. Validation remained a constant throughout the simulation study maintaining credibility.

There are several different methods of validation used for this study. Chi-square goodness of fit values helped approximate distribution patterns through a software package. The best hypothesized distribution was selected by comparing the computed chi-square value with the critical value of the hypothesized distribution at a 0.05 level of significance (alpha=.05). For example, item 7, table 1, waiting time for lab results, closely resembled a Weibull distribution pattern. The number of degrees of freedom is three (five class intervals minus two factors: total observations and a mean value). The critical value (degrees of freedom = three, and a level of significance =0.05) is 7.815. Since the chi-square value, 2.486, is less than the critical value, 7.815, there is insufficient evidence to declare the hypothesized distribution as not being a good statistical representation of the empirical distribution. (Harrell and others 1992, 56) Therefore, we can use the Weibull distribution to represent the waiting time for lab results.

Interaction with the EMS staff helped address the impact of any assumptions and maintained overall validity of the model. During the initial stages of model development, the nursing and physician staff were led through the process flow diagram which would provide the key to the process logic. Software limitations and the modeler's inexperience contributed to a simplified process logic that did not account for several variances. Differences among physicians and nursing staff were not simulated due to the complexity of developing a process logic for five different resources. These variances will be addressed in Chapter 4, Discussion. A final method of validation is adjusting the input data and comparing the outputs with known responses. An example is comparing the waiting time for physicians in the model and through the collected data. Waiting time for physicians, patient throughput time, and utilization rates of locations and resources were all examples of feedback mechanisms that helped fine tune this simulation.

Verification (Reliability)

Verification ensures the model works the way the modeler intended. This differs from validation which ensures measurement of the right variables. The reliability of simulations is probably its greatest asset. The model will consistently measure the same results over time if the trait or characteristic were remeasured under similar conditions. Several techniques were employed to debug the simulation and ensure the right variables were measured correctly. The greatest attribute of MedModel is the animation which allows close monitoring of the operation. Variable speed control allows visual confirmation of each entry, exit, or movement within the simulation. Supplementing this process is the MedModel trace option. A trace is a list of events that occur over the course of the simulation. The trace listing may be sent to the monitor or a separate file for later viewing. This assisted with the verification process as the step mode allowed the modeler to move through each command while visually confirming the action on the monitor. Each command is displayed on the monitor and can help identify errors in the process logic.

Experimentation

The basis of this experimental design is the addition of location capacity and resources. The study compares the current EMS process to several alternate processes that contain identical events except for the addition of two treatment beds, three nurse FTEs, or three physician FTEs. Harrell (1992) stated an appropriate purpose for an experimental design, "to maximize the usefulness of the information produced from simulation runs, while minimizing effort." Keeping with this spirit, the EMS simulation study includes many assumptions to maintain validity and reliability. To measure the output affected by a change, certain decisions are made on such issues as initial conditions for the simulation run, the length of the warmup period (if required), the length of the simulation run and the number of independent simulation runs (replications) required. (Law and Kelton 1991, 109)

Initial Conditions for the Simulation Run

Initial conditions include the determination of probability distributions to represent a multitude of randomly occurring events. The EMS simulation required probability distributions for data listed in table 1. Through the Statistical Package for the Social Sciences (SPSS), raw data was processed to create a relative frequency histogram. Extreme values, or outliers, may not be represented during this short period and can significantly influence performance responses. The CHCS data, collected in October, and survey data, collected in April, may not represent seasonal differences. This was another limiting factor in the model design. The software package will fit the relative frequency curve to a standard distribution that helps level out data irregularities due to missed outliers. (Harrell and others 1992, 49)

Another initial condition is the determination of the type of simulation that affects output analysis. The distinction between a terminating and nonterminating simulation directly affects the need for a warm-up period before collecting information. A terminating simulation is one for which there is a natural event that specifies the length of each simulation run (replication). (Law and Kelton 1991, 529) For example, a bank closes each evening at 5:00 P.M. and opens each day at 9:00 A.M. A simulation study measuring customer satisfaction may be a terminating simulation since the number of customers present at the closing and opening is zero. A nonterminating simulation is one for which there is no natural event to specify length of a run. (Law and Kelton 1991, 530) The WRAMC EMS is in a steady-state condition since there is no natural event where the patient population is consistently zero. The EMS never closes and patient arrivals could occur at any time.

Length of the Warm-up Period

A steady-state simulation requires a warm-up period to reach a point in time where the state of the model is independent of the initial start-up conditions. Reliable data can be collected once the model achieves a steady-state condition. The Welch graphical method (Law and Kelton 1991, 545) is one method of determining the length of the warm-up period. This approach uses moving averages calculated from the output produced by multiple model replications. The EMS model used five replications to gather average throughput times for each hour in a day (see appendix B). Various "windows" of moving averages (w=5, w=8, and w=12) used the average throughput time for each hour across the five replications. These values were plotted on a line graph to determine a "flattening-of-the-curve." (see figure 5) The point where the graph flattens displays the steady-state condition and the length of the warm-up period, nine hours.

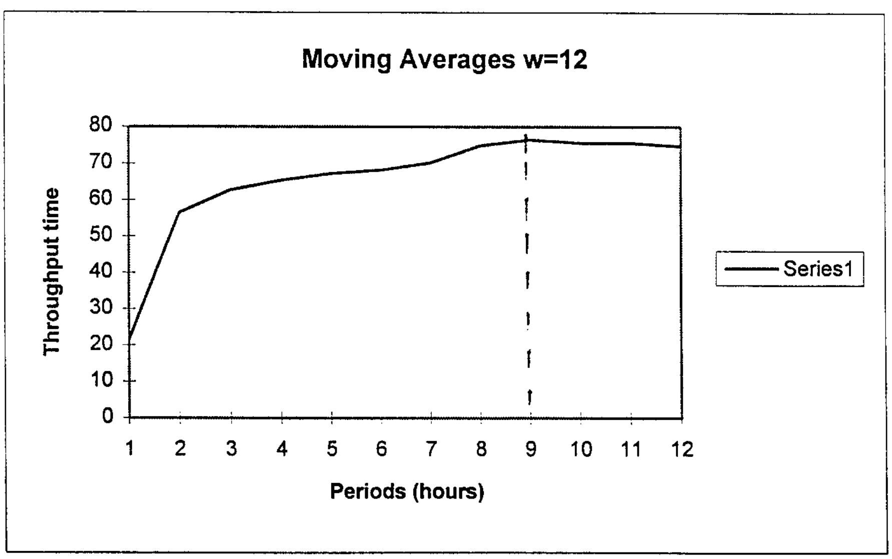

Figure 5. EMS Model Warm-up Period Determination, "Flattening-of-the-Curve."

<u>Number of Independent Simulation Runs</u>

Another essential method for improving the reliability of output results is to perform multiple runs or replications of the simulation. A study cannot compare two systems, which produce stochastic data, based on a single simulation run or replication. One approach to computing the number of replications required to attain a defined degree of accuracy is described in table 4. Ten independent simulation runs provided an average throughput time for each run. Using the formula in table 4, led to an estimate of seven replications based on an alpha=.05. This infers that with seven replications, the project is 95 percent confident that the point estimate of the average throughput does not vary from the true mean by more than ten minutes.

Make Production Runs

The model continuously revisits the validity and verification steps. At some point, the modeler decides that the time spent perfecting the model is not worth the added benefits. Running a MedModel program is simple once all the processing errors are solved. The animation continues to provide the verification of the appropriate process. Three alternative courses of action were each run through seven replications and compared to the replications of the original model. In the first alternative, one treatment bed was added to locations *Treatment_10* and *Treatment_4* raising their capacities to three. Adding three

TABLE 4

EMS Model Replication Determination

ith Replication	Avg. Thrupu	(xi-x(mean))**2	
1	71.50	184.1449	
2	91.00	35.1649	
3	88.40	11.0889	
4	73.20	140.8969	
5	106.60	463.5409	
6	72.90	148.1089	
7	97.10	144.7209	
8	92.30	52.2729	
9	79.20	34.4569	
10	78.50	43.1649	
Total =	850.70	1257.5610	
Mean =	85.07	139.7290	=s(10)**
		11.8207	=S(10)

N= [(t * s(n)) / e]**2
N= ((2.262*11.821)/10)**2
= 7.149795758 replications

N= number of model replications needed to achieve
a desired accuracy level.
t=critical value from a t-distribution
e= amount of error between the est. and true means.
S(n)= point est. of σ based on "n" model replications

RN FTEs in the second alternative provided another *Nurse* to each shift. The final alternative provided a similar addition except the resource added was a *Doctor*.

Analyze Output Data

The goal of this step in the simulation process is to decide the best alternative compared with some specified measure of performance. (Law and Kelton 1992, 109) The EMS study based this decision on the statistically significant reduction of patient throughput times. The EMS model used a hypothesis test to decide if the mean of observed differences in throughput times were significantly different from zero. The MedModel outputs are included at appendix C, D, E, and F for the original model and alternatives one through three. The presentation of results and analysis of data will follow in Chapters 3 and 4.

Presentation and Implementation

The last step in the simulation process is to define all costs and benefits to implement the proposed solution. A simulation provides the quantitative information that displays the potential benefits. These benefits will be discussed in Chapter 4.

CHAPTER 3

RESULTS

The EMS project required four separate simulation runs of seven replications each to determine the mean differences between the various scenarios. The descriptive statistics of the seven replications for each scenario are listed in table 5. The EMS study tested three hypotheses for point biserial

TABLE 5

Descriptive Statistics for Throughput Times, Replications=7

Variables	n	Mean	SD
MODEL	7	188.99	69.103
2 Beds	7	235.33	80.698
3 RN FTE	7	287.45	208.35
3 Phys FTE	7	153.78	41.667

correlations between the original model and the three alternatives. These hypotheses tested for significant mean differences of patient throughput times for each alternative paired with the original model. The alpha level was set at .05 critical probability and a Paired t-Test was used to compare the three alternatives to the original model. This t-test was appropriate since the number of model replications performed for each alternative was equal. The common random number streams were also reset to the same stream for each alternative creating paired values for mean comparisons. The critical value for $p<.05$ with six degrees of freedom was 1.943. The results of the Paired t-Tests are listed in table 6. Statistix version 4.1 by Analytical Software was used to run the Paired t-Tests. Two alternatives, increased beds and nurses, did not show significant

TABLE 6

Paired T Test for Throughput Times
Listed Variables Paired with the Original Model

Variables	n	Differences Mean	SD	df	T	
2 Beds	7	-46.341	16.441	6	-2.82	not signif.
3 RN FTE	7	-98.464	53.493	6	-1.84	not signif.
3 Phys FTE	7	35.211	13.167	6	2.67	p<.025

differences leading to acceptance of the null hypothesis (Ho). In fact, negative T values reflected an increase in throughput times for both alternatives. Only the addition of three physician FTEs significantly reduced the patient throughput times. In this hypothesis, the null (Ho) was rejected and the alternate (Ha) accepted. The t-value indicates that there is less than a 2.5 percent chance that any mean differences between the original model and the physician alternative is due to chance alone. We can conclude that the productivity significantly increases when physicians are added to the system. Any decrease in throughput times associated with additional beds and nurses were probably due to chance alone.

CHAPTER 4

DISCUSSION

The results of these simulation runs were somewhat surprising especially in the alternative which added physicians. However, throughout the development of the model, many factors limited the model's validity relying on several assumptions. This leads to an appropriate separation of this chapter into two parts; a discussion of the results and their possible causes, and a summary of the model's limitations.

Interpretation of Results

To interpret the results, the study analyzed functions contributing to throughput times for the physician alternative and the original model. *LabXray_Waiting* and *Waiting_Room* average minutes per entry for the original model were 43.9 and 75.0 minutes respectively (see appendix C). The former relied on a stated time distribution which limits its affect on the overall throughput time. *Waiting_Room* average minutes per entry for the additional bed and RN alternatives were not significantly lower, 116.4 and 159.2 minutes respectively (see appendices D and E). The physician alternative revealed a larger reduction of average minutes per entry of 47.5 minutes. This reduction of

27.5 minutes accounts for the majority of the differences in throughput means between the original model and the physician alternative. These results would lead to a conclusion that the main factor in physician wait times was not the availability of beds, but the availability of physicians. Other variables contributing to the throughput time did not lead to significant time reductions among the alternatives.

Further analysis supported the model's validity by comparing results with actual throughput times from CHCS data. This revealed a mean throughput time of 131.1 minutes with a standard deviation of 98.54 for a sample size of 1945. The throughput times from the original model ranged from 114.3 to 326.0 minutes with a mean of 189.0. A simple T-test comparing means (189.0 and 131.1) reveals no significant differences(T=5.53<t(.05)=6.34). There is a greater than 95 percent chance that these differences are due to chance alone.

EMS Simulation Limitations

The results listed in the previous chapter would lead the EMS to consider the addition of three physician FTEs. However, this project identified many limiting factors and assumptions that may have skewed the results. In Chapter 2, arrivals were described as the main input to the EMS model. MedModel allows for hourly differences in arrivals through a Cycle Table that uses a distribution of the number of arrivals per day. Interarrival times could not be incorporated into the Cycle Table leaving an EMS model that did not account for varying arrivals based on the time of day or day of week. These differences were significant as demand peaked during the hours of 6:00 A.M. and 6:00 P.M. Data collected through CHCS also showed significant differences in patient demand between the days of the week with Monday, Tuesday, and Friday identified as peak times. Inaccurate accounting of arrivals may have contributed to differences between the actual and simulated throughput times.

Throughout the original simulation, various data collected through CHCS were compared to the modeling times. Patient waiting times for physicians were significantly higher, seventy-five minutes, than the collected data, thirty-five minutes. This difference would question the validity of the EMS model.

Another limitation was the consolidation of physician and nurse types despite differences in abilities and speed in accomplishing work. Medics and RN s accomplish different tasks, while Residents and Interns must receive approval for each diagnosis from a staff physician. This assumption simplified the process logic, but may have hurt the model's validity. The model also assumed minimal impact of administrative responsibilities. The nature of military health care creates many requirements and responsibilities not normally found in civilian health care organizations.

The actual process logic and flow of EMS staff relied on several assumptions. The resource, *Nurse*, moved from the nursing area to the triage area as each patient entered the system. This process assumes that a staff member is not required to monitor patients in the waiting area. Another assumption is the minimal effects of nursing staff departing the EMS to deliver lab samples. This action would shut down a resource for a short period of time when a physician ordered a lab work-up.

Another potential limitation to the EMS model was the collection of data. As noted in Chapter 2, the retrospective data collected through CHCS helped prevent any bias. However, the limited information produced by this system led to the use of patient surveys which relied on the validity and reliability of the survey. In many cases, survey results were eliminated due to inaccurate or incomplete information. This left a relatively small sample size of 109 respondents over a three week period compared to the CHCS data sample size of 2004 over a four week period.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Despite the limitations and assumptions addressed in the previous chapter, this study met its original purpose. Through the development of the EMS simulation, it was demonstrated that this tool is an effective means of identifying problem areas. Three hypotheses were tested and only one, the addition of three physician FTEs, significantly reduced the patient throughput times. The true benefit of simulations is the cause-and-effect analysis that allows organizations to measure the effect of a change without the investment of resources. This project allowed the EMS to look at three alternative solutions to the problem of extended patient throughput times. Only one proved to cause significant differences which avoided costly implementation of the other alternatives. Additional treatment beds or RN s would have led to costly construction or recruitment of additional nursing staff. In each of these cases, reversing the decision once implemented would add to the cost.

Simulations provide an appropriate tool for the health care industry which must adjust to a constant variation in demand. The rapid changes in health care today will not only affect patient demand, but also how we provide care in the future. These changes have caused health care organizations to reduce costs through improved efficiency. Modeling is one tool that provides quantitative information for cost-benefit analyses when evaluating different alternatives to improve efficiency.

The EMS simulation exhibited several benefits and limitations. Future studies on the WRAMC EMS or other clinical areas should use this study as a basis and adjust for the identified limitations and assumptions. Further modeling of the EMS should add check points along the patient flow that measures the patient's throughput time at a specific point in the process. This would help validate the model and make comparisons to actual data.

The importance of data collection was mentioned several times throughout this study. More accurate data could be collected through modification of CHCS fields in the EMS format. Another improvement in data collection is the patient survey which supplemented the CHCS data. In future studies, more time may allow the development of an accurate survey that maximizes patient input.

These recommendations for improvement in the modeling process will help future modelers use the MedModel program. Civilian health care organizations such as Presbyterian Hospital in Dallas and Kaiser Permanente have identified the value of simulations. Their investment in management engineering leads to creating a more efficient health care delivery system. Competition in the managed care environment is fierce and if the Department of Defense is to compete, we must invest in management tools such as simulations.

Formatted Listing of Model:
A:\ER.MOD

Time Units: Minutes
Distance Units: Feet

Locations

Name	Cap	Units	Stats	Rules
Enter	1	1	Basic	Oldest, No Queue,
Leave	1	1	Basic	Oldest, No Queue,
Waiting_Room	19	1	Detailed	Oldest, FIFO,
Treatment_1	2	1	Detailed	Oldest, FIFO,
Treatment_4	2	1	Detailed	Oldest, FIFO,
Treatment_5	2	1	Detailed	Oldest, FIFO,
Treatment_8	2	1	Detailed	Oldest, FIFO,
Treatment_10	2	1	Detailed	Oldest, FIFO,
LabXray_Waiting	6	1	Detailed	Oldest, FIFO,
Triage	1	1	Detailed	Oldest, FIFO,

Entities

Name	Stats	Speed (fpm)
Patient	Detailed	100
Lpatient	Detailed	100
Xpatient	Detailed	75

Processing

```
                                  Process                              Routing

Entity   Location        Operation           Blk Output   Destination      Rule
-------- --------------- ------------------  --- -------- ---------------  ----
Patient  Enter           0                   1   Patient  Waiting_Room     FIRS


Patient  Waiting_Room    Graphic 2           1   Patient  Triage           FIRS
Patient  Triage          Get Nurse
                         Wait E(5,1)
                         Free Nurse
                         TYPE=Type_Distribution()
                         GRAPHIC 1
                         GET Doctor
                         If TYPE=1
                             then
                         {
```

```
                              Action=4
                              Route 1
                             }
                                else
                             {
                               Action=Action_Distribution ()
                               Route 2
                             }                    1  Patient  Treatment_4    FIRS
                                                     Patient  Treatment_5    ALT
                                                     Patient  Treatment_1    ALT
                                                  2  Patient  Treatment_10   FIRS
                                                     Patient  Treatment_8    ALT
                                                     Patient  Treatment_5    ALT
                                                     Patient  Treatment_4    ALT
Patient   Treatment_10       Graphic 3
                             IF Action=1 THEN
                             {
                               Get Nurse
                               P5(1.14,3.73,2)
                                Free All
                                Graphic 1
                                Route 1
                             }
                             If Action=2 then
                             {
                                 T(0,0,49,3)
                                Free Doctor
                                Get Nurse
                                 E (5,2)
                                 Free Nurse
                                 Route 2
                             }
                             If Action=3 then
                             {
                                 ER(1, 32.91,3)
                                 Free Doctor
                                 Route 3
                             }
                             If Action=4 then
                             {
                                T(0, 0, 49,3)
                                Free Doctor
                                Wait E(24.8,4)
                                Get Doctor
                                Get Nurse
                                P5(1.14, 3.73,2)
                                Free All
                                Graphic 1
                                Route 1
                             }                    1  Patient  Leave             FIRS
                                                  2  Lpatient LabXray_Waiting   FIRS
                                                  3  Xpatient LabXray_Waiting   FIRS
Lpatient  Treatment_10       Graphic 3
                             Get Doctor
                             L(3.48,1.06,2)
                             Free Doctor
                             Graphic 1            1  Lpatient Leave             FIRS
Xpatient  Treatment_10       Graphic 2
                             Get Doctor
                             P5(.82, 30.27,2)
                             Free Doctor
                             Graphic 1
```

```
                                                1    Xpatient Leave              FIRS
Patient   Treatment_8         Graphic 3
                              If Action=1 then
                              {
                                    Get Nurse
                                     P5(1.14, 3.73,2)
                                     Free All
                                     Graphic 1
                                     Route 1
                              }
                              If Action=2 then
                              {
                                     T(0, 0, 49,3)
                                     Free Doctor
                                     Get Nurse
                                     E(5,2)
                                    Free Nurse
                                    Route 2
                              }
                              If Action=3 then
                              {
                                       ER(1, 32.91,3)
                                    Free Doctor
                                    Route 3
                              }
                              If Action=4 then
                              {
                                     T(0, 0, 49,3)
                                    Free Doctor
                                    Wait E(24.8,4)
                                    Get Doctor
                                    Get Nurse
                                    P5(1.14, 3.73,2)
                                    Free All
                                        Graphic 1
                                    Route 1
                              }                 1    Patient  Leave              FIRS
                                                2    Lpatient LabXray_Waiting FIRS
                                                3    Xpatient LabXray_Waiting FIRS
Lpatient Treatment_8          Graphic 3
                              Get Doctor
                              L(3.48, 1.06,2)
                              Free Doctor
                              Graphic 1
                                                1    Lpatient Leave              FIRS
Xpatient Treatment_8          Graphic 2
                              Get Doctor
                              P5(.82, 30.27,2)
                              Free Doctor
                              Graphic 1
                                                1    Xpatient Leave              FIRS
Patient   Treatment_5         Graphic 3
                              If Action=1 then
                              {
                                     Get Nurse
                                    P5(1.14,  3.73,2)
                                    Free All
                                        Graphic 1
                                    Route 1
                              }
                              If Action=2 then
                              {
```

```
                            T(0, 0, 49,3)
                           Free Doctor
                           Get Nurse
                           E(5,2)
                           Free Nurse
                           Route 2
                     }
                     If Action=3 then
                     {
                            ER(1, 32.91,3)
                           Free Doctor
                           Route 3
                     }
                     If Action=4 then
                     {
                            T(0,0,49,3)
                             If Type=1 then Get Nurse
                           Free Doctor
                           Wait E(24.8,4)
                           Get Doctor
                           If Type=2 then Get Nurse
                           P5(1.14, 3.73,2)
                           Free Doctor
                             If TYPE=1 then
                                Wait  E(60,4)
                            Free Nurse
                            Graphic 1
                            Route 1
                     }                       1   Patient  Leave            FIRS
                                             2   Lpatient LabXray_Waiting FIRS
                                             3   Xpatient LabXray_Waiting FIRS
Lpatient Treatment_5 Graphic 3
                     Get Doctor
                     L(3.48, 1.06,2)
                     Free Doctor
                     Graphic 1               1   Lpatient Leave            FIRS
Xpatient Treatment_5 Graphic 2
                     Get Doctor
                     P5(.82, 30.27,2)
                     Free Doctor
                     Graphic 1               1   Xpatient Leave            FIRS
Patient  Treatment_4 Graphic 3
                     If Action=1 then
                     {
                            Get Nurse
                             P5(1.14, 3.73, 2)
                           Free All
                               Graphic 1
                           Route 1
                     }
                     If Action=2 then
                     {
                            T(0, 0, 49,3)
                           Free Doctor
                           Get Nurse
                           N(5, 2)
                           Free Nurse
                           Route 2
                     }
                     If Action=3 then
                     {
                            ER(1,32.91,3)
```

```
                            Free Doctor
                            Route 3
                      }
                      If Action=4 then
                      {
                             T(0,0,49,3)
                              If Type=1 then Get Nurse
                            Free Doctor
                            Wait E(24.8,4)
                            Get Doctor
                            If Type=2 then Get Nurse
                            P5(1.14,3.73,2)
                            Free Doctor
                             If TYPE=1 then
                                  Wait E(60,4)
                            Free Nurse
                            Graphic 1
                            Route 1
                      }                         1   Patient  Leave             FIRS
                                                2   Lpatient LabXray_Waiting FIRS
                                                3   Xpatient LabXray_Waiting FIRS
Lpatient Treatment_4  Graphic 3
                      Get Doctor
                      L(3.48,1.06,2)
                      Free Doctor
                      Graphic 1                 1   Lpatient Leave             FIRS
Xpatient Treatment_4  Graphic 2
                      Get Doctor
                      P5(.82,30.27,2)
                      Free Doctor
                      Graphic 1                 1   Xpatient Leave             FIRS
Patient  Treatment_1  Graphic 3
                      If Action=1 then
                      {
                            Get Nurse
                            P5(1.14,3.73,2)
                            Free All
                                Graphic 1
                            Route 1
                      }
                      If Action=2 then
                      {
                             T(0,0,49,3)
                            Free Doctor
                            Get Nurse
                            N(5,2)
                            Free Nurse
                            Route 2
                      }
                      If Action=3 then
                      {
                              ER(1,32.91,3)
                            Free Doctor
                            Route 3
                      }
                      If Action=4 then
                      {
                             T(0,0,49,3)
                             If Type=1 then Get Nurse
                            Free Doctor
                            Wait E(24.8,4)
                            Get Doctor
```

```
                                        If Type=2 then Get Nurse
                                        P5(1.14,3.73,2)
                                        Free Doctor
                                          If TYPE=1 then
                                             Wait E(60,4)
                                          Free Nurse
                                          Graphic 1
                                          Route 1
                                }                         1    Patient  Leave                FIRS
                                                          2    Lpatient LabXray_Waiting FIRS
                                                          3    Xpatient LabXray_Waiting FIRS
Lpatient Treatment_1     Graphic 3
                         Get Doctor
                         L(3.48,1.06,2)
                         Free Doctor
                         Graphic 1                        1    Lpatient Leave                FIRS
Xpatient Treatment_1     Graphic 2
                         Get Doctor
                         P5(.82,30.27,2)
                         Free Doctor
                         Graphic 1                        1    Xpatient Leave                FIRS
Xpatient LabXray_Waiting Wait  W(1.21,54.67,5)
                                                          1    Xpatient Treatment_10         FIRS
                                                               Xpatient Treatment_8          ALT
                                                               Xpatient Treatment_5          ALT
                                                               Xpatient Treatment_4          ALT
Lpatient LabXray_Waiting Wait  Geo(0.0231,5)
                                                          1    Lpatient Treatment_10         FIRS
                                                               Lpatient Treatment_8          ALT
                                                               Lpatient Treatment_5          ALT
                                                               Lpatient Treatment_4          ALT
Patient  Leave                                            1    Patient  EXIT                 FIRS

Lpatient Leave                                            1    Lpatient EXIT                 FIRS

Xpatient Leave                                            1    Xpatient EXIT                 FIRS


********************************************************************************
*                                   Arrivals                                   *
********************************************************************************

  Entity   Location Qty each   Occurrences Frequency  First Time Logic
  -------- -------- ---------- ----------- ---------- ---------- ------------
  Patient  Enter    1          inf         E(21.2)    0

********************************************************************************
*                                  Resources                                   *
********************************************************************************

                         Res          Ent
  Name     Units Stats   Search       Search       Path         Motion
  -------- ----- ------- ------------ ------------ ------------ ------------
  Nurse    5     By Unit Least Used   Oldest       Provider_Net Empty: 150
                                                   Home: N3     Full: 125
                                                   (Return)     Accel:
                                                                Decel:
```

						Pickup: Deposit:
Doctor	5	By Unit	Least Used	Oldest	Provider_Net Home: N1 (Return)	Empty: 150 Full: 125 Accel: (59) Decel: Pickup: Deposit:

****
* Path Networks *
****

Name	Queuing	T/S	From	To	BI	Dist/Time	Speed
Clinic_Net	No	Speed & Distance	N1	N2	Bi	7.00	1
			N2	N3	Bi	5.00	1
			N2	N4	Bi	10.00	1
			N4	N5	Bi	16.00	1
			N5	N6	Bi	7.07	1
			N5	N7	Bi	8.00	1
			N7	N8	Bi	10.00	1
			N8	N9	Bi	9.00	1
			N9	N10	Bi	6.08	1
			N9	N11	Bi	27.00	1
			N7	N12	Bi	52.00	1
			N8	N13	Bi	20.00	1
			N13	N14	Bi	15.70	1
			N13	N15	Bi	13.45	1
			N13	N16	Bi	22.81	1
Provider_Net	No	Speed & Distance	N1	N2	Bi	6.00	1
			N3	N4	Bi	5.65	1
			N2	N4	Bi	6.00	1
			N4	N5	Bi	15.04	1
			N2	N6	Bi	9.00	1
			N6	N7	Bi	19.26	1
			N6	N8	Bi	18.16	1
			N6	N9	Bi	18.00	1
			N9	N10	Bi	9.00	1
			N10	N11	Bi	36.85	1
			N10	N12	Bi	9.05	1
			N9	N13	Bi	36.00	1
			N13	N14	Bi	15.00	1
			N4	N15	Bi	24.08	1
			N15	N16	Bi	36.81	1

****
* Interfaces *
****

Net	Node	Location
Clinic_Net	N1	Enter
	N3	Waiting_Room
	N12	LabXray_Waiting
	N4	Triage
	N6	Leave
	N10	Treatment_8
	N11	Treatment_10

```
              N14          Treatment_4
              N15          Treatment_5
              N16          Treatment_1
  Provider_Net N13         Triage
              N12          Treatment_8
              N11          Treatment_10
              N8           Treatment_4
              N7           Treatment_5
              N5           Treatment_1
              N14          Waiting_Room


********************************************************************************
*                            Distribution tables                               *
********************************************************************************

  ID                  Cumulative   Type         Percentage   Value
  ------------------- ------------ ------------ ------------ ------------
  Type_Distribution   No           Discrete     20           1
                                                80           2
  Action_Distribution No           Discrete     30           1
                                                40           2
                                                20           3
                                                10           4


********************************************************************************
*                                Cycle tables                                  *
********************************************************************************

  ID              Qty / %      Cumulative   Time (Hours) Value
  --------------- ------------ ------------ ------------ ------------
  Clinic_Arrivals Percent      No           6            6.4
                                            12           37.5
                                            18           34.4
                                            24           21.7


********************************************************************************
*                                 Variables                                    *
********************************************************************************

  ID         Type         Initial value Stats
  ---------- ------------ ------------- --------
#
#Number of Pts in ER
  Pt_in_ER   Real         0             Detailed


********************************************************************************
*                                 Attributes                                   *
********************************************************************************

  ID            Type         Classification
  ------------- ------------ -------------
#
#Patient Classification  1=urgent, 2=nonurgent
  TYPE          Integer      Entity
#
#Patient Treatment: 1=procedure
#                                       2=lab
#                                       3=xray
```

```
#                                                  4=consult
  ACTION          Integer        Entity
#
#Time patient stays in the ER
  Total_Pt_Time Real            Entity
```



```
**********************************************************************************
*                                  Streams                                       *
**********************************************************************************

  Stream #      Seed #        Reset
  ------------ ------------ ------------
  1             13            No
  2             89            No
  3             40            No
  4             29            No
  5             36            No


**********************************************************************************
*                              External Files                                    *
**********************************************************************************

  ID          Type                File Name      Prompt
  ---------- ----------------- -------------- ----------
#
#2nd RN Shift 1100-1100
  RN1         Shift               A:\MDRN.SFT
#
#2nd Staff Day shift
  DOC1        Shift               A:\DOC1.SFT
#
#2nd Intern 0700-1900
  DOC2        Shift               A:\DOC2.SFT
#
#Med. Res.  1300-2300
  DOC3        Shift               A:\DOC3.SFT
#
#Day + Evening Para 0700-2300
  RN2         Shift               A:\RN2.SFT
#
#1 RN, 2 Para, & 2 Docs Full-time
  DOCRN       Shift               A:\MDRN.SFT
#
#Daily  Throughput Times
  THRPT       General Write       A:\THRPT


**********************************************************************************
*                         Resource Shift Assignments                             *
**********************************************************************************

  File ID     Resource    Units       Off-shift Node Break Node Disable
  ---------- ---------- ---------- -------------- ---------- -------
  DOCRN       Nurse       1,2,3       N16            N15        No
  DOCRN       Doctor      1,2         N16            N15        No
  RN1         Nurse       4           N16            N15        No
  RN2         Nurse       5           N16            N15        No
  DOC1        Doctor      3           N16            N15        No
  DOC2        Doctor      4           N16            N15        No
  DOC3        Doctor      5           N16            N15        No
```

TABLE 7

EMS Model Warm-up Period Determination Using the Welch Graphical Method

Period	Repl=1	Repl=2	Repl=3	Repl=4	Repl=5	AVG/per	w=5	w=8	w=12
0	21.4875	11.25	7.54998	30.39	36.76002	21.4875	21.4875	21.4875	21.4875
1	36.08	81.4401	47.10009	47.29328	42.43666	50.87003	56.53312	56.53312	56.53312
2	211.125	82.6976	51.15326	103.92	37.31334	97.24184	62.76097	62.76097	62.76097
3	87.27285	77.19672	76.6002	96.11996	123.1302	92.06399	65.41584	65.41584	65.41584
4	81.65495	49.26	52.14	28.06002	49.59248	52.14149	67.19723	67.19723	67.19723
5	102.7644	48.21326	121.3075	66.99992	107.6075	89.37852	68.1561	68.1561	68.1561
6	90.65204	96.36746	44.18666	25.55	56.0466	62.56055	74.03838	70.14138	70.14138
7	107.5744	67.6449	87.08741	47.28501	41.81505	70.28136	76.3164	74.88913	74.88913
8	69.86776	22.37502	13.8	55.80489	85.64745	49.49902	77.55244	76.41533	76.41533
9	110.2312	49.91006	103.515	89.205	33.32001	77.23625	78.33397	78.61083	75.57163
10	47.95143	81.86804	87.3032	141.1749	76.485	86.95651	81.23635	80.20609	75.53901
11	87.73113	90.78396	91.6749	102.9801	57.79326	86.19266	81.44339	77.7617	74.66808
12	64.04855	69.05006	116.9199	86.5824	43.03998	75.92818	81.10252	77.92094	
13	134.5043	30.09999	171.185	159.1398	59.2625	110.8383	81.80325	79.75949	
14	114.0951	80.82501	160.3776	72.18999	75.816	100.6607	82.36582	77.30485	
15	90.87495	64.27666	91.24673	82.02501	91.91499	84.06767	83.95988	77.89147	
16	69.65673	79.6899	117.7602	88.7802	102.3932	91.65605	83.63628		
17	80.87992	50.41994	40.47999	66.96501	55.31001	58.81097	80.13238		
18	42.32852	110.2351	71.45334	78	87.93	77.98939	79.82373		
19	76.83	13.63002	41.12008	60.13604	86.72001	55.68723			
20	76.04235	61.56	123.1849	122.5651	90.50255	94.77098			
21	87.46661	51.5901	103.3625	91.16505	83.4	83.39684			
22	14.23998	61.30674	62.51008	69.222	30.97002	47.64976			
23	107.2701	71.45511	80.9649	72.53	30.44499	72.53302			

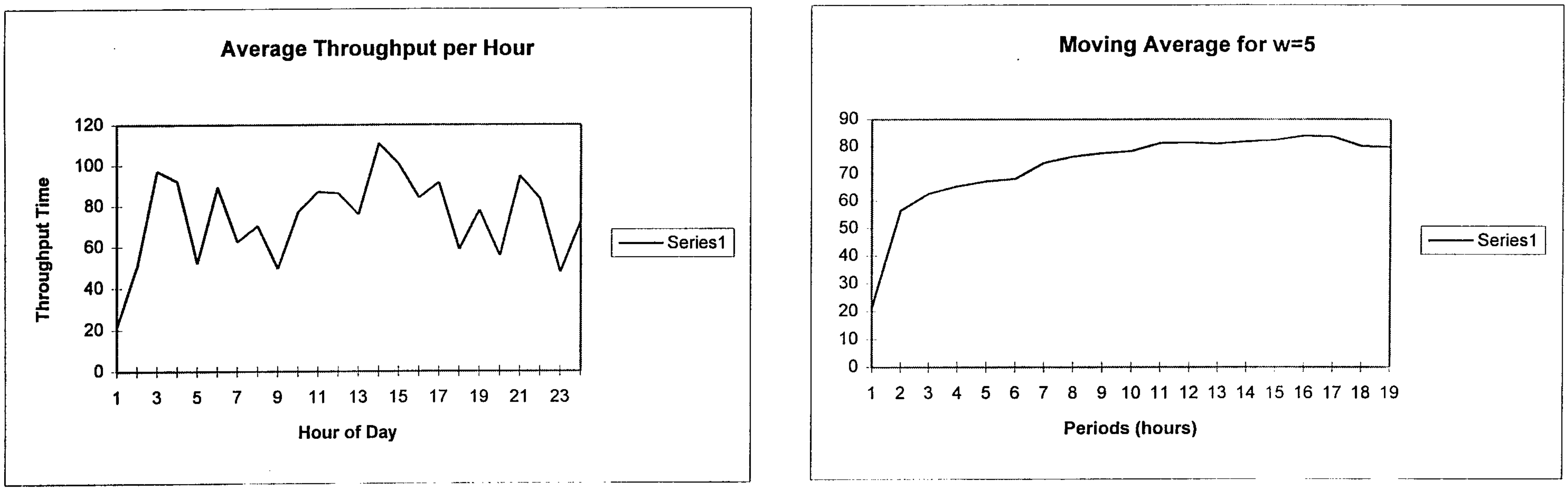

Figure 6. EMS Model Warm-up Period Determination Graphical Plots.

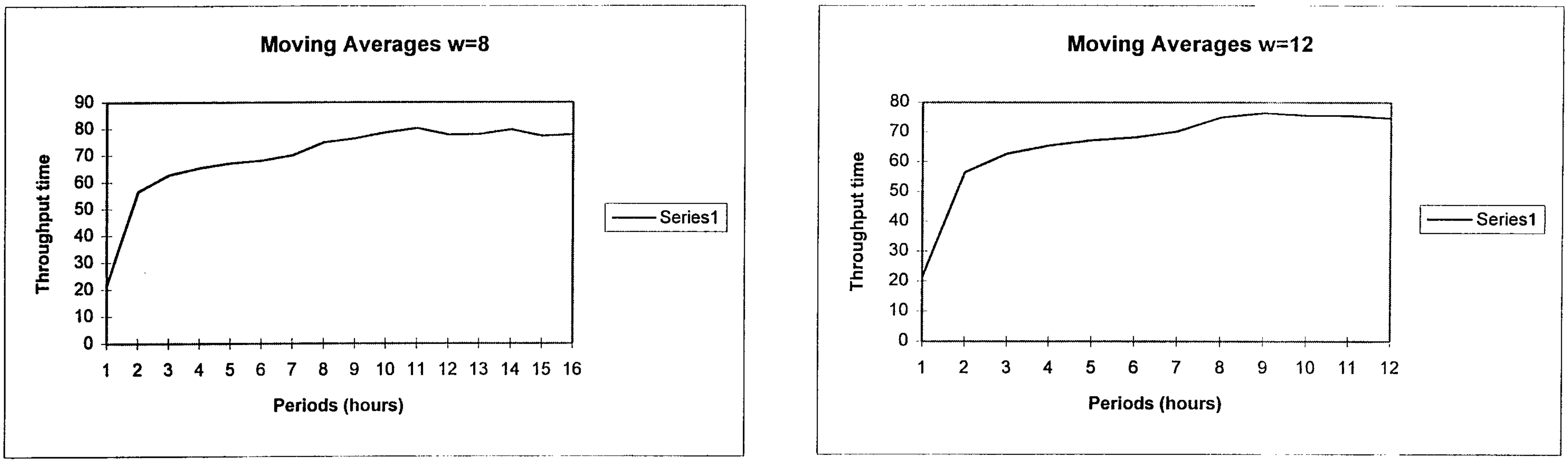

Figure 7. EMS Model Warm-up Period Determination Graphical Plot

MULTIPLE REPLICATION SUMMARY

Statistics for:	Reps	Mean	Median	Std Dev	Std Err	Skewness
Doctor - % In Use	7	68.4711	63.9895	11.6279	4.39494	-0.0456682
Doctor - % In Use Unit 1	7	64.1145	60.7902	12.2776	4.6405	0.12139
Doctor - % In Use Unit 2	7	70.1224	62.9065	17.3877	6.57194	0.243015
Doctor - % In Use Unit 3	7	72.6821	71.5973	10.0437	3.79616	0.635056
Doctor - % In Use Unit 4	7	66.4369	64.4299	12.9199	4.88327	-0.0566906
Doctor - % In Use Unit 5	7	70.4942	71.921	7.53683	2.84865	0.0663022
LabXray_Waiting - % Utilization	7	15.288	15.3281	1.46851	0.555045	0.244888
LabXray_Waiting - Avg Contents	7	0.917278	0.919688	0.0881107	0.0333027	0.244888
LabXray_Waiting - Avg Min/Entry	7	43.8896	42.8386	3.47018	1.3116	0.513952
Lpatient - Total Exits	7	142.857	147	9.33503	3.52831	-1.18281
Nurse - % In Use	7	34.0441	34.6263	4.39026	1.65936	-0.268974
Nurse - % In Use Unit 1	7	32.4668	33.4907	4.0911	1.54629	-0.614188
Nurse - % In Use Unit 2	7	31.7151	32.2501	4.70488	1.77828	-0.230812
Nurse - % In Use Unit 3	7	32.1041	33.8987	4.96845	1.8779	-0.0208727
Nurse - % In Use Unit 4	7	32.1265	32.1608	3.86929	1.46245	-0.57238
Nurse - % In Use Unit 5	7	45.5538	46.5463	5.44567	2.05827	-0.335483
Patient - Total Exits	7	239.429	246	23.3371	8.82059	-0.271591
Patient Thruput Average	7	188.99	174.999	69.1027	26.1184	1.1033
Patient Thruput Maximum	7	2768.83	2317.4	1308.87	494.707	0.139929
Patient Thruput Minimum	7	4.71	4.63	0.616144	0.232881	-0.0973229
Treatment_1 - % Down	7	0	0	0	0	0
Treatment_1 - % Utilization	7	4.39749	4.65293	2.37497	0.897652	-0.500676
Treatment_1 - Avg Contents	7	0.0879498	0.0930585	0.0474993	0.017953	-0.500676
Treatment_1 - Avg Min/Entry	7	161.353	154.762	77.8391	29.4204	1.00042
Treatment_10 - % Down	7	0	0	0	0	0
Treatment_10 - % Utilization	7	67.3492	68.1904	9.76497	3.69081	0.0130273
Treatment_10 - Avg Contents	7	1.34698	1.36381	0.195299	0.0738162	0.0130273
Treatment_10 - Avg Min/Entry	7	45.4231	44.497	16.0133	6.05244	0.912761
Treatment_4 - % Down	7	0	0	0	0	0
Treatment_4 - % Utilization	7	46.2504	47.221	7.34611	2.77657	-0.341055
Treatment_4 - Avg Contents	7	0.925008	0.944421	0.146922	0.0555314	-0.341055
Treatment_4 - Avg Min/Entry	7	125.137	123.633	15.6843	5.92811	1.32255
Treatment_5 - Avg Contents	7	0.560418	0.514525	0.16705	0.0631388	0.184089
Treatment_5 - Avg Min/Entry	7	75.0915	77.6122	12.6915	4.79695	-0.668877
Treatment_8 - Avg Contents	7	0.869755	0.745731	0.278866	0.105401	0.955092
Treatment_8 - Avg Min/Entry	7	56.0909	46.401	40.6099	15.3491	1.58476
Triage - Total Entries	7	449.571	454	30.7075	11.6064	-0.473073
Waiting_Room - % Utilization	7	17.3414	15.0631	10.3699	3.91947	0.53047
Waiting_Room - Avg Contents	7	3.29486	2.86199	1.97029	0.7447	0.53047
Waiting_Room - Avg Min/Entry	7	74.9655	62.8516	50.2446	18.9907	0.912811
Xpatient - Total Exits	7	63.1429	66	6.91444	2.61341	-0.683953

Confidence Intervals for:	90%	95%	99%
Doctor - % In Use	59.939 - 77.0033	57.7251 - 79.2172	51.9212 - 85.0211
Doctor - % In Use Unit 1	55.1056 - 73.1234	52.768 - 75.461	46.6399 - 81.5891
Doctor - % In Use Unit 2	57.3639 - 82.8809	54.0533 - 86.1914	45.3745 - 94.8702
Doctor - % In Use Unit 3	65.3124 - 80.0518	63.4001 - 81.9641	58.387 - 86.9773
Doctor - % In Use Unit 4	56.9568 - 75.9171	54.4968 - 78.3771	48.0481 - 84.8258
Doctor - % In Use Unit 5	64.9639 - 76.0244	63.5289 - 77.4594	59.7671 - 81.2213
LabXray_Waiting - % Utilization	14.2104 - 16.3655	13.9308 - 16.6451	13.1978 - 17.3781
LabXray_Waiting - Avg Contents	0.852626 - 0.981931	0.835849 - 0.998707	0.791871 - 1.04269
LabXray_Waiting - Avg Min/Entry	41.3433 - 46.4358	40.6825 - 47.0966	38.9505 - 48.8286
Lpatient - Total Exits	136.007 - 149.707	134.23 - 151.484	129.571 - 156.144
Nurse - % In Use	30.8226 - 37.2655	29.9867 - 38.1014	27.7954 - 40.2927
Nurse - % In Use Unit 1	29.4649 - 35.4687	28.6859 - 36.2476	26.6439 - 38.2896
Nurse - % In Use Unit 2	28.2628 - 35.1674	27.367 - 36.0632	25.0187 - 38.4115
Nurse - % In Use Unit 3	28.4584 - 35.7497	27.5124 - 36.6957	25.0325 - 39.1756
Nurse - % In Use Unit 4	29.2874 - 34.9657	28.5507 - 35.7024	26.6194 - 37.6337
Nurse - % In Use Unit 5	41.5579 - 49.5496	40.5211 - 50.5865	37.803 - 53.3046
Patient - Total Exits	222.305 - 256.552	217.861 - 260.996	206.213 - 272.644
Patient Thruput Average	138.285 - 239.695	125.128 - 252.852	90.6366 - 287.344
Patient Thruput Maximum	1808.42 - 3729.23	1559.22 - 3978.44	905.917 - 4631.74
Patient Thruput Minimum	4.2579 - 5.1621	4.14058 - 5.27942	3.83305 - 5.58695
Treatment_1 - % Down	0 - 0	0 - 0	0 - 0
Treatment_1 - % Utilization	2.65483 - 6.14016	2.20264 - 6.59235	1.01722 - 7.77777
Treatment_1 - Avg Contents	0.0530965 - 0.12280	0.0440527 - 0.13184	0.0203443 - 0.15555
Treatment_1 - Avg Min/Entry	104.238 - 218.469	89.4172 - 233.289	50.5653 - 272.141
Treatment_10 - % Down	0 - 0	0 - 0	0 - 0
Treatment_10 - % Utilization	60.184 - 74.5144	58.3248 - 76.3736	53.4507 - 81.2476
Treatment_10 - Avg Contents	1.20368 - 1.49029	1.1665 - 1.52747	1.06901 - 1.62495
Treatment_10 - Avg Min/Entry	33.6731 - 57.173	30.6242 - 60.2219	22.6315 - 68.2147
Treatment_4 - % Down	0 - 0	0 - 0	0 - 0
Treatment_4 - % Utilization	40.8601 - 51.6407	39.4614 - 53.0394	35.7947 - 56.7061
Treatment_4 - Avg Contents	0.817202 - 1.03281	0.789228 - 1.06079	0.715894 - 1.13412
Treatment_4 - Avg Min/Entry	113.628 - 136.645	110.642 - 139.632	102.813 - 147.46
Treatment_5 - Avg Contents	0.437843 - 0.682993	0.406037 - 0.714799	0.322657 - 0.798179
Treatment_5 - Avg Min/Entry	65.7789 - 84.4041	63.3625 - 86.8205	57.0277 - 93.1553
Treatment_8 - Avg Contents	0.665133 - 1.07438	0.612038 - 1.12747	0.472847 - 1.26666
Treatment_8 - Avg Min/Entry	26.2928 - 85.889	18.5608 - 93.621	-1.70888 - 113.891
Triage - Total Entries	427.039 - 472.104	421.193 - 477.95	405.866 - 493.277
Waiting_Room - % Utilization	9.73229 - 24.9505	7.75787 - 26.9249	2.5819 - 32.1009
Waiting_Room - Avg Contents	1.84914 - 4.74059	1.474 - 5.11573	0.490562 - 6.09917
Waiting_Room - Avg Min/Entry	38.0978 - 111.833	28.5313 - 121.4	3.45261 - 146.478
Xpatient - Total Exits	58.0693 - 68.2164	56.7528 - 69.5329	53.3016 - 72.9841

Data for:	Sorted Data					
Doctor - % In Use	51.9222	60.0973	62.8294	63.9895	78.3891	80.2381
	81.8323					
Doctor - % In Use Unit 1	48.128	54.8606	55.8026	60.7902	74.099	74.2585
	80.8627					
Doctor - % In Use Unit 2	48.1738	55.2997	62.7196	62.9065	79.8835	86.2501
	95.6232					

Doctor - % In Use Unit 3	64.1215	64.132	64.1852	71.5973	71.8199	84.8592	88.0596
Doctor - % In Use Unit 4	46.6094	58.5862	60.6186	64.4299	70.6383	81.2709	82.9052
Doctor - % In Use Unit 5	61.0294	64.0431	64.1737	71.921	74.81	76.1922	81.2899
LabXray_Waiting - % Utilization	13.5619	13.9318	14.2237	15.3281	15.7953	16.7318	17.4431
LabXray_Waiting - Avg Contents	0.813714	0.835909	0.853425	0.919688	0.947718	1.00391	1.04659
LabXray_Waiting - Avg Min/Entry	39.6243	41.386	41.9202	42.8386	45.2764	46.4192	49.7622
Lpatient - Total Exits	125	135	146	147	148	149	150
Nurse - % In Use	27.1932	30.9938	31.3733	34.6263	36.9422	37.5386	39.6409
Nurse - % In Use Unit 1	25.4764	28.8366	32.1328	33.4907	34.6007	35.2992	37.431
Nurse - % In Use Unit 2	25.5128	26.1877	29.7652	32.2501	35.334	35.6907	37.2653
Nurse - % In Use Unit 3	25.5747	26.8505	29.4291	33.8987	34.3819	35.249	39.3445
Nurse - % In Use Unit 4	25.285	29.8211	31.2519	32.1608	34.2456	35.1953	36.9258
Nurse - % In Use Unit 5	37.5236	40.2355	42.7801	46.5463	50.3302	50.5309	50.9297
Patient - Total Exits	204	218	229	246	252	257	270
Patient Thruput Average	114.267	145.25	149.983	174.999	200.108	212.336	325.988
Patient Thruput Maximum	1261.8	1346.95	2250.35	2317.4	3559.79	4151.86	4493.65
Patient Thruput Minimum	3.83	4.12	4.53	4.63	5.01	5.38	5.47
Treatment_1 - % Down	0	0	0	0	0	0	0
Treatment_1 - % Utilization	0.38869	2.31434	4.606	4.65293	5.21062	6.07307	7.53681
Treatment_1 - Avg Contents	0.00777381	0.0462867	0.09212	0.0930585	0.104212	0.121461	0.150736
Treatment_1 - Avg Min/Entry	78.36	102.028	116.642	154.762	175.077	189.928	312.677
Treatment_10 - % Down	0	0	0	0	0	0	0
Treatment_10 - % Utilization	53.366	57.4253	66.2612	68.1904	70.4095	73.1847	82.6071
Treatment_10 - Avg Contents	1.06732	1.14851	1.32522	1.36381	1.40819	1.46369	1.65214
Treatment_10 - Avg Min/Entry	26.499	32.3378	41.4852	44.497	45.5205	51.2293	76.3927
Treatment_4 - % Down	0	0	0	0	0	0	0
Treatment_4 - % Utilization	34.8655	39.9294	42.7673	47.221	51.5312	52.7986	54.6397
Treatment_4 - Avg Contents	0.697311	0.798587	0.855346	0.944421	1.03062	1.05597	1.09279
Treatment_4 - Avg Min/Entry	111.57	111.802	118.108	123.633	123.675	129.807	157.362
Treatment_5 - Avg Contents	0.324551	0.445649	0.485062	0.514525	0.63624	0.70074	0.81616
Treatment_5 - Avg Min/Entry	52.0151	68.0627	72.6993	77.6122	78.4829	86.4402	90.3282
Treatment_8 - Avg Contents	0.61758	0.631248	0.739814	0.745731	0.883842	1.08207	1.388
Treatment_8 - Avg Min/Entry	24.6056	31.2601	31.6566	46.401	51.787	64.1604	142.766
Triage - Total Entries	394	437	444	454	459	464	495
Waiting_Room - % Utilization	3.30145	10.2034	13.8066	15.0631	20.5149	22.7023	35.798
Waiting_Room - Avg Contents	0.627276	1.93864	2.62325	2.86199	3.89783	4.31344	6.80163
Waiting_Room - Avg Min/Entry	14.469	39.5577	58.1151	62.8516	85.228	92.7067	171.831
Xpatient - Total Exits	51	58	61	66	67	68	71

MULTIPLE REPLICATION SUMMARY

Statistics for:	Reps	Mean	Median	Std Dev	Std Err	Skewness
Doctor - % In Use	7	75.8975	78.2792	12.4571	4.70832	-1.51831
Doctor - % In Use Unit 1	7	79.2822	77.0675	17.6295	6.66332	-0.491076
Doctor - % In Use Unit 2	7	70.8323	74.9109	11.5283	4.35727	-1.30438
Doctor - % In Use Unit 3	7	81.0502	77.1964	13.1966	4.98785	0.170893
Doctor - % In Use Unit 4	7	71.8741	72.2598	12.9948	4.91158	-0.967404
Doctor - % In Use Unit 5	7	73.4336	75.8246	13.7164	5.18432	-1.05457
LabXray_Waiting - % Utilization	7	14.9585	14.5601	1.62242	0.613218	0.38683
LabXray_Waiting - Avg Contents	7	0.897509	0.873604	0.0973453	0.0367931	0.38683
LabXray_Waiting - Avg Min/Entry	7	43.4645	43.6848	2.86899	1.08438	0.00787385
Lpatient - Total Exits	7	141.571	140	9.94748	3.75979	0.483717
Nurse - % In Use	7	33.5935	33.3356	5.45957	2.06352	0.139011
Nurse - % In Use Unit 1	7	32.3105	31.1607	6.34133	2.3968	0.566243
Nurse - % In Use Unit 2	7	32.6485	32.0034	7.17693	2.71263	0.737875
Nurse - % In Use Unit 3	7	31.3928	33.0872	4.67181	1.76578	-0.0850245
Nurse - % In Use Unit 4	7	30.6571	31.1182	4.12437	1.55887	0.0693363
Nurse - % In Use Unit 5	7	44.1356	42.0648	6.67772	2.52394	0.502541
Patient - Total Exits	7	226.286	231	12.7504	4.81918	-0.157388
Patient Thruput Average	7	235.331	256.991	80.6979	30.501	-0.478787
Patient Thruput Maximum	7	3323.49	2244.86	2767.35	1045.96	1.7912
Patient Thruput Minimum	7	4.73429	4.53	0.679874	0.256968	1.8411
Treatment_1 - % Down	7	0	0	0	0	0
Treatment_1 - % Utilization	7	0.609127	0	0.822864	0.311013	0.650517
Treatment_1 - Avg Contents	7	0.0121825	0	0.0164573	0.00622027	0.650517
Treatment_1 - Avg Min/Entry	7	59.6707	0	77.9098	29.4472	0.513265
Treatment_10 - % Down	7	0	0	0	0	0
Treatment_10 - % Utilization	7	71.9835	73.2067	10.8633	4.10595	-0.717072
Treatment_10 - Avg Contents	7	2.15951	2.1962	0.325899	0.123178	-0.717072
Treatment_10 - Avg Min/Entry	7	58.8391	57.6503	17.3024	6.53971	-0.165058
Treatment_4 - % Down	7	0	0	0	0	0
Treatment_4 - % Utilization	7	36.7492	37.3951	5.8816	2.22303	-0.56215
Treatment_4 - Avg Contents	7	1.10248	1.12185	0.176448	0.066691	-0.56215
Treatment_4 - Avg Min/Entry	7	128.238	123.184	16.319	6.168	0.454418
Treatment_5 - Avg Contents	7	0.43292	0.393317	0.28652	0.108294	0.288176
Treatment_5 - Avg Min/Entry	7	139.342	87.265	116.259	43.9416	1.25767
Treatment_8 - Avg Contents	7	0.66184	0.724076	0.213684	0.0807651	-1.04531
Treatment_8 - Avg Min/Entry	7	52.5937	46.19	22.0014	8.31575	0.790018
Triage - Total Entries	7	434.857	440	21.6828	8.19532	-0.0983992
Waiting_Room - % Utilization	7	26.5762	31.1086	13.707	5.18075	-0.623712
Waiting_Room - Avg Contents	7	5.04949	5.91064	2.60432	0.984342	-0.623712
Waiting_Room - Avg Min/Entry	7	116.363	128.122	61.9046	23.3978	-0.537151
Xpatient - Total Exits	7	63.8571	65	6.79285	2.56746	-0.318369

Confidence Intervals for:	90%	95%	99%
Doctor - % In Use	66.7569 - 85.038	64.3851 - 87.4098	58.1674 - 93.6275
Doctor - % In Use Unit 1	66.3463 - 92.2181	62.9897 - 95.5747	54.1902 - 104.374
Doctor - % In Use Unit 2	62.3732 - 79.2913	60.1783 - 81.4862	54.4242 - 87.2404
Doctor - % In Use Unit 3	71.367 - 90.7334	68.8544 - 93.246	62.2675 - 99.8328
Doctor - % In Use Unit 4	62.339 - 81.4093	59.8648 - 83.8835	53.3787 - 90.3696
Doctor - % In Use Unit 5	63.369 - 83.4982	60.7574 - 86.1098	53.9111 - 92.9561
LabXray_Waiting - % Utilization	13.768 - 16.149	13.4591 - 16.4579	12.6493 - 17.2677
LabXray_Waiting - Avg Contents	0.82608 - 0.968937	0.807546 - 0.987472	0.758958 - 1.03606
LabXray_Waiting - Avg Min/Entry	41.3594 - 45.5697	40.8131 - 46.1159	39.3811 - 47.5479
Lpatient - Total Exits	134.272 - 148.871	132.378 - 150.765	127.413 - 155.73
Nurse - % In Use	29.5874 - 37.5995	28.5479 - 38.639	25.8229 - 41.364
Nurse - % In Use Unit 1	27.6575 - 36.9636	26.4501 - 38.1709	23.2849 - 41.3361
Nurse - % In Use Unit 2	27.3823 - 37.9147	26.0159 - 39.2812	22.4336 - 42.8634
Nurse - % In Use Unit 3	27.9648 - 34.8208	27.0753 - 35.7103	24.7435 - 38.0422
Nurse - % In Use Unit 4	27.6308 - 33.6834	26.8455 - 34.4687	24.7869 - 36.5273
Nurse - % In Use Unit 5	39.2357 - 49.0355	37.9643 - 50.3069	34.6312 - 53.64
Patient - Total Exits	216.93 - 235.641	214.502 - 238.069	208.138 - 244.433
Patient Thruput Average	176.117 - 294.544	160.753 - 309.909	120.474 - 350.188
Patient Thruput Maximum	1292.9 - 5354.07	766.004 - 5880.97	-615.268 - 7262.24
Patient Thruput Minimum	4.23542 - 5.23315	4.10597 - 5.3626	3.76662 - 5.70195
Treatment_1 - % Down	0 - 0	0 - 0	0 - 0
Treatment_1 - % Utilization	0.0053386 - 1.21292	-0.151333 - 1.36959	-0.56205 - 1.7803
Treatment_1 - Avg Contents	0.000106772 - 0.024	-0.00302666 - 0.027	-0.011241 - 0.03560
Treatment_1 - Avg Min/Entry	2.50322 - 116.838	-12.3307 - 131.672	-51.2179 - 170.559
Treatment_10 - % Down	0 - 0	0 - 0	0 - 0
Treatment_10 - % Utilization	64.0124 - 79.9546	61.9441 - 82.023	56.5218 - 87.4452
Treatment_10 - Avg Contents	1.92037 - 2.39864	1.85832 - 2.46069	1.69565 - 2.62336
Treatment_10 - Avg Min/Entry	46.1432 - 71.535	42.8488 - 74.8294	34.2126 - 83.4656
Treatment_4 - % Down	0 - 0	0 - 0	0 - 0
Treatment_4 - % Utilization	32.4335 - 41.0649	31.3137 - 42.1848	28.378 - 45.1205
Treatment_4 - Avg Contents	0.973005 - 1.23195	0.93941 - 1.26554	0.851339 - 1.35361
Treatment_4 - Avg Min/Entry	116.264 - 140.212	113.157 - 143.319	105.011 - 151.465
Treatment_5 - Avg Contents	0.222683 - 0.643158	0.16813 - 0.697711	0.0251188 - 0.84072
Treatment_5 - Avg Min/Entry	54.0353 - 224.648	31.8999 - 246.784	-26.1285 - 304.812
Treatment_8 - Avg Contents	0.505045 - 0.818634	0.46436 - 0.859319	0.357704 - 0.965975
Treatment_8 - Avg Min/Entry	36.4498 - 68.7375	32.2608 - 72.9265	21.2792 - 83.9081
Triage - Total Entries	418.947 - 450.767	414.819 - 454.896	403.996 - 465.718
Waiting_Room - % Utilization	16.5186 - 36.6339	13.9088 - 39.2437	7.0672 - 46.0853
Waiting_Room - Avg Contents	3.13853 - 6.96045	2.64267 - 7.45631	1.34277 - 8.75621
Waiting_Room - Avg Min/Entry	70.9398 - 161.787	59.1533 - 173.573	28.2547 - 204.472
Xpatient - Total Exits	58.8728 - 68.8415	57.5794 - 70.1348	54.1889 - 73.5254

Data for:	Sorted Data						
Doctor - % In Use	49.4093	74.9986	76.5933	78.2792	81.7617	82.1219	88.1182
Doctor - % In Use Unit 1	49.0773	67.592	76.0139	77.0675	89.8199	95.4048	100
Doctor - % In Use Unit 2	47.2983	66.0848	72.0242	74.9109	74.9657	78.3087	82.2331

Doctor - % In Use Unit 3	62.1288	72.5368	75.9504	77.1964	84.1837	95.3551	100
Doctor - % In Use Unit 4	46.3546	69.6651	71.5685	72.2598	73.0458	83.5411	86.6841
Doctor - % In Use Unit 5	46.0134	69.7762	74.6963	75.8246	76.855	80.1184	90.7511
LabXray_Waiting - % Utilization	13.2187	13.2704	14.1212	14.5601	15.6017	16.4382	17.499
LabXray_Waiting - Avg Contents	0.793124	0.796225	0.847274	0.873604	0.936103	0.986294	1.04994
LabXray_Waiting - Avg Min/Entry	39.3429	40.6691	42.7524	43.6848	44.9282	44.9857	47.8886
Lpatient - Total Exits	130	133	137	140	141	154	156
Nurse - % In Use	27.2104	28.0416	30.0148	33.3356	36.1124	39.8707	40.5687
Nurse - % In Use Unit 1	25.3441	26.4551	28.6696	31.1607	34.4501	36.9168	43.1772
Nurse - % In Use Unit 2	25.2904	26.4487	27.8852	32.0034	33.4836	37.9529	45.4755
Nurse - % In Use Unit 3	25.8197	26.2711	27.8564	33.0872	34.5007	34.6623	37.5523
Nurse - % In Use Unit 4	25.6344	26.3468	28.0376	31.1182	32.6313	34.4171	36.4145
Nurse - % In Use Unit 5	37.1623	37.337	41.1912	42.0648	45.7437	50.5343	54.9159
Patient - Total Exits	208	216	217	231	232	237	243
Patient Thruput Average	111.824	140.628	256.1	256.991	260.582	279.108	342.082
Patient Thruput Maximum	1427.64	1824.26	1937.46	2244.86	3150.75	3273.95	9405.48
Patient Thruput Minimum	4.23	4.39	4.46	4.53	4.63	4.66	6.24
Treatment_1 - % Down	0	0	0	0	0	0	0
Treatment_1 - % Utilization	0	0	0	0	0.803869	1.6121	1.84792
Treatment_1 - Avg Contents	0	0	0	0	0.0160774	0.0322421	0.0369583
Treatment_1 - Avg Min/Entry	0	0	0	0	93.135	162.06	162.5
Treatment_10 - % Down	0	0	0	0	0	0	0
Treatment_10 - % Utilization	51.7769	67.6458	70.035	73.2067	74.1378	82.1542	84.9283
Treatment_10 - Avg Contents	1.55331	2.02937	2.10105	2.1962	2.22413	2.46462	2.54785
Treatment_10 - Avg Min/Entry	30.5807	48.8212	56.7576	57.6503	58.1829	79.3719	80.5089
Treatment_4 - % Down	0	0	0	0	0	0	0
Treatment_4 - % Utilization	26.1376	34.3866	35.0906	37.3951	37.884	42.0963	44.2542
Treatment_4 - Avg Contents	0.784129	1.0316	1.05272	1.12185	1.13652	1.26289	1.32763
Treatment_4 - Avg Min/Entry	108.274	116.609	119.523	123.184	129.98	148.022	152.073
Treatment_5 - Avg Contents	0.0390159	0.221915	0.363604	0.393317	0.394192	0.778935	0.839464
Treatment_5 - Avg Min/Entry	56.1829	62.1361	67.1973	87.265	110.374	224.333	367.904
Treatment_8 - Avg Contents	0.254378	0.513222	0.66645	0.724076	0.786874	0.842188	0.845688
Treatment_8 - Avg Min/Entry	30.8931	35.4305	36.7208	46.19	58.7899	67.8568	92.2746
Triage - Total Entries	405	414	422	440	446	453	464
Waiting_Room - % Utilization	5.45871	9.77998	29.9701	31.1086	31.2344	35.7288	42.7532
Waiting_Room - Avg Contents	1.03715	1.8582	5.69431	5.91064	5.93453	6.78848	8.1231
Waiting_Room - Avg Min/Entry	22.4346	41.7163	127.007	128.122	142.876	160.629	191.758
Xpatient - Total Exits	53	58	62	65	67	69	73

MULTIPLE REPLICATION SUMMARY

Statistics for:	Reps	Mean	Median	Std Dev	Std Err	Skewness
Doctor - % In Use	7	73.1443	65.9892	10.9303	4.13127	0.524938
Doctor - % In Use Unit 1	7	71.5469	73.4264	15.2748	5.77332	0.178788
Doctor - % In Use Unit 2	7	68.2247	59.7624	13.9625	5.27732	0.527614
Doctor - % In Use Unit 3	7	82.3122	83.1457	6.27992	2.37359	-0.61618
Doctor - % In Use Unit 4	7	74.7635	75.412	10.9821	4.15086	-0.0477655
Doctor - % In Use Unit 5	7	74.0561	71.9117	11.3442	4.28769	0.442557
LabXray_Waiting - % Utilization	7	14.157	14.7474	2.97525	1.12454	-1.06606
LabXray_Waiting - Avg Contents	7	0.849419	0.884843	0.178515	0.0674724	-1.06606
LabXray_Waiting - Avg Min/Entry	7	43.507	43.7459	2.24394	0.848131	-0.390931
Lpatient - Total Exits	7	128.714	128	25.4081	9.60336	-0.652441
Nurse - % In Use	7	26.9386	25.4786	4.71108	1.78062	0.0383396
Nurse - % In Use Unit 1	7	25.2604	23.9916	4.58497	1.73296	-0.333592
Nurse - % In Use Unit 2	7	24.5413	23.3628	4.59177	1.73553	-0.421927
Nurse - % In Use Unit 3	7	26.0133	27.5759	3.92473	1.48341	-0.374563
Nurse - % In Use Unit 4	7	26.8371	23.3181	7.60475	2.87433	0.908267
Nurse - % In Use Unit 5	7	35.7	35.0933	6.69709	2.53126	-0.461912
Nurse - % In Use Unit 6	7	26.0932	25.6663	2.88857	1.09178	0.332091
Patient - Total Exits	7	209.286	214	42.2954	15.9862	-1.30449
Patient Thruput Average	7	287.454	173.184	208.351	78.7492	1.17387
Patient Thruput Maximum	7	2923.89	2260	1616.75	611.075	1.11216
Patient Thruput Minimum	7	5.34	4.74	1.4723	0.556477	1.2719
Treatment_1 - % Down	7	0	0	0	0	0
Treatment_1 - % Utilization	7	1.16766	0.477381	2.1394	0.808619	1.96908
Treatment_1 - Avg Contents	7	0.0233532	0.00954762	0.0427881	0.0161724	1.96908
Treatment_1 - Avg Min/Entry	7	106.263	96.24	102.536	38.7548	0.843814
Treatment_10 - % Down	7	0	0	0	0	0
Treatment_10 - % Utilization	7	65.3626	61.9457	8.73782	3.30259	0.999001
Treatment_10 - Avg Contents	7	1.96088	1.85837	0.262135	0.0990776	0.999001
Treatment_10 - Avg Min/Entry	7	55.5012	41.7	29.429	11.1231	1.53501
Treatment_4 - % Down	7	0	0	0	0	0
Treatment_4 - % Utilization	7	35.8751	35.1199	5.61447	2.12207	0.385354
Treatment_4 - Avg Contents	7	1.07625	1.0536	0.168434	0.0636621	0.385354
Treatment_4 - Avg Min/Entry	7	137.969	134.434	27.2241	10.2897	0.873964
Treatment_5 - Avg Contents	7	0.340339	0.319495	0.238384	0.0901006	0.807656
Treatment_5 - Avg Min/Entry	7	94.8154	82.5772	34.595	13.0757	1.41284
Treatment_8 - Avg Contents	7	0.808341	0.737575	0.438783	0.165844	0.260174
Treatment_8 - Avg Min/Entry	7	109.251	100.47	84.9729	32.1167	0.94752
Triage - Total Entries	7	405.286	432	77.9823	29.4745	-1.52663
Waiting_Room - % Utilization	7	28.9199	13.4897	25.1807	9.51742	0.577488
Waiting_Room - Avg Contents	7	5.49477	2.56305	4.78434	1.80831	0.577488
Waiting_Room - Avg Min/Entry	7	159.156	57.4124	177.262	66.9989	1.23849
Xpatient - Total Exits	7	64.5714	68	15.6083	5.89938	-1.21355

Confidence Intervals for:	90%	95%	99%
Doctor - % In Use	65.124 - 81.1646	63.0429 - 83.2457	57.5872 - 88.7013
Doctor - % In Use Unit 1	60.3388 - 82.755	57.4305 - 85.6633	49.8064 - 93.2874
Doctor - % In Use Unit 2	57.9795 - 78.4698	55.3211 - 81.1283	48.352 - 88.0974
Doctor - % In Use Unit 3	77.7042 - 86.9202	76.5085 - 88.1159	73.374 - 91.2504
Doctor - % In Use Unit 4	66.7052 - 82.8218	64.6142 - 84.9128	59.1327 - 90.3943
Doctor - % In Use Unit 5	65.7321 - 82.38	63.5722 - 84.5399	57.91 - 90.2022
LabXray_Waiting - % Utilization	11.9738 - 16.3401	11.4074 - 16.9066	9.92231 - 18.3916
LabXray_Waiting - Avg Contents	0.71843 - 0.980407	0.684441 - 1.0144	0.595339 - 1.1035
LabXray_Waiting - Avg Min/Entry	41.8604 - 45.1535	41.4332 - 45.5807	40.3132 - 46.7007
Lpatient - Total Exits	110.071 - 147.358	105.233 - 152.196	92.5511 - 164.877
Nurse - % In Use	23.4817 - 30.3954	22.5848 - 31.2924	20.2333 - 33.6438
Nurse - % In Use Unit 1	21.8961 - 28.6247	21.0231 - 29.4976	18.7346 - 31.7861
Nurse - % In Use Unit 2	21.172 - 27.9106	20.2978 - 28.7848	18.0059 - 31.0767
Nurse - % In Use Unit 3	23.1335 - 28.8931	22.3862 - 29.6404	20.4272 - 31.5993
Nurse - % In Use Unit 4	21.257 - 32.4172	19.8091 - 33.8652	16.0133 - 37.661
Nurse - % In Use Unit 5	30.7859 - 40.6141	29.5108 - 41.8892	26.1681 - 45.2319
Nurse - % In Use Unit 6	23.9736 - 28.2127	23.4237 - 28.7627	21.9819 - 30.2045
Patient - Total Exits	178.251 - 240.321	170.198 - 248.374	149.087 - 269.485
Patient Thruput Average	134.574 - 440.335	94.9043 - 480.005	-9.09018 - 583.999
Patient Thruput Maximum	1737.58 - 4110.21	1429.75 - 4418.03	622.78 - 5225.01
Patient Thruput Minimum	4.25968 - 6.42032	3.97936 - 6.70064	3.24448 - 7.43552
Treatment_1 - % Down	0 - 0	0 - 0	0 - 0
Treatment_1 - % Utilization	-0.40216 - 2.73748	-0.809499 - 3.14482	-1.87734 - 4.21266
Treatment_1 - Avg Contents	-0.00804321 - 0.054	-0.01619 - 0.062896	-0.0375469 - 0.0842
Treatment_1 - Avg Min/Entry	31.0259 - 181.5	11.5033 - 201.022	-39.6755 - 252.201
Treatment_10 - % Down	0 - 0	0 - 0	0 - 0
Treatment_10 - % Utilization	58.9511 - 71.7741	57.2874 - 73.4378	52.9261 - 77.7991
Treatment_10 - Avg Contents	1.76853 - 2.15322	1.71862 - 2.20313	1.58778 - 2.33397
Treatment_10 - Avg Min/Entry	33.9072 - 77.0951	28.304 - 82.6984	13.615 - 97.3873
Treatment_4 - % Down	0 - 0	0 - 0	0 - 0
Treatment_4 - % Utilization	31.7554 - 39.9948	30.6864 - 41.0638	27.8841 - 43.8662
Treatment_4 - Avg Contents	0.952663 - 1.19984	0.920593 - 1.23191	0.836522 - 1.31599
Treatment_4 - Avg Min/Entry	117.993 - 157.945	112.809 - 163.128	99.2207 - 176.716
Treatment_5 - Avg Contents	0.165421 - 0.515256	0.120033 - 0.560644	0.00104855 - 0.6796
Treatment_5 - Avg Min/Entry	69.4308 - 120.2	62.844 - 126.787	45.5766 - 144.054
Treatment_8 - Avg Contents	0.486377 - 1.1303	0.402834 - 1.21385	0.183823 - 1.43286
Treatment_8 - Avg Min/Entry	46.9005 - 171.601	30.7218 - 187.779	-11.6908 - 230.192
Triage - Total Entries	348.065 - 462.506	333.217 - 477.354	294.294 - 516.277
Waiting_Room - % Utilization	10.4431 - 47.3966	5.64876 - 52.1909	-6.91974 - 64.7594
Waiting_Room - Avg Contents	1.98419 - 9.00535	1.07326 - 9.91628	-1.31475 - 12.3043
Waiting_Room - Avg Min/Entry	29.0873 - 289.225	-4.66309 - 322.975	-93.1403 - 411.453
Xpatient - Total Exits	53.1186 - 76.0242	50.1468 - 78.996	42.3562 - 86.7866

Data for:	Sorted Data					
Doctor - % In Use	62.9018	64.9186	65.352	65.9892	79.6809	82.8167
	90.3508					
Doctor - % In Use Unit 1	55.1007	56.2922	58.9112	73.4264	76.3561	89.4447
	91.2972					

Doctor - % In Use Unit 2	55.6371	56.246	58.6186	59.7624	78.2665	78.5253	90.5169
Doctor - % In Use Unit 3	71.1249	78.9789	79.9637	83.1457	86.1042	86.8819	89.986
Doctor - % In Use Unit 4	58.8548	64.8406	70.2612	75.412	80.2552	83.0809	90.6401
Doctor - % In Use Unit 5	62.0711	62.4366	67.3655	71.9117	80.7507	81.1011	92.7557
LabXray_Waiting - % Utilization	8.29395	13.1399	13.675	14.7474	15.3886	16.5668	17.2872
LabXray_Waiting - Avg Contents	0.497637	0.788395	0.820497	0.884843	0.923318	0.99401	1.03723
LabXray_Waiting - Avg Min/Entry	40.1486	41.1162	42.8896	43.7459	45.2752	45.4115	45.9616
Lpatient - Total Exits	84	110	127	128	144	152	156
Nurse - % In Use	19.9001	23.9794	25.1081	25.4786	29.2719	31.0124	33.8195
Nurse - % In Use Unit 1	17.7142	22.6438	23.7324	23.9916	28.9321	28.9602	30.8483
Nurse - % In Use Unit 2	16.7117	22.4253	22.9649	23.3628	27.7073	28.4793	30.1378
Nurse - % In Use Unit 3	19.9102	22.7794	23.6766	27.5759	28.616	28.8055	30.7296
Nurse - % In Use Unit 4	18.4874	22.5713	22.7993	23.3181	27.3544	32.3661	40.9635
Nurse - % In Use Unit 5	24.2581	32.1536	33.0039	35.0933	39.734	42.6404	43.0166
Nurse - % In Use Unit 6	23.0314	23.4355	23.7632	25.6663	27.7826	28.4545	30.5187
Patient - Total Exits	122	205	210	214	218	248	248
Patient Thruput Average	127.83	136.634	151.022	173.184	356.388	368.225	698.899
Patient Thruput Maximum	1401.47	1801.74	1940.32	2260	3427.28	3539.98	6096.46
Patient Thruput Minimum	3.97	4.41	4.53	4.74	5.48	5.93	8.32
Treatment_1 - % Down	0	0	0	0	0	0	0
Treatment_1 - % Utilization	0	0	0.393452	0.477381	0.620238	0.703968	5.97857
Treatment_1 - Avg Contents	0	0	0.00786905	0.00954762	0.0124048	0.0140794	0.119571
Treatment_1 - Avg Min/Entry	0	0	79.32	96.24	125.04	141.92	301.32
Treatment_10 - % Down	0	0	0	0	0	0	0
Treatment_10 - % Utilization	57.2053	59.236	61.2262	61.9457	63.1419	73.4604	81.3229
Treatment_10 - Avg Contents	1.71616	1.77708	1.83679	1.85837	1.89426	2.20381	2.43969
Treatment_10 - Avg Min/Entry	36.4955	37.6323	41.3293	41.7	44.3895	69.8567	117.105
Treatment_4 - % Down	0	0	0	0	0	0	0
Treatment_4 - % Utilization	29.8617	30.381	32.3717	35.1199	36.8867	43.0672	43.4378
Treatment_4 - Avg Contents	0.89585	0.911429	0.971152	1.0536	1.1066	1.29201	1.30313
Treatment_4 - Avg Min/Entry	111.484	116.294	118.665	134.434	139.74	156.91	188.254
Treatment_5 - Avg Contents	0.126375	0.126681	0.15467	0.319495	0.394078	0.483387	0.777686
Treatment_5 - Avg Min/Entry	63.693	74.2414	75.1141	82.5772	99.4396	101.854	166.789
Treatment_8 - Avg Contents	0.335559	0.339018	0.537269	0.737575	1.09394	1.14473	1.4703
Treatment_8 - Avg Min/Entry	31.6417	32.5234	58.233	100.47	107.84	164.581	269.465
Triage - Total Entries	241	378	417	432	450	456	463
Waiting_Room - % Utilization	5.6093	9.43946	10.9845	13.4897	42.6707	50.4927	69.7525
Waiting_Room - Avg Contents	1.06577	1.7935	2.08705	2.56305	8.10744	9.59361	13.253
Waiting_Room - Avg Min/Entry	23.5591	40.1744	45.2419	57.4124	206.894	227.004	513.808
Xpatient - Total Exits	33	61	62	68	71	77	80

MULTIPLE REPLICATION SUMMARY

Statistics for:	Reps	Mean	Median	Std Dev	Std Err	Skewness
Doctor - % In Use	7	61.6256	69.8243	14.2301	5.37849	-0.412005
Doctor - % In Use Unit 1	7	52.65	57.1996	12.5452	4.74165	-0.33047
Doctor - % In Use Unit 2	7	52.8449	58.7099	11.6817	4.41527	-0.540516
Doctor - % In Use Unit 3	7	69.6916	70.3548	7.34984	2.77798	0.102588
Doctor - % In Use Unit 4	7	62.7388	61.7561	13.7174	5.18468	0.261149
Doctor - % In Use Unit 5	7	68.808	63.1344	14.5979	5.51747	1.00901
Doctor - % In Use Unit 6	7	68.9687	64.4692	26.413	9.98316	0.0609501
LabXray_Waiting - % Utilization	7	15.7162	16.2337	2.05565	0.776963	0.354425
LabXray_Waiting - Avg Contents	7	0.942973	0.974025	0.123339	0.0466178	0.354425
LabXray_Waiting - Avg Min/Entry	7	43.6717	43.6363	2.64068	0.998082	0.0682563
Lpatient - Total Exits	7	149.857	151	12.7204	4.80787	0.527488
Nurse - % In Use	7	33.8722	33.8262	3.57012	1.34938	0.933564
Nurse - % In Use Unit 1	7	32.3633	31.9283	4.78048	1.80685	1.51006
Nurse - % In Use Unit 2	7	31.6142	31.7995	3.24811	1.22767	0.42275
Nurse - % In Use Unit 3	7	32.1334	31.553	3.14274	1.18784	0.521981
Nurse - % In Use Unit 4	7	31.6511	31.8717	3.22892	1.22042	0.62645
Nurse - % In Use Unit 5	7	45.2375	44.5579	4.36727	1.65067	0.496149
Patient - Total Exits	7	242.286	244	19.2675	7.28245	0.526121
Patient Thruput Average	7	153.779	158.64	41.6668	15.7486	-0.0776254
Patient Thruput Maximum	7	3009.96	2226.48	1223.88	462.584	0.376897
Patient Thruput Minimum	7	4.65	4.67	0.826458	0.312372	-0.455974
Treatment_1 - % Down	7	0	0	0	0	0
Treatment_1 - % Utilization	7	0.0608773	0	0.161066	0.0608773	2.04124
Treatment_1 - Avg Contents	7	0.00121755	0	0.00322132	0.00121755	2.04124
Treatment_1 - Avg Min/Entry	7	12.2729	0	32.4709	12.2729	2.04124
Treatment_10 - % Down	7	0	0	0	0	0
Treatment_10 - % Utilization	7	63.5567	58.0341	13.2761	5.01788	0.00341342
Treatment_10 - Avg Contents	7	1.9067	1.74102	0.398282	0.150536	0.00341342
Treatment_10 - Avg Min/Entry	7	50.5221	41.5481	21.0669	7.96252	0.547901
Treatment_4 - % Down	7	0	0	0	0	0
Treatment_4 - % Utilization	7	36.6066	37.356	3.4116	1.28946	-0.189217
Treatment_4 - Avg Contents	7	1.0982	1.12068	0.102348	0.0386839	-0.189217
Treatment_4 - Avg Min/Entry	7	121.014	124.675	9.62165	3.63664	-0.269379
Treatment_5 - Avg Contents	7	0.24536	0.222409	0.14525	0.0548993	0.538332
Treatment_5 - Avg Min/Entry	7	60.0766	40.2439	39.7114	15.0095	1.72232
Treatment_8 - Avg Contents	7	0.798631	0.777375	0.416757	0.157519	-0.141594
Treatment_8 - Avg Min/Entry	7	71.2125	56.9584	54.989	20.7839	1.33572
Triage - Total Entries	7	457.571	450	23.2584	8.79084	1.2316
Waiting_Room - % Utilization	7	11.4203	15.3571	7.84525	2.96522	-0.353999
Waiting_Room - Avg Contents	7	2.16985	2.91785	1.4906	0.563393	-0.353999
Waiting_Room - Avg Min/Entry	7	47.4779	58.6948	33.4186	12.6311	-0.207273
Xpatient - Total Exits	7	65.8571	66	8.15329	3.08166	-0.308241

Confidence Intervals for:	90%	95%	99%
Doctor - % In Use	51.1841 - 72.0672	48.4747 - 74.7766	41.3719 - 81.8793
Doctor - % In Use Unit 1	43.4448 - 61.8553	41.0562 - 64.2439	34.7945 - 70.5056
Doctor - % In Use Unit 2	44.2733 - 61.4166	42.0491 - 63.6407	36.2184 - 69.4714
Doctor - % In Use Unit 3	64.2985 - 75.0846	62.8991 - 76.484	59.2306 - 80.1526
Doctor - % In Use Unit 4	52.6735 - 72.8041	50.0617 - 75.4159	43.2149 - 82.2626
Doctor - % In Use Unit 5	58.0966 - 79.5194	55.3172 - 82.2988	48.0309 - 89.585
Doctor - % In Use Unit 6	49.5877 - 88.3496	44.5588 - 93.3785	31.3752 - 106.562
LabXray_Waiting - % Utilization	14.2078 - 17.2246	13.8165 - 17.616	12.7904 - 18.642
LabXray_Waiting - Avg Contents	0.852471 - 1.03347	0.828987 - 1.05696	0.767425 - 1.11852
LabXray_Waiting - Avg Min/Entry	41.734 - 45.6093	41.2313 - 46.1121	39.9132 - 47.4301
Lpatient - Total Exits	140.523 - 159.191	138.101 - 161.613	131.752 - 167.962
Nurse - % In Use	31.2526 - 36.4918	30.5728 - 37.1716	28.7909 - 38.9535
Nurse - % In Use Unit 1	28.8555 - 35.871	27.9453 - 36.7812	25.5592 - 39.1673
Nurse - % In Use Unit 2	29.2308 - 33.9975	28.6124 - 34.616	26.9912 - 36.2372
Nurse - % In Use Unit 3	29.8274 - 34.4394	29.229 - 35.0378	27.6604 - 36.6065
Nurse - % In Use Unit 4	29.2818 - 34.0204	28.667 - 34.6351	27.0554 - 36.2468
Nurse - % In Use Unit 5	42.033 - 48.442	41.2014 - 49.2736	39.0216 - 51.4534
Patient - Total Exits	228.148 - 256.424	224.479 - 260.092	214.862 - 269.709
Patient Thruput Average	123.206 - 184.353	115.272 - 192.286	94.4751 - 213.083
Patient Thruput Maximum	2111.92 - 3908	1878.9 - 4141.03	1268.02 - 4751.91
Patient Thruput Minimum	4.04357 - 5.25643	3.88622 - 5.41378	3.47371 - 5.82629
Treatment_1 - % Down	0 - 0	0 - 0	0 - 0
Treatment_1 - % Utilization	-0.0573074 - 0.1790	-0.087974 - 0.20972	-0.168367 - 0.29012
Treatment_1 - Avg Contents	-0.00114615 - 0.003	-0.00175948 - 0.004	-0.00336734 - 0.005
Treatment_1 - Avg Min/Entry	-11.5532 - 36.0989	-17.7356 - 42.2813	-33.9428 - 58.4885
Treatment_10 - % Down	0 - 0	0 - 0	0 - 0
Treatment_10 - % Utilization	53.8152 - 73.2982	51.2875 - 75.826	44.661 - 82.4525
Treatment_10 - Avg Contents	1.61446 - 2.19895	1.53862 - 2.27478	1.33983 - 2.47357
Treatment_10 - Avg Min/Entry	35.064 - 65.9803	31.0529 - 69.9913	20.5378 - 80.5065
Treatment_4 - % Down	0 - 0	0 - 0	0 - 0
Treatment_4 - % Utilization	34.1032 - 39.1099	33.4537 - 39.7594	31.7508 - 41.4623
Treatment_4 - Avg Contents	1.0231 - 1.1733	1.00361 - 1.19278	0.952525 - 1.24387
Treatment_4 - Avg Min/Entry	113.954 - 128.075	112.123 - 129.906	107.32 - 134.709
Treatment_5 - Avg Contents	0.13878 - 0.351939	0.111125 - 0.379594	0.0386262 - 0.45209
Treatment_5 - Avg Min/Entry	30.9378 - 89.2155	23.3768 - 96.7765	3.55559 - 116.598
Treatment_8 - Avg Contents	0.492829 - 1.10443	0.41348 - 1.18378	0.205463 - 1.3918
Treatment_8 - Avg Min/Entry	30.8635 - 111.562	20.3937 - 122.031	-7.05306 - 149.478
Triage - Total Entries	440.505 - 474.638	436.077 - 479.066	424.468 - 490.675
Waiting_Room - % Utilization	5.66372 - 17.1769	4.17 - 18.6706	0.254193 - 22.5864
Waiting_Room - Avg Contents	1.07611 - 3.2636	0.7923 - 3.54741	0.0482966 - 4.29141
Waiting_Room - Avg Min/Entry	22.9565 - 71.9993	16.5936 - 78.3621	-0.0866666 - 95.042
Xpatient - Total Exits	59.8745 - 71.8397	58.3222 - 73.3921	54.2526 - 77.4617

Data for:	Sorted Data						
Doctor - % In Use	39.7456	49.0612	53.0593	69.8243	70.4176	71.3223	77.9491
Doctor - % In Use Unit 1	33.0151	41.6357	47.1445	57.1996	59.8609	60.5519	69.1426

Doctor - % In Use Unit 2	33.695	42.1779	48.9494	58.7099	59.6711	60.1034	66.6077
Doctor - % In Use Unit 3	58.6033	65.3741	65.5397	70.3548	72.9982	73.4585	81.5123
Doctor - % In Use Unit 4	43.3936	52.8331	56.9015	61.7561	65.3739	74.1802	84.7331
Doctor - % In Use Unit 5	52.5863	62.1645	62.2764	63.1344	65.3348	79.6662	96.4935
Doctor - % In Use Unit 6	37.2897	41.71	53.4294	64.4692	87.2288	98.6535	100
LabXray_Waiting - % Utilization	13.141	14.0131	14.258	16.2337	16.4884	16.7263	19.1529
LabXray_Waiting - Avg Contents	0.788461	0.840786	0.855477	0.974025	0.989305	1.00358	1.14918
LabXray_Waiting - Avg Min/Entry	39.9381	41.4577	42.5885	43.6363	44.175	46.8178	47.0882
Lpatient - Total Exits	134	141	141	151	152	158	172
Nurse - % In Use	29.1735	31.8398	33.1211	33.8262	33.9435	34.2921	40.9091
Nurse - % In Use Unit 1	27.6344	29.3487	31.0122	31.9283	32.0412	32.0439	42.5342
Nurse - % In Use Unit 2	27.243	28.64	31.0059	31.7995	32.5698	32.6943	37.3468
Nurse - % In Use Unit 3	27.4046	31.3436	31.5028	31.553	31.7206	33.484	37.9253
Nurse - % In Use Unit 4	27.6328	28.4962	31.5532	31.8717	31.9018	32.4803	37.6216
Nurse - % In Use Unit 5	39.1289	42.8719	43.1668	44.5579	46.4111	47.5343	52.9915
Patient - Total Exits	219	227	229	244	250	251	276
Patient Thruput Average	93.9521	111.727	142.783	158.64	169.59	185.326	214.437
Patient Thruput Maximum	1684.75	2174.52	2185.11	2226.48	3730.17	4343.7	4725.01
Patient Thruput Minimum	3.27	4.15	4.23	4.67	5.32	5.35	5.56
Treatment_1 - % Down	0	0	0	0	0	0	0
Treatment_1 - % Utilization	0	0	0	0	0	0	0.426141
Treatment_1 - Avg Contents	0	0	0	0	0	0	0.00852282
Treatment_1 - Avg Min/Entry	0	0	0	0	0	0	85.91
Treatment_10 - % Down	0	0	0	0	0	0	0
Treatment_10 - % Utilization	43.534	57.2936	57.6849	58.0341	68.9953	78.439	80.9161
Treatment_10 - Avg Contents	1.30602	1.71881	1.73055	1.74102	2.06986	2.35317	2.42748
Treatment_10 - Avg Min/Entry	26.2245	36.5615	38.7643	41.5481	52.0304	77.7704	80.7558
Treatment_4 - % Down	0	0	0	0	0	0	0
Treatment_4 - % Utilization	31.1814	34.0777	35.2221	37.356	38.0703	38.7547	41.5837
Treatment_4 - Avg Contents	0.935443	1.02233	1.05666	1.12068	1.14211	1.16264	1.24751
Treatment_4 - Avg Min/Entry	107.151	112.276	114.529	124.675	126.511	129.844	132.117
Treatment_5 - Avg Contents	0.0992302	0.116129	0.131751	0.222409	0.2976	0.363216	0.487182
Treatment_5 - Avg Min/Entry	35.712	37.0459	40.0336	40.2439	53.3782	67.8004	146.322
Treatment_8 - Avg Contents	0.203632	0.386808	0.661124	0.777375	1.01319	1.25323	1.29506
Treatment_8 - Avg Min/Entry	25.3409	33.9045	38.4115	56.9584	61.8967	98.8952	183.081
Triage - Total Entries	435	442	450	450	451	471	504
Waiting_Room - % Utilization	0.548042	2.34883	7.79294	15.3571	15.5379	17.9961	20.3611
Waiting_Room - Avg Contents	0.104128	0.446277	1.48066	2.91785	2.95221	3.41926	3.8686
Waiting_Room - Avg Min/Entry	2.37468	9.9966	31.6208	58.6948	63.2514	76.762	89.6449
Xpatient - Total Exits	54	57	64	66	71	74	75

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