

**ALTERNATIVE SOLUTIONS TO 1960'S SINGLE CORRIDOR WARD DESIGN  
IN HOSPITALS: A CASE STUDY BASED ON NURSES' PERSPECTIVES**

by

**Nandita P. Rastogi**

**Thesis submitted to the Faculty of the  
Virginia Polytechnic Institute and State University  
in partial fulfillment of the requirements for the degree**

of

**Master of Science**

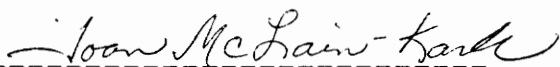
in

**Housing, Interior Design and Resource Management**

**Approved:**



-----  
**Prof. Nancy Canestaro, Chairman**



-----  
**Prof. Joan McLain-Kark**



-----  
**Prof. Len Singer**

**August, 1991**

**Blacksburg, Virginia**

c.2

LD  
5655  
V855  
1991  
R388  
C.2

**ALTERNATIVE SOLUTIONS TO 1960'S SINGLE CORRIDOR WARD DESIGN  
IN HOSPITALS: A CASE STUDY BASED ON NURSES' PERSPECTIVES**

by

Nandita P. Rastogi

Committee Chairman: Prof. Nancy Canestaro

Housing, Interior Design and Resource Management

**(ABSTRACT)**

Many existing hospitals have problems with their ward layouts. However, the increase in construction costs and the decrease in the number of hospitals have made renovation more economical than building new facilities. Compounding the problem of inefficient floor layouts is the increasing severity of cases treated on an inpatient basis.

This research was designed to evaluate the problems faced by nurses working on long corridor patient wards in Montgomery Regional Hospital in Blacksburg, Virginia. It was shown in the study and through previous studies in the literature that these types of wards have physical design problems that affect adversely nurses' activities in patient care.

This study used a time travel method to evaluate the amount of time the nurses spent travelling between the nurses' station, patient rooms and other functional areas.

Nurses perspectives concerning their physical environment and layout were also studied using a questionnaire.

It was found that the travel time on the ward was directly related to the geometry of the ward. It was also shown that the total travel time was dependant on the number of patients in the ward. The average amount of time nurses spent travelling in Ward-A was more than the average time they spent in patient rooms. The average time the nurses spent travelling in Ward-B was less than the average time they spent in patient rooms. In addition to a discussion of the time travel data the study also posed several design solutions to problems found in Montgomery Regional Hospital.

## ACKNOWLEDGMENTS

The process of researching and writing this thesis was a great learning experience for me. I would like to extend my sincere gratitude to my advisor and chairman Prof. Nancy Canestaro for having made it so. I will always be indebted to her for her support, encouragement and understanding. I would also like to take this opportunity to thank her for her patience, and for pushing me in the late stages of my thesis. In addition I would also like to thank my advisory committee members, Prof. Joan McLain-Kark and Prof. Len Singer for their time and highly respected advice. I also take this opportunity to thank the faculty and staff of the Department of Housing, Interior Design and Resource Management for being supportive and encouraging me throughout my master's program. They made my master's program a very pleasant experience. Many thanks are also in order to the fourth floor nursing staff of the Montgomery Regional Hospital for their time, cooperation and assistance during the information gathering stages of this thesis. Finally I would like to offer my sincere gratitude to my parents' for their blessings, support and constant encouragement throughout my master's program. Papa, Mummy, I hope I make you proud one day. To my constant source of strength, my best friend, my husband Prateek, without whom

this thesis would not have been possible, I extend much love and appreciation. Lastly, but not the least, I wish to express my sincere thanks to all my friends who have directly or indirectly helped in completion of my thesis and my masters program.

## TABLE OF CONTENTS

1.	INTRODUCTION .....	1
	Problem Statement .....	10
	Research Objectives .....	10
	Outline of the Research .....	12
2.	LITERATURE REVIEW .....	14
	History of Hospitals .....	18
	Early American Hospitals .....	21
	The Modern Era .....	22
	The Role of Nurses in Hospitals .....	23
	Contemporary Ward Design .....	27
	Privacy in Ward Design .....	28
	Types of Wards .....	39
	Nursing Station Design .....	44
	The Physical Environment and Perceived Work Performance .....	46
	Nursing Unit: Design and Evolution .....	52
	Behavior at a Typical Nurses' Station .....	54
	Traffic Link Distances in Common Nursing Unit Designs .....	55

3.	METHODOLOGY .....	61
	Preliminary Observations .....	68
	Data Collection for the Final Case Study .....	72
4.	RESULTS AND DISCUSSION .....	75
	Description of Data Analysis .....	75
	Description of Results .....	82
	Recommendations .....	100
5.	CONCLUSIONS .....	108
6.	BIBLIOGRAPHY .....	113
	APPENDIX-A .....	121
	APPENDIX-B .....	125
	VITA .....	127



## LIST OF ILLUSTRATIONS

Figure 1.	Typical Layout of Single Corridor Ward .....	6
Figure 2.	Overview of the Problem Statement.....	11
Figure 3.	Outline of the Literature Review.....	15
Figure 4.	Decrease in Total Number of Hospitals.....	16
Figure 5.	Inpatient Days Versus Outpatient Visits.....	17
Figure 6.	Rigs Hospital, Copenhagen (1910).....	31
Figure 7a.	St. Thomas Ward, London (1871).....	34
Figure 7b.	St. Thomas Hospital, Rebuilt (1956).....	35
Figure 8.	Dundee Medical Center, (1961).....	36
Figure 9.	Rochester Methodist Hospital, (1960).....	38
Figure 10.	Nevill Hall Hospital, Abergavenny.....	40
Figure 11.	Rigs Hospital, Copenhagen, (1910).....	41
Figure 12.	Whitesberg Hospital, Virginia (1956).....	43
Figure 13.	Overview of Methodology.....	63
Figure 14.	Fourth Floor Patient Ward in Montgomery Regional Hospital.....	67
Figure 15.	Montgomery Regional Hospital Ward, 2nd Floor.....	69
Figure 16.	Matrix Used to Record Travel Time.....	76
Figure 17.	Comparison of the Combined Time Spent in Ward-A and Ward-B.....	96
Figure 18.	Comparison of Individual Time Spent in Ward-A and Ward-B.....	97
Figure 19.	Conceptual Design Solution on 4th Floor Ward.....	101

Figure 20. Secondary Nurses' Station for Ward-A..... 102  
Figure 21. Linen Shelves Added in the Corridor..... 104  
Figure 22. Detail of Nurses' Station Counter..... 105  
Figure 23. Waiting Lounge Opposite  
Secondary Nurses' Station..... 107

## LIST OF TABLES

Table 1.	Average Time Spent by Nurses with Patients in Ward-A.....	80
Table 2.	Average Time Spent by Nurses with Patients in Ward-B.....	81
Table 3.	Location of Nurses' Station, Medicine Room, and Utility Room.....	84
Table 4.	Location of the Linen Room/Linen Cart.....	85
Table 5.	Accessibility to Patient Rooms, Ward-A.....	85
Table 6.	Accessibility to Patient Rooms, Ward-B.....	87
Table 7.	Efficiency of Fourth Floor Ward.....	87
Table 8.	Communication Between Nurses and Patients.....	88
Table 9.	Time Spent Travelling to Patient Rooms.....	88
Table 10.	Observed Travel Time in Ward-A and Ward-B.....	91
Table 11.	Time Spent in Patient Rooms and Time Spent Travelling.....	95
Table 12.	Nurses' Job Satisfaction.....	99

## CHAPTER 1

### Introduction

In recent years the cost of hospital operations has risen rapidly. Research identified various factors contributing to this increase including: 1) technological changes in medical care and equipment, 2) increased patient demand, and 3) the rising cost of labor and supplies (Snook, 1981). In addition to these factors, the public expects more health services including more skilled and, therefore, more expensive care givers. This public demand has increased over the last two decades, and has been stimulated by rising consumer income levels, increased insurance coverage and changes in the demographic characteristics of the population (Snook, 1981). Hence we can say that hospitals represent a major input in the economics of a state.

Statistics show that the hospital payment strategy adopted by medicine has echoed a broader effort made by private insurers to promote cost-containment measures for their enrollees. These new payment efforts have encouraged hospitals and their medical staffs to emphasize cost efficiency in treating patients (AHA Statistics, 1989-1990).

The most significant trend to emerge in this decade has been the major shift in where the health care services are provided. The results of the new payment system saw a dramatic decline in the number of hospital inpatients and a corresponding increase in the number of outpatients (AHA Statistics, 1989-1990). Payment incentives have encouraged treatment of more patients on an outpatient basis, which has correspondingly increased the severity of cases treated on an inpatient basis (AHA Statistics, 1989-1990). The number of beds per hospital on the other hand, has increased by approximately 2.6%. In addition, hospitals now employ more registered nurses' and fewer licensed practical nurses than they did in the past.

The medical staff has the greatest impact on the quality and quantity of care given in the hospital. These people are the heart of the hospital, rendering medical care to patients. The staff most involved with the direct care of patients are the nurses. There are more than one million practicing nurses in the United States, or twice the estimated half million physicians (Fox, 1989). However, most physicians are engaged in full-time medical practice; whereas many nurses are no longer practicing their profession. Thus, in sharp contrast to the oversupply of physicians there is an increasing concern about the

difficulties in retaining a sufficient number of nurses to fill a wide range of important nursing jobs (Fox, 1989). Hospitals should try every possible way to retain the nurses which they already have in order to remain viable in the total health care environment.

The nursing department is a major part of the medical staff, as it uses 25% of hospital operating costs and 36% of the total salary expenses of hospital employees (Wheeler, 1964). Nurses also play a very important role in the operations and management of a hospital. Hospitalized patients need gentle, courteous and considerate care from skillful understanding personnel. This is typically provided by the nursing staff. For nurses to be able to provide and perform their duties efficiently, their working environment and layout of the wards where their patients are located should be efficient and functional to support their health care activities. It has been seen that an inefficient layout can increase the physical and mental stress in an individual which may inhibit the work activities and lead to unsatisfactory work performance (Kaplan, 1972).

Research has also shown that mental fatigue within an interior environment can inhibit good performance. A well

designed environment would be one in which people could function comfortably and effectively over an extended period of time (Kaplan, 1972).

There is another widely held belief that poorly designed environments extract a cost on those who must use them (Kaplan, 1972). This argument justifies improving the physical hospital environment for the nursing staff, who in turn will be able to function more effectively for their patients.

This study will concentrate first on the evolution of hospital design. This will include a description of the influences of society on the design of hospitals and patient care. The next step will be a description of the evolution of patient wards and the influence of wards on the design of the total hospital from the inside out. From the evolution of patient ward designs, efficiency of nursing units can be discussed as well as the nurses' performance in relation to the layout of the units.

The term "nursing units" for the purpose of this discussion refers to the patient wards, patient rooms,

nurses' station, utility rooms, medication rooms, as well as other ancillary rooms and waiting rooms used for both visitors and patients. A "long corridor ward" consists of halls over 75 feet long which provide access to patient rooms, utility rooms, and other functional areas within the ward. This goes along with the description of corridors in compliance with fire codes (BOCA, 1981). The "nurses' travel time" to and from the nurses' station and functional areas within the long corridor ward is compared to wards where the patient rooms and functional areas are in close proximity to the nurses' station.

The final portion of the thesis is the design of conceptual solutions to problems found in the research with the single long corridor ward in one particular hospital. Single corridor wards have only one hallway for nurse and visitor traffic flow, and patient rooms located on either side of the corridor (See Figure 1). The single corridor ward design has been in existence since the 1960's and can still be seen in many hospitals today.

It was in the late 1970's when cost containment became a vital concern for health care facilities, and decision



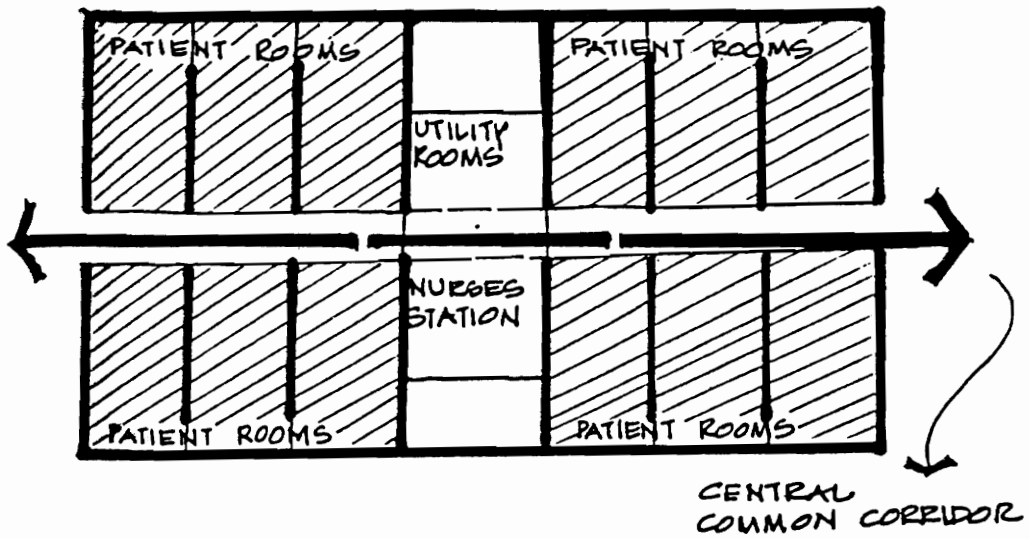


Figure 1: Typical Layout of Single Corridor Ward.

makers began assessing the differences in the cost between new construction and renovation (Levitan, 1979). Seminars stressed renovation of existing facilities rather than building new space (Strugath, 1984). Levitan (1979,) also stated that the financial feasibility of renovation projects over new construction could be examined by looking at various areas, such as foundations, the structural frame, exterior walls, land costs, demolition etc. Upgrading a health care facility could mean, for example, converting acute care hospital beds into critical care beds. Upgrading a health care facility in this way was potentially more expensive than renovating, in that it could incur higher engineering, architectural, and contingency fees (Levitan, 1979). These additional costs could make new construction appear to be the less expensive alternative. However severe limitations of additional land or the scope of projects undertaken compared with institutional size could make renovation the only alternative (Levitan, 1979). Hence with the ever increasing cost of design and construction of hospitals it is important to try and adapt as many of these existing hospitals to meet the current needs of society, as well as improve their efficiency by designing alternative solutions to the existing problems inherent in their designs. This study will focus on just such an issue as

nurses' travel within long single corridor inpatient wards within hospitals.

Montgomery Regional Hospital in Blacksburg, Virginia was the focus of the study. The fourth floor patient wing in this hospital, a long single corridor ward, was used to study potential ward design problems faced by the nurses. Alternative means were explored to reduce nursing staff travel distances in the care of their patients within the ward. This study examined relative locations of functions and facilities in the hospital inpatient nursing unit at one location. Other studies could compare different hospital configurations to the facility arrangement at Montgomery Regional Hospital.

To date not much research has been done in the design of work environments to increase the efficiency and performance of nurses involved in patient care. Herbert McLaughlin's study (1964) on the shape of nursing units focused on comparing the efficiency of differently shaped nursing units. A study conducted in the 1970's by Garfield focused on the design of an ideal nursing unit. It focused on imaginative solutions to common problems in traffic

control and nurse-patient relationships within an ideal nursing unit. A few studies on nursing station design were done late in the 1970's (Goldstein, R. 1979, Gagneaux and Shaver, 1977, Grubbs and Short, 1979). Not much research, however, has been conducted since the late 1970's focusing on the design of nursing units and nursing stations.

Patient care is very important within hospitals and therefore virtually all hospitals focus on the needs of patients in the design of their facilities. It is important to remember, however, that it is the nursing staff who mainly attend to inpatient needs. By providing better working conditions and improving the physical environment on the wards, nurses' performance can be improved, ultimately benefiting the patients. Studies have proven that positive physical environments can promote positive attitudes in the staff. These studies will be described in the next chapter.

History has shown that the design of the wards in hospitals has changed with the changing trends and norms of society. With the increasing cost in health care (including increasing construction costs of hospital facilities) as well as a corresponding steady decrease in the number of hospitals, it becomes important for designers to know how to

adapt existing hospital environments to meet the needs of all involved hospital patients and staff. This case study will examine the possibilities for change in one hospital ward. Other studies can be carried out in different settings that build on the concepts established in this initial study. The next chapter will present the literature relevant to this discussion.

### **Problem Statement**

The existing long corridor patient wards in hospitals today can have physical design problems that affect the nurses' activities within these wards. One particular problem is the long length of single corridor wards. This is directly related to nurses travel distance within the nursing units. The position of the various functional areas within the nursing unit used in patient care also affects the nurses' activities and the time that nurses use to perform these activities (See Figure 2).

### **Research Objectives**

The overall goal of this research was to explore potential problems with single corridor wards designed in

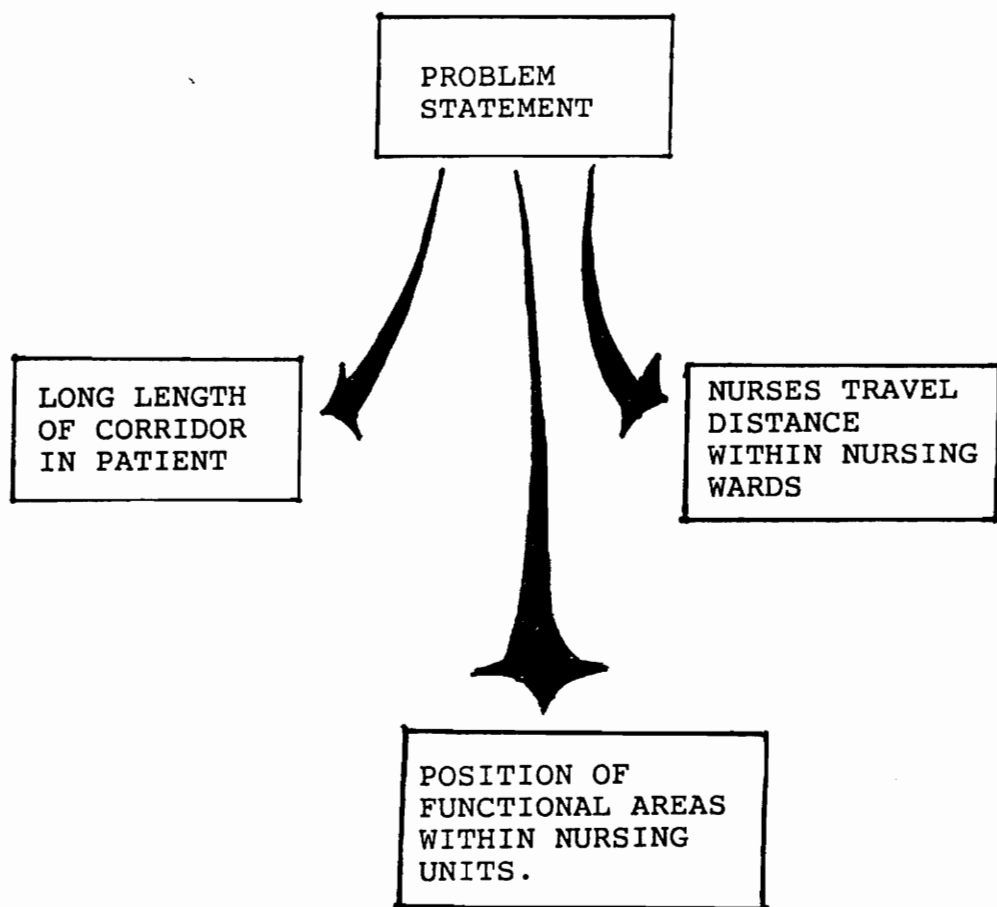


Figure 2: Overview of the Problem Statement

the 1960's, through examining in detail one hospital with this ward configuration. In the future this may lead to redesign alternatives that overcome these potential design problems concerning nurses' performance within the ward.

The specific objectives of this research were to: 1) explore the amount of time nurses spend travelling to and from patient rooms, 2) document the amount of time nurses spend with patients, 3) assess perceptions of nurses as to impeded delivery of services to patients, and 4) propose conceptual design alternatives to problem areas that were found through the research.

### **Outline of the Research**

Chapter 2 is a literature review of the evaluation of hospital and ward designs, economics in the health care industry, the evolution of nursing and nurses' stations, and the importance of the physical environment and perceived work performance in patient health care. Chapter 3 is a presentation of the methodology that was used to conduct the case study, while Chapter 4 includes the results from the study and design recommendations for the case study hospital. Chapter 5 includes conclusions from the analysis,

as well as recommendations for further development and research in the area of delivery of nursing services to patients.



## CHAPTER 2

### Literature Review

Figure-3 is a graphic of the issues covered in this chapter. One concern of hospital planning is the quality of medical care and the improvement of its standards (Putsep, 1979). In the last decade changes in the economy and in the delivery of health care services has affected the hospital industry more than any other sector of the health care market (AHA Statistics, 1989-1990).

Statistics show that the average number of hospitals in 1979 (6,988) decreased to 6,720 (3.8%) in 1989 (See Figure 4). In addition the average number of beds in hospitals reduced from 196 in 1979 to 182 in 1989, for a decline of 7.1%. An additional blow to the health care industry came as a result of increased outpatient care. The total number of inpatient days decreased from 380,580 in 1979 to 311,079 in 1989 (AHA Statistics, 1989-1990) (See Figure 5). These statistics clearly indicate changing trends in the health care industry concerning hospital inpatient care. These statistics indicate that it is generally not practical to build new hospitals. There is instead a need to continue improving and adapting these older facilities to meet the changing trends and needs of society.

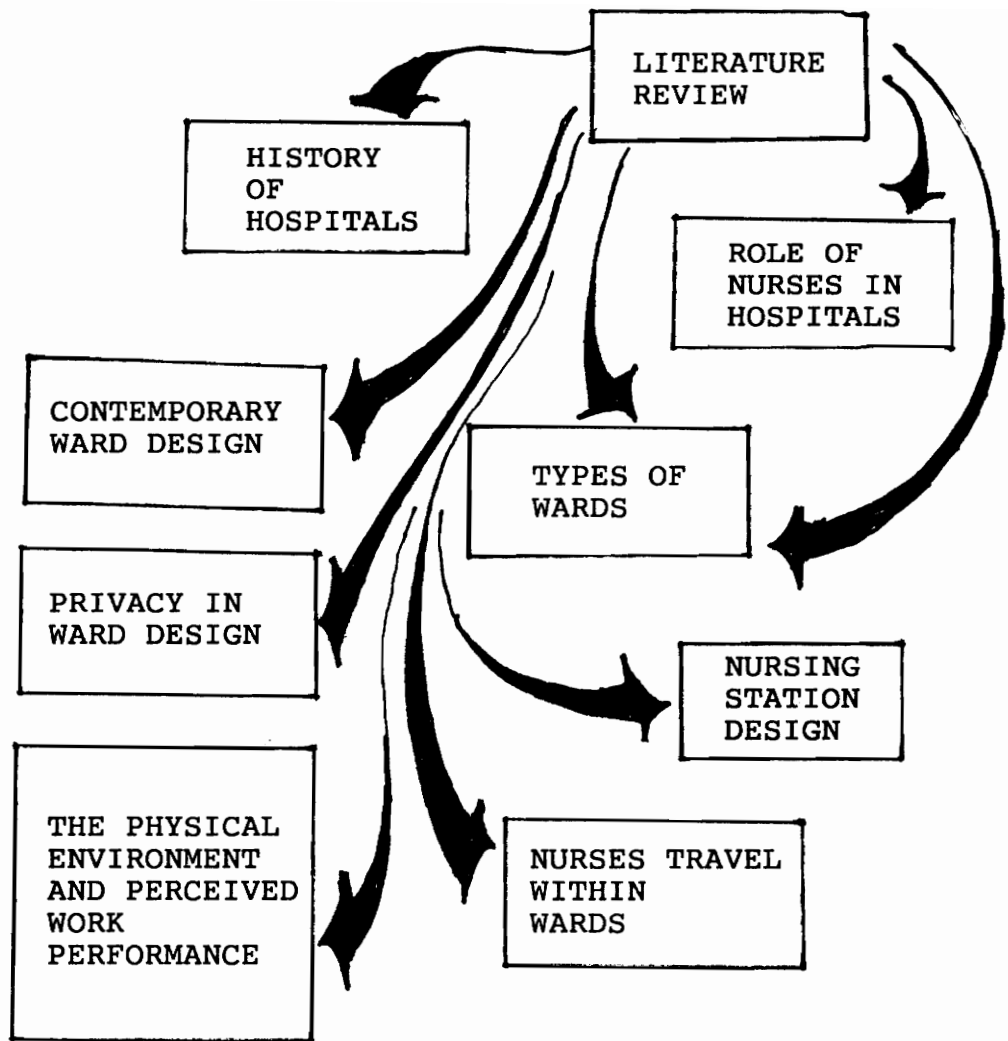
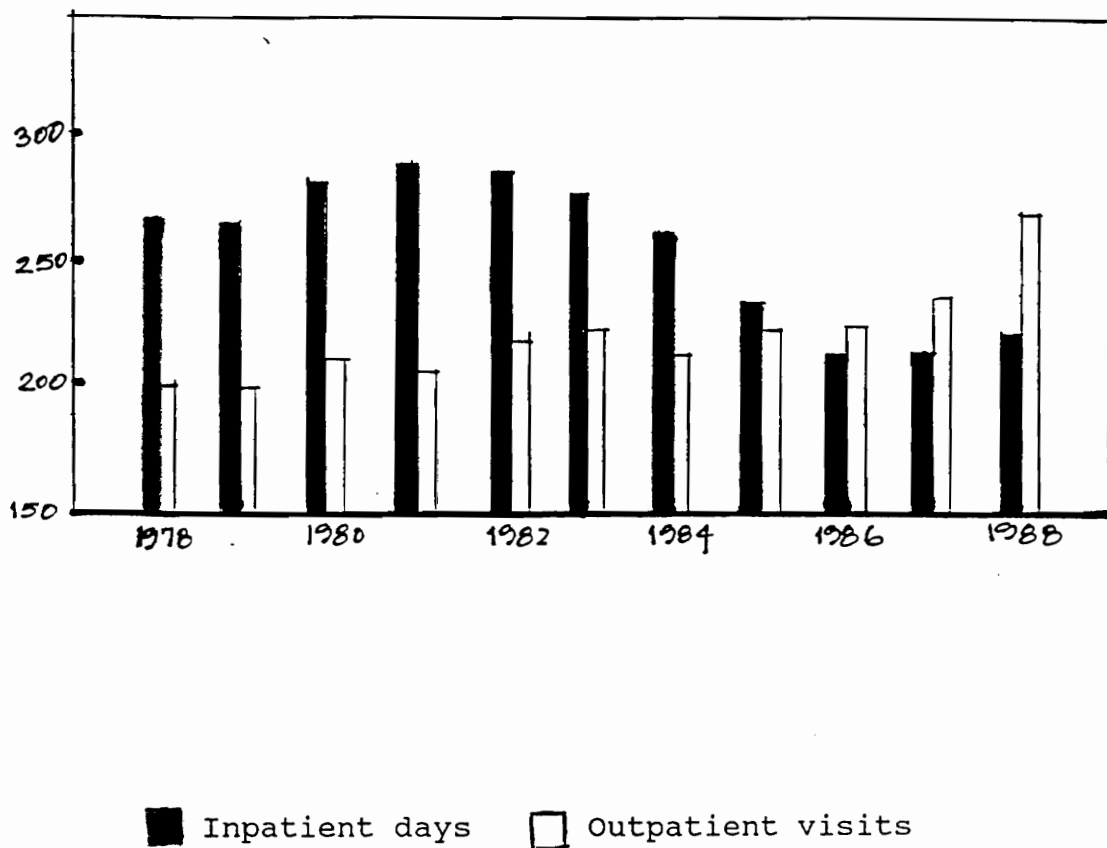


Figure 3: Outline of the Literature Review



Figure 4: Decrease in Total Number of Hospitals.

(AHA Statistics, 1989-1990)



**Figure 5:** Inpatients Days Versus Outpatient Visits.

(AHA Statistics, 1989-1990)

Health care facilities are designed for patient care. Statistics show that with the increase in outpatient care the corresponding severity of cases treated on an inpatient basis increases. This has made hospital inpatient care more expensive than outpatient care over the ten years of the study (AHA Statistics, 1989-1990).

Illness is a physical weakness making people dependent on other human beings for care (Snook, 1981). Throughout history societies have considered personal care and shelter a responsibility of the community. The hospital of today is a cornerstone of the modern system of health care (Freidson, 1963).

### **History of Hospitals**

The word hospital was derived from the Greek word "hospitium", a word that has been frequently mentioned from the fifth century onwards (Thompson and Goldin, 1975). Throughout history societies have accepted illness as a responsibility of the community and have created various services to treat these illnesses.

A hospital is one of these services. The hospital is seen as an organ of society, sharing its characteristics, changing as the society of which it is part is transformed and carrying into the future evidence of its past (Freidson, 1963).

The Greek "Asklepieai", in the fifth century B.C., was probably the earliest form of nursing unit or ward. This inpatient nursing unit included bed rest areas, treatment areas, medication, baths, diet, and exercise areas. The rooms were 24' deep and 96' long. In addition the rooms were totally enclosed on three sides and oriented towards the sun.

After the Greek "Asklepieia", Roman military hospitals came into being as patient care institutions designed for the soldiers. These hospitals were located far from busy city centers. The plan of the barracks of Vindonissa was completely symmetrical with a large entrance hall, a courtyard in the center and rooms around the courtyard on both sides of the corridor. The rooms were extremely irregular in shape with a small vestibule between every two rooms. This vestibule helped reduce the dust and noise in

the rooms considerably. These rooms were remarkable for the degree of privacy they offered.

In the days following the birth of Christ, Christians were encouraged to make pilgrimages. The early Christian Monastic Hospice was founded in 475 A.D. A hospice was basically an establishment providing rest or entertainment for travellers or inns for pilgrims. For a thousand years Christian charitable institutions such as hospitals for the sick were shaped by the seven works of mercy. "For I was hungered, and ye gave me meat; I was thirsty and ye gave me drink; I was a stranger and ye took me in; I was naked and ye clothed me; I was sick and ye visited me; I was in prison and ye came unto me;" (Thompson and Goldin, 1975). Added to these six works of mercy was a seventh, burying the dead, which was added in the 13th century. For a thousand years Christian charitable institutions were shaped by these seven works of mercy.

The "Turmaninan" in Syria was a Christian institution. It had a group of buildings including a church, a convent building, a house for the priest, administration and a tomb,

together with a couple of quarries, one of which was an open air cistern. This institution also housed the sick.

The St. Gall monastery in Switzerland was a medieval Christian hospital. The plan of this hospital speaks of distinctions among persons, the monks and layman, masters and servants, the rich and poor pilgrims, inpatients and outpatients (meaning those inside and those outside the area of the monastery). One half corner of the monastery was for medical purposes leading to yet another distinction of the plan of the hospital between the sick and the well.

### **Early American Hospitals**

The first semblance of hospitals in America appeared in the early 18th century well before the Revolution (Wheeler, 1964). They were hastily built structures found mainly in seaport towns such as New York, Philadelphia, Charleston and Newport. It was not until the 18th century that attempts were made to provide continuous service in the current form of the hospital (Snook, 1981). The Pennsylvania Hospital in Philadelphia, established in 1751, is considered to be the oldest hospital in the country (Thompson and Goldin, 1975).



Following World War II, American medical technology expanded rapidly. Hospitals began to care for the sick almost incidentally. In the earliest forms, hospitals were interested in pilgrims, the indigent, and plague victims (O'Connor, 1976). After World War II they became institutions where people from all parts of society could go to get well.

### **The Modern Era**

Hospitals today are among the most complex institutions in our society (Wheeler, 1964). This particular facility touches all our lives. Over the years the main mission of the hospital has evolved to become the focal point of community medical care. As of 1989 there are 6,720 hospitals in the United States. Hospitals constitute one of the nations most complex industries, with a total capacity of 2.2 million beds (AHA Statistics, 1989-1990). The hospital is not an isolated entity. Its relationship to both the neighboring social group and larger groups of society is complex and widespread. Over time functions have changed with the changing needs of society.

Hospitals are designed for patient care and can be divided into long term and short term care. Short term care patients are basically outpatients (Freidson, 1963). Long term care patients are the inpatients who require constant medical care and attention for more than a few hours. They stay on hospital wards and are constantly attended to by nurses.

Inpatient wards have come a long way from this early beginning. The most important part of a nursing ward is the bed area. In this respect, historical and modern nursing units are similar. Wards have evolved and changed with the changing living trends in society. Wards are not living areas but are designed for patients who are bedridden (Snook, 1981).

### **The Role of Nurses in Hospitals**

Early organized nursing services began under the Roman Catholic sisters who dedicated their lives to caring for the sick. The religious influence, authoritative influence of individuals and nursing traditions established by the military were the three major influences that had an impact on the early history of nursing (Snook, 1981).

In ancient Greece and Rome the only form of nursing care was performed by servants as a household duty. The primary influence in nursing thereafter was the altruism of the Jewish and Christian religions (Murray, 1980).

During the Middle ages care of the sick people was undertaken by military as well as religious individuals (O'Connor, 1976). The design of churches and priests within these centers could be justified in this way. Nursing practice meant giving medicine, bathing and dressing wounds and ulcers, washing linens, and attending to clients religious needs (Thompson and Goldin, 1975). Florence Nightingale is probably the founder of modern nursing and one of the greatest humanitarians in the nineteenth century because of her numerous efforts in social, hospital, medical, and military reform (Palmer, 1983).

In the early 19th century, hospitals were noted for high mortality rates. In addition, many hospitals were stuffy, dirty places, and the nursing staff were generally unkempt (O'Connor, 1976). However between 1840 and 1860 the Catholic sisters founded twelve hospitals in cities across the country. They were later responsible for founding many

nursing' schools. An increased need for nurses during the Civil War served as an opening for many nurses. The influence of Florence Nightingale also improved the training of nurses. As the number of nursing schools increased, the nursing profession became more organized. The image of nursing has changed just in the last 30 years to a highly respected professional field today.

Nurses comprise approximately 50% of all employees within a hospital today. They account for the single largest health care professional group in the country. Since nursing service accounts for 25% of all hospital operating costs and represents up to 37% of the total salary of employees, this group is a major factor in the hospital (Fox, 1989). Approximately 50% of all employees in a hospital work in the nursing department (AHA Statistics, 1989-1990).

Basically the nursing function is performed by a team, not by any single individual. The team consists of registered nurses, student nurses, aides, orderlies, ward clerks, and maids in varying numbers as dictated by the size of the unit (Garfield, 1971). Team members relieve each

other, exchange information, and assist and consult with each other in the care of their patients. The team provides a variable need/variable demand service that in major part cannot be routinized and generally cannot be performed consecutively from room to room, but rather must be rendered in random fashion over the entire nursing unit.

Thus it becomes evident that the nursing staff should be located near their patients for effective patient care, and should be near each other for highest team efficiency. Most of the prevalent nursing unit designs show little evidence of this concept. Garfield (1971) reported that the "ideal" design for nursing units (including associated nurse's stations) is circular in structure, not linear. Another study (New Shape, 1970) proposed elimination of the centralized nurses' station altogether.

Nurses play a central role in the economic development of the hospital (Andrew and Richard, 1977 in Fox, 1989). Nursing is a diverse collection of professionals, rather than a single occupational group. The unique function of the nurse is to assist the individual sick or well. Good

nursing in all hospitals requires above all things, kindness especially to the people who are sick.

### **Contemporary Ward Design**

Until a century ago the ward was considered group housing for the sick in terms of those who were poor or without family or friends to take care of them (Snook, 1981). A contemporary ward is a place where patients are treated and cared for by nurses. A nursing unit is a term used for that portion of the hospital where the patient is housed and fed (Butler and Erdman, 1946). This could either consist of open wards, semiprivate rooms, or private rooms.

In addition to appropriate design of the wards another important factor for effective inpatient care is the requirement for efficient nursing. There are various factors that influence the quality of care that nurses provide to patients. Patient care can be improved by: 1) designing the layout of the ward to maximize the efficiency of the staff in providing care and supervision to patients, 2) providing technological equipment to maximize supervision from the nursing unit/station, and 3) taking into

consideration the environmental and psychological aspects of the design (Gainsborough and Gainsborough, 1964).

One study showed that positive nursing attitudes led to good patient care (Eriksen, 1987). Ward designs in hospitals have come a long way with changes in the design and layout of hospitals as previously discussed in this chapter. One primary aspect in the layout of a contemporary ward floor is that it should be planned with a proportionate amount of space given to both the patient beds, utility rooms and circulation (Gainsborough and Gainsborough, 1964).

### **Privacy in Ward Design**

The old type of ward with twenty to thirty beds facing each other and with the heads of beds against the outside walls has been gone since the 1930's. Privacy was a very important issue in the hospitals of the earlier days (Thompson and Goldin, 1975). This issue of privacy in patient rooms has carried over even to this day. Two forms of privacy were taken for granted within the hospital (Thompson and Goldin, 1975). First was the single room provided to patients for medical reasons, and second was the single room that patients were assigned because of their wealth or social status. Though hospitals today try to

provide private rooms to anyone who can pay for them, private rooms in some hospitals are still for the privileged few. Privacy is important in that this issue has affected the design of patient rooms and patient ward designs within hospitals for a long time (Thompson and Goldin, 1975).

Designing with privacy in mind first appeared in the Victorian period. The Victorian attitude was indifferent towards privacy. Florence Nightingale, the major hospital planner in the Victorian era, was absolutely against planning for privacy, mainly because, in her opinion, the primary function of a hospital ward was to allow ease of supervision, which is the exact opposite of privacy (Lagemann, 1983). Miss Nightingale said she would rather place 40 patients together in one large ward, that could be efficiently overlooked by one head nurse, than provide separate rooms for patients. This kind of a ward was later termed as an open or pavilion type ward.

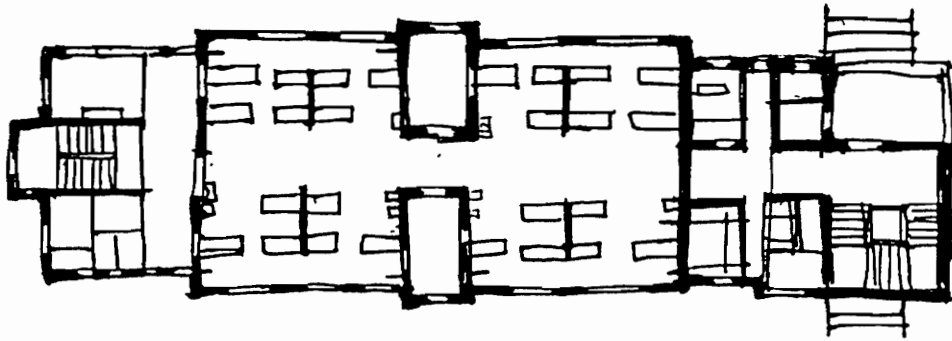
The first hospital where Florence Nightingale dictated the design of the ward was the Herbert Hospital in England, built between 1859-1864 without a single isolation (private) room. It was the St. Thomas Hospital in London built in



1871 where isolation rooms were seen for the first time (Thompson and Goldin, 1975). Each ward had 30 beds, with two small rooms opposite the nurses' station serving as the isolation rooms. Later hospitals included isolation rooms in various Nightingale wards.

The first significant development in privacy, the open ward (pavilion type), appeared in the Rigs Hospital in Denmark (See Figure 6). The major changes were three to four beds in open bay areas separated by low partitions, as well as the placement of beds parallel to the windows (Gainsborough and Gainsborough, 1964). These bays evolved into rooms with ceiling high partitions and doors leading on to a common corridor.

In 1893 Henry Burdett, an English writer, published medical reasons for providing private rooms to ward patients (Thompson and Goldin, 1975). In 1926, S. Bluestone in a study on privacy in hospital wards, was the first to bring in the concept of semiprivacy within wards (Thompson and Goldin, 1975).



**Figure 6:** Rigs Hospital, Copenhagen (1910).  
[Thompson & Goldin, 1975]

After the 1920's several changes were made in the design of wards; however the depression changed things overnight. Many hospitals closed, and four, three, and two bedrooms were set up in smaller facilities. Nation wide insurance enabled patients to enter these wards and select their desired rooms. In addition wards were designed to locate nurses closer to patient areas and reduce nurses travel distances. Facilities were also designed for observation of patients while nurses were at work in the utility rooms (Thompson and Goldin, 1975). From an economic view point, two or four beds in rooms had an undeniable advantage over the single bed room, as twice as many patients could be lodged along the same length of corridor.

After World War-II help with caring for patients became scarce and expensive. With a greater patient load, it became important for nurses not to have to walk far to tend to their patients. Every step became a precious commodity. For this reason the provision of inexpensive private rooms without increasing the length of the corridor was a primary factor in the design of wards (Thompson and Goldin, 1975).

Improvement can be seen in the arrangement of the facilities of the patient wards from the time of the St.

Thomas' Hospital, built in 1871 (See Figures 7a, 7b), to the Dundee Medical Center built in 1961 (See Figure 8) (Gainsborough and Gainsborough, 1964). Various ward designs were developed over time beginning with the long T-shaped corridor ward, first seen in the St. Thomas Hospital. In this hospital, because of the ward layout of four single bed rooms and large ward areas for 28 patients in all, there was basically no provision for flexibility of admission of patients, male and female, on to the floor. The proportion of private rooms to wards was low (14.3%) and the nursing station was minimal in providing services to staff and patients (Gainsborough and Gainsborough, 1964).

The Dundee Medical Center Hospital built 90 years later had a T-shaped single long corridor design (See Figure 8). It was in the Dundee Medical Center that significant progress can be seen in ward design (Gainsborough and Gainsborough, 1964). The wards in this hospital were distributed on three floors with complete communication between the different ward levels. Each ward unit consisted of 48 beds which was more than in the St. Thomas Hospital. St. Thomas accommodated 28 patients in all. The ward had three bays holding six beds

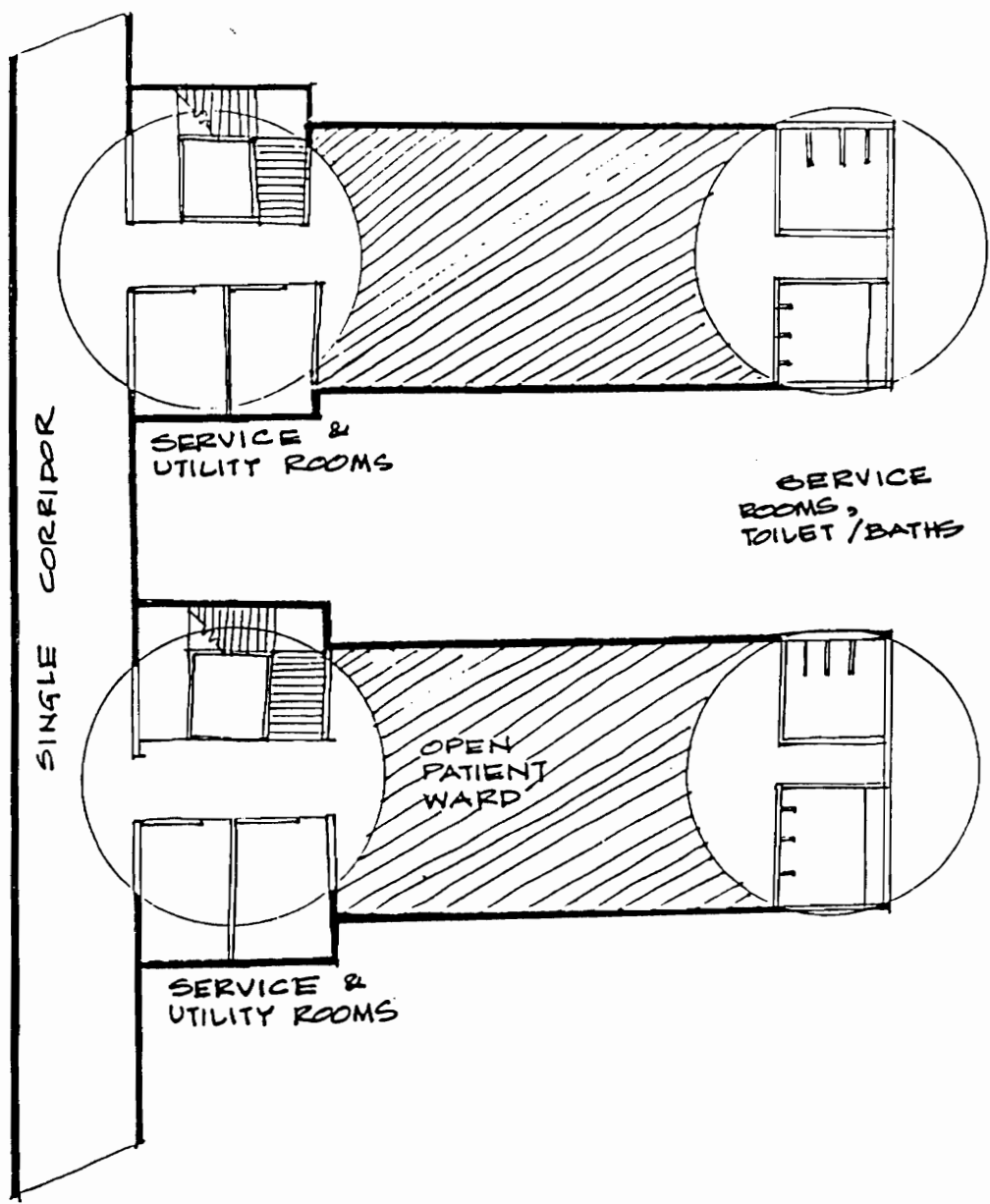


Figure 7a: St. Thomas Ward, London (1871).  
 [Thompson & Goldin, 1975]

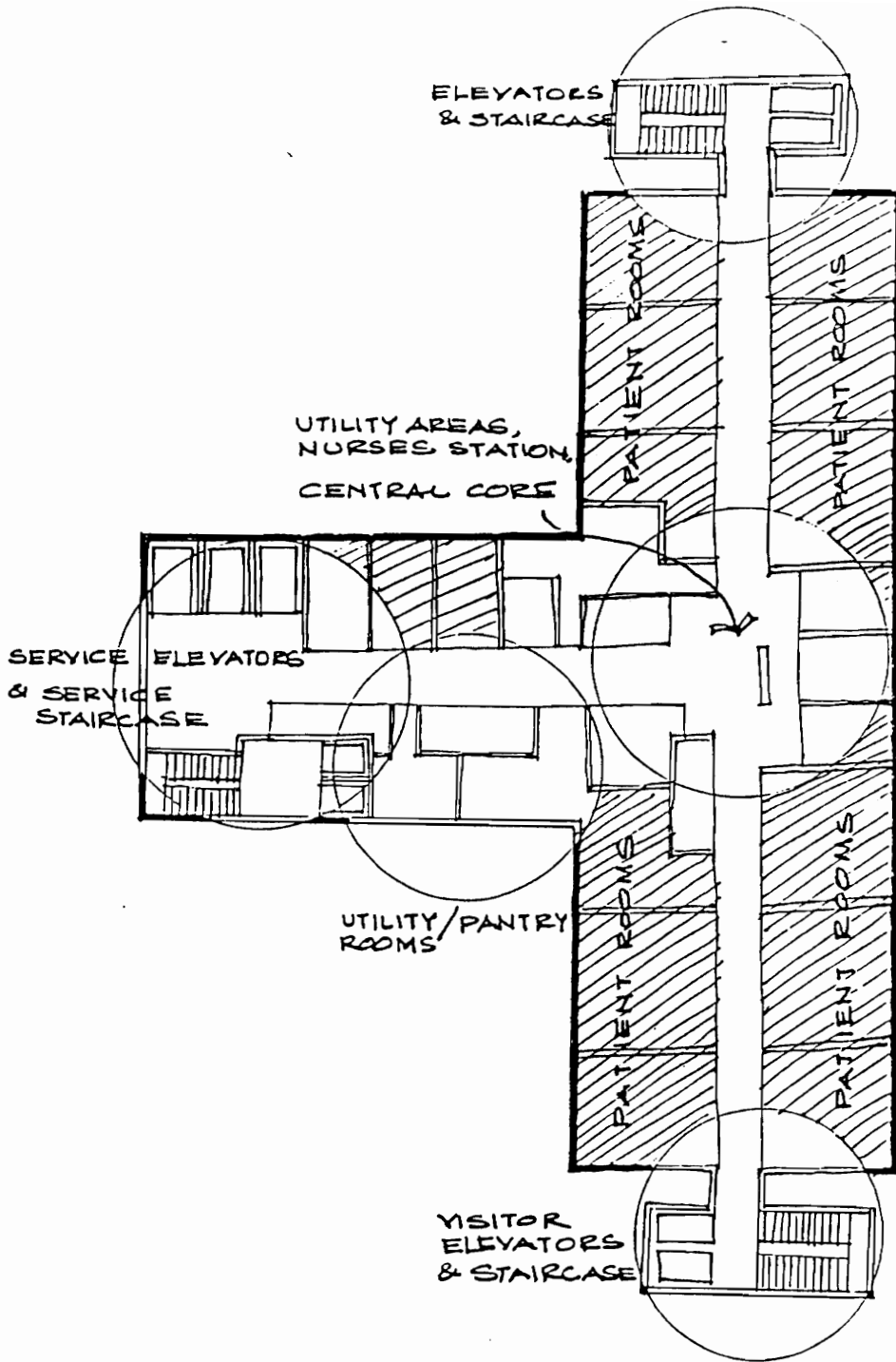
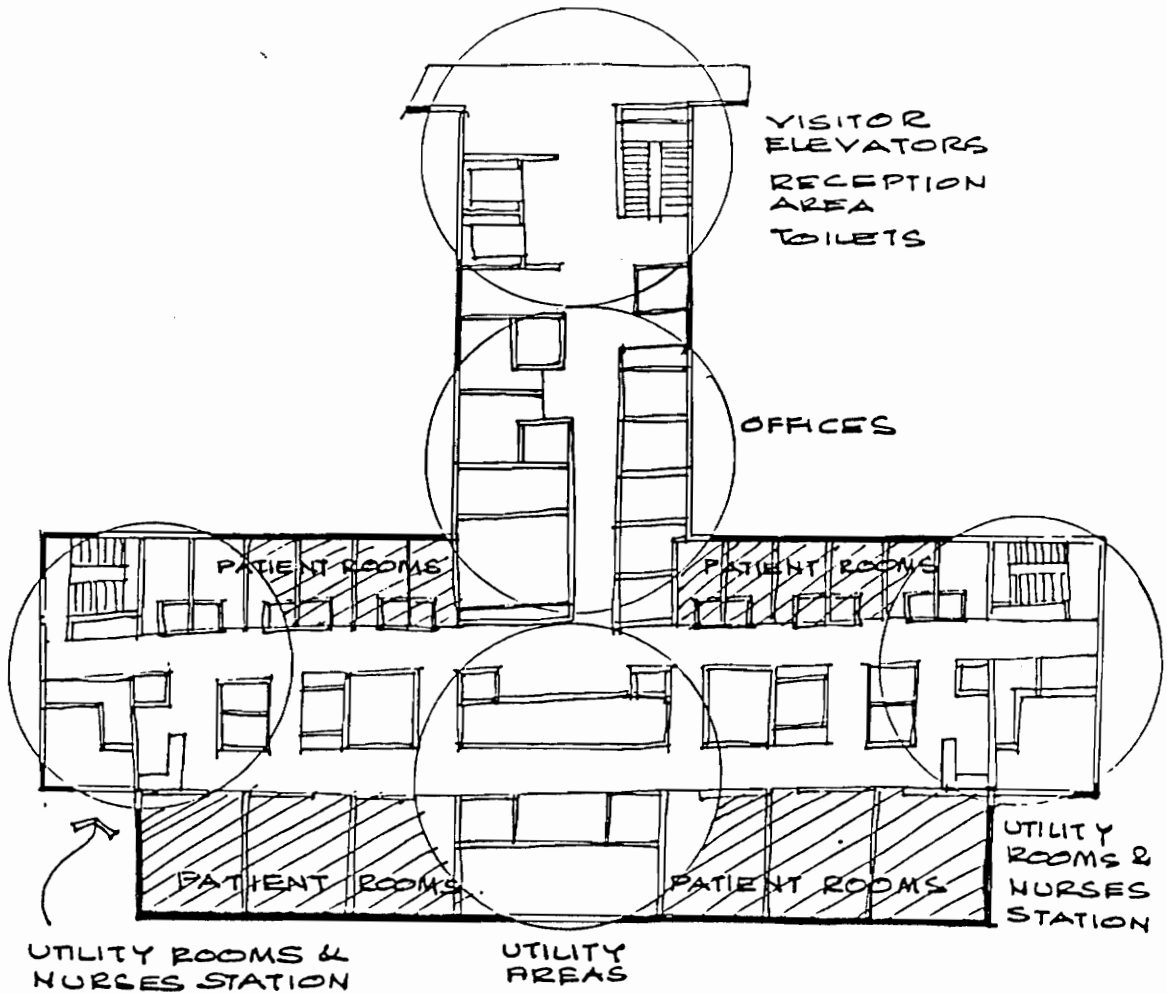


Figure 7b: St. Thomas Hospital, Rebuilt (1956).  
 [Thompson & Goldin, 1975]



Double Corridor Ward Design

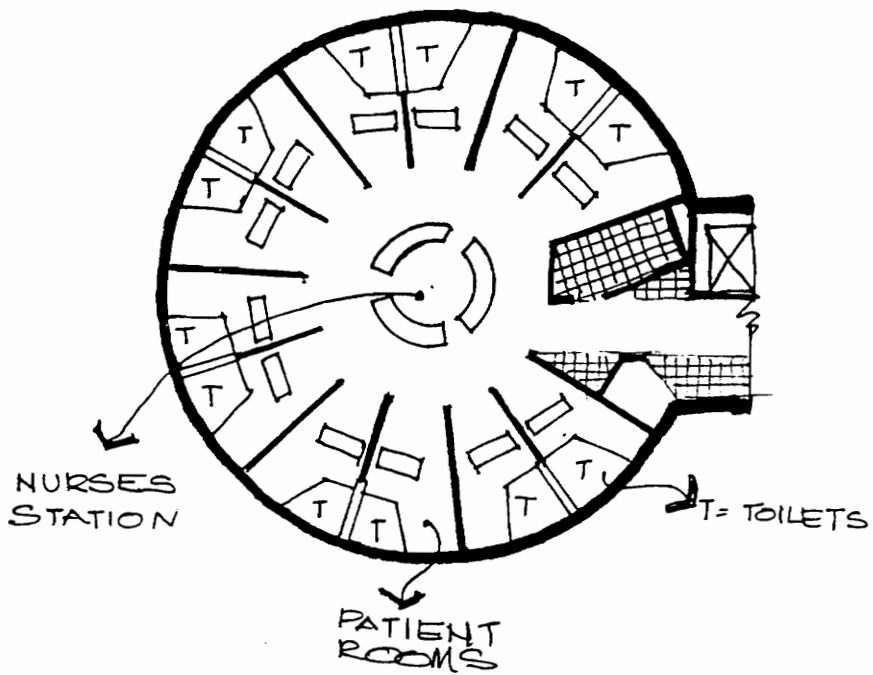
Figure 8: Dundee Medical Center (1961)  
 [Gainsborough and Gainsborough, 1964]

each, and a centrally ventilated portion for toilets and other ancillary rooms. On the opposite side of this area were the single bed rooms (private rooms), which was 25% of the total bed area or almost double the percentage in the St. Thomas Hospital. The overall design of the Dundee patient ward was a double corridor T-shaped plan.

The T-shaped ward plan has been around for a long time. These wards had single long corridor wards with patient rooms on both sides of a single corridor. The corridor was usually centrally located in the building.

It was around 1952 that the double corridor or race-track plans were first seen (Gainsborough and Gainsborough, 1964). Further developments in the design of wards included square shaped wards (first seen around 1940's) and circular shaped wards (first seen in the 1960's). One good example of the square shaped ward is the of St. Thomas Hospital discussed above which was completed in 1966. An example of circular shaped ward is the Rochester Methodist Hospital built in 1960 (See Figure 9). The Kaiser Foundation Hospital in Panorama City built in 1962 is another example of a circular ward.





### Circular Ward Design

**Figure 9:** Rochester Methodist Hospital (1960)  
[Gainsborough and Gainsborough, 1964]

## Types of Wards

Of the few single corridor ward designs published in 1964, the Nevill Hall Hospital, Abergavenny (See Figure, 10), is considered to have one of the best ward configurations of this type (Gainsborough and Gainsborough, 1964). It has two linked H-blocks, each containing two 32-bed wards joined by a double corridor link. Single bedrooms are 25% of the total number of patient rooms. The other bedrooms included four beds per room. Both types of rooms could be observed from the corridor, where the main flow of nursing traffic occurred. Toilets were centralized, but only one in four of the single bed rooms had its own toilet (Thompson and Goldin, 1975). For the most part single corridor wards were not considered very functional.

The double corridor ward came into existence in 1942 after the long single corridor "T" shaped wards (Neergard, 1942). A good example of the double corridor ward is the Dundee Medical Center discussed earlier (Refer back to Figure 8). Double corridor wards, also termed as racetrack or deep plan ward units, consisted of shorter corridors than single corridor wards as seen in the Rigs Hospital (See Figure 11). These wards separated the total space into an

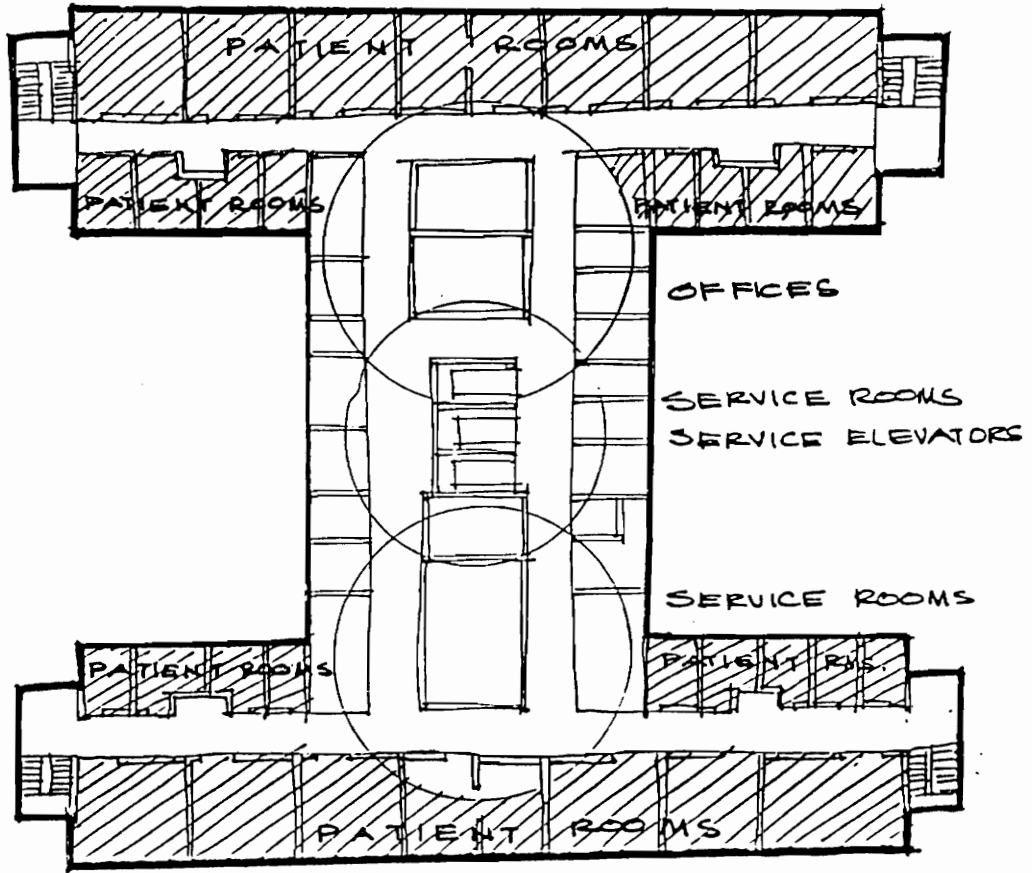
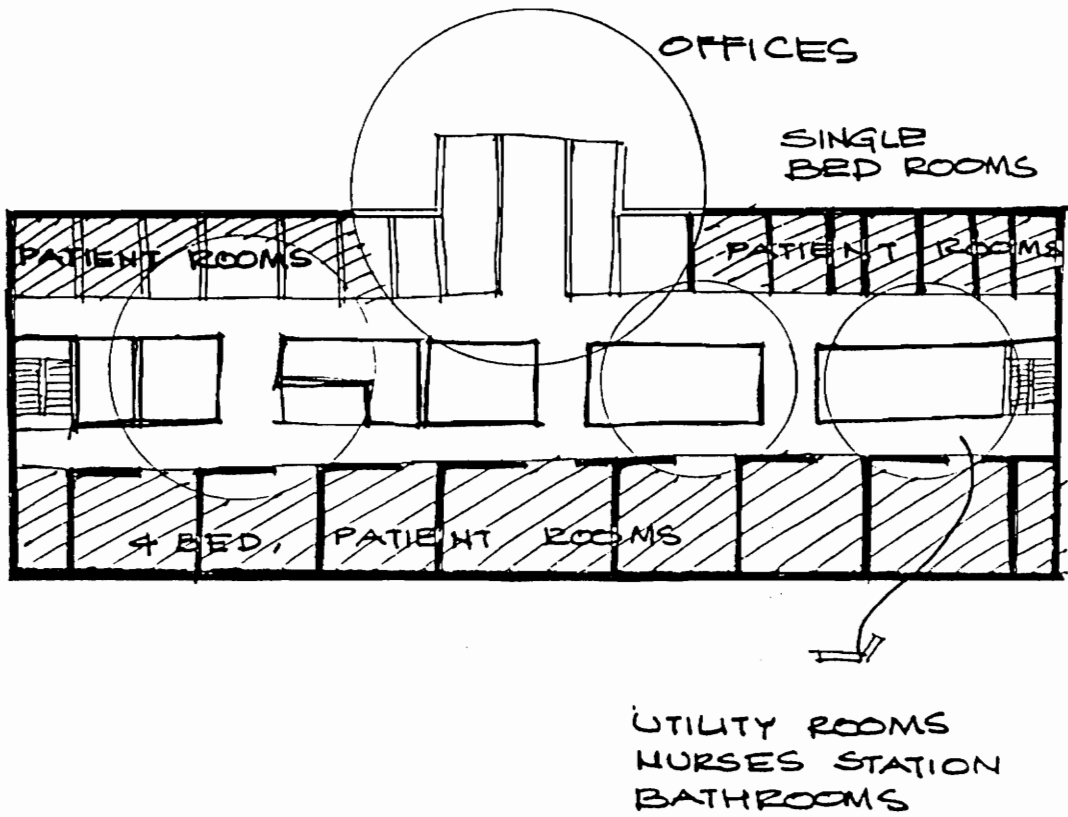


Figure 10: Nevill Hall Hospital, Abergavenny  
[Gainsborough and Gainsborough, 1964]



Double Corridor Ward Design

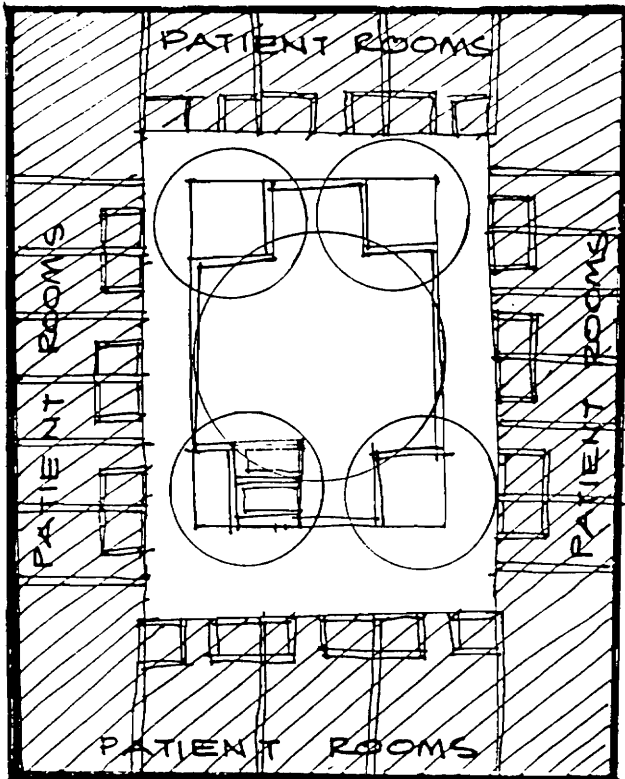
Figure 11: Rigs Hospital, Copenhagen (1910)  
[Gainsborough and Gainsborough, 1964]

external area, an internal area, and a central core. This type of ward design was very popular because of the operational advantage of better nursing care resulting from the compact unit design (Llewelyn, 1960).

Another type of ward configuration was the square design. The square corridor design provides the largest area compared to its perimeter for staff communication with patients. Square format hospitals have not demonstrated other gains because of the difficulty of planning the internal areas to best advantage (Gainsborough and Gainsborough, 1964). The Whitesberg Hospital in Virginia, built in 1956 appears to be a racetrack design, yet it is not truly a double corridor ward as each side constitutes a single corridor ward (See Figure 12). Four nurses' stations are provided, one on each corner of the square plan. Each station has a view of two sides of the square which have been provided in each corner on the internal corridor wall.

The most recent type of ward configuration designed in the 1960's was circular. The geometry of a circle has greater significance than the square for visual

NURSES STATION  
IN ALL FOUR  
CORNERS



CENTRAL CORE  
UTILITY AREA

Figure 12: Whitesberg Hospital, Virginia (1956)  
[Gainsborough and Gainsborough, 1964]

communication between nurses and patients as the circle provides the largest contained area for a given length of perimeter (Gainsborough and Gainsborough, 1964). The Rochester Methodist Hospital built in 1960 in New York provides nurse observability of patient rooms from a central area (Refer back to Figure 9). In the Lakeview Memorial Hospital built in Stillwater, Minnesota (1963) toilet suites have been inserted at the periphery of the patient rooms. McLaughlin (1961) maintained that circular wards were not necessary and demonstrated that similar results as in Rochester could be achieved by using an irregular square shape.

The design of wards has changed to enhance patient needs and care. These various design configurations tended to predetermine the location of nurses' stations. The next section addresses the effect of various designs of the nursing units on the size and location of the nurses' station. This can be seen in the design and location of the nurses' station within the different types of wards.

### **Nursing Station Design**

The size, shape, and facility components that support the nursing function have been tied to relatively recent

efforts to "build-in" hospital efficiency (Pulley, 1969). It has been only since the 1950's that the traditional size of the ward units, maintained at 30 beds, has changed. To maximize hospital efficiency, different structural shapes have been proposed and tried (as discussed previously) the single-corridor, the double-corridor, and the circular designs together with designs based on letters of the alphabet, such as "H" shapes, and "T" shapes (Pulley, 1969).

The size of the nursing unit as a whole has a direct bearing on the size and location of the nursing station. Although many administrators, government personnel, and directors feel that it is not possible to provide good patient care in units larger than 30 to 40 beds, there is a definite trend towards larger units (Goldstein, 1979).

Relative to physical design features in hospital settings, new structural designs of patient wards first began to appear in the 1960's. The centrally located nurses' station with patient rooms arranged in a circular fashion around the station periphery was seen as particularly advantageous in the intensive care unit. Since



then the circular ward has become a design feature in general patient wards.

This contrasts with the typical design of wards, where the nurses' station was located at one end of the ward with patient rooms on either side of a hallway extending in one direction or the other out from the nurses' station. While the contemporary, centralized design was generally viewed as advantageous for more effective care, there has been little or no attention paid to the potential influence of physical design features on attitudes of nurses working in those situations, or how such design factors might have an impact on interpersonal relationships.

### **The Physical Environment and Perceived Work Performance**

Contemporary hospitals must create functional, safe and healthy working environments for their employees even though the main objective in hospital planning is patient welfare. To create a conducive work environment, it is important that the design of the interior space contributes to the employees' physical and mental well being or at least does not impede it (Bertz et al, 1976). Good interior space design, choice of furnishings and graphics can increase

employee performance and can elicit positive attitudes by the staff towards their environment (Bertz et al, 1976). The hospital should do more than simply house the sick, it should also be an effective working environment.

Productivity and high levels of job satisfaction are related to work environments that are positive and supportive (Moos and Wandersman, 1981). Rudolf Moos developed an instrument to measure the environment called "The Work-Environment Scale", which measures change over time and demonstrates empirically the effect of planned changes, such as introduction of nursing on the physical environment (Moos, 1981). The WES can measure objectively what nurses want. From this, changes can be implemented that would make the environment more positive for both workers and patients. ( In one study Moos generalized that nurses who work in a more positive environment will use less leave for sick time and have fewer complaints of non-specific problems. )

Further studies on absenteeism in the nursing unit have proven this factor. One important problem facing nurse executives is the provision of quality patient care services

(Milne, 1986). Creating more favorable environments for the implementation of nursing practice and the delivery of patient care should be the focal point of designers (Oberlander, 1979). One of the first analytical studies of the effects of design and facilities upon the patterns of work was conducted by Nuffield Provincial Hospitals Trust in England in the mid-1950's (Freeman, 1967).

A disturbing trend, perhaps reflected in less than effective environments for nursing staffs, is the current nursing shortage. Nursing shortages have occurred in the past, most recently in 1979. Characteristics of the current shortage suggest a more lasting problem than previously. The shortage of nurses before was in the health care industry and not in the enrollment in nursing schools, as today. Today's shortage conceivably could curtail the ability of hospitals and other health care organizations to provide safe and effective patient care (Moritz, 1989). Access to health care and the cost of services could also be adversely affected if nursing resources become insufficient to meet minimum nursing requirements. Hospitals should do everything possible to retain their staff and increase morale within the workplace.

Studies of job satisfaction among hospital nurses are important because of the relationship between satisfaction, job turnover and performance (Weisman, 1980). Nurse satisfaction depends on various factors, such as the organizational structure of the organization as well as the arrangement of the physical environment. All of these factors are important today because of the difficulties the health care professions are experiencing in attracting and retaining qualified nurses (Wolf, 1981).

Much research has been done studying the effect of the environment on the productivity and performance of office workers (Barnes, 1963). Studies have been conducted to investigate the effect of various environmental factors on the expressed productivity of office workers. One example is Young and Berry's study (1979) which showed that nature sounds, soft music, and the provision of windows within the workplace had a significant effect on the productivity of the office workers in the study.

The delivery of nursing care can be enhanced by improving space allocations of critical hospital functions and designing nursing units to promote the relationships of

nurses to their clinical patient populations. In many respects, the effectiveness of nurses as well as the efficiency of wards depend upon locational factors as much upon knowledge, skill and timing (Simchuk and Howard, 1986).

Studies in the United States and Finland have shown that patients in pleasing environments have reduced anxiety levels, need less medication and are discharged earlier (Design for, 1989). These studies indicate that ward atmosphere in general should be positive for the people who work there. Of all the factors contributing to patient satisfaction, hospital staff probably have the greatest impact on patients' overall impression of the facility. Employee satisfaction is also a key to patient satisfaction (Morana, 1987). It is the staff who spend the greatest amount of time with the patients. These staff have a lot to do with the overall impression of patients concerning the facility. Staff members want to work where they can comfortably and efficiently serve patients, as well as attain their own sense of professional standards and growth. Anything that helps meet these objectives is likely to reduce costs and improve the quality of care rendered in the community over the long run (Becker, 1980).

It is generally believed that the context or environment of work has an impact on attitudes and behavior; however, typically this has been defined to mean the psychological environment (Chapman and Campbell, 1957), and not the physical environment of work. Yet, the physical design of the work environment can have a direct impact on the nature of interpersonal interactions between the supervisors and subordinates and the extent to which they develop agreement and understanding concerning performance related matters (Freeman, 1967). The social-relations approach states that the physical environment that facilitates greatest interaction between the supervisor and subordinate will ultimately increase work satisfaction and performance (Allen and Gerstberger, 1973).

Most studies have given primary emphasis to the relationship between the physical environment and employee attitudes and not employee behavior, especially work performance. Only a few studies have examined the relationship between physical environment and work performance. In one of several related studies, Sundstrom, Burt, and Kamp (1980) found a negative relationship between the number of clerical workers in a room performing relatively routine, repetitive work and self-ratings of

performance. In another study, they found a positive relationship between the amount of perceived privacy of subordinates performing complex jobs and their supervisors' performance ratings of them (Sundstrom, Burt and Kamp, 1980).

Mike Brill (1985), in his study on the impact of the office environment on productivity and quality of working life, focused on the fact that environmental design affects behavior. He also stated that job performance and job satisfaction have an economic value to any organization. He showed that job satisfaction is directly related to job performance. It is also seen in the many studies conducted in recent years that job dissatisfaction of nurses, and dissatisfaction with physical working conditions, has been a problem repeatedly over the last few years (Simpson, 1985). Studies only recently have started to address the implications of the physical working environment on the job performance evaluation process.

#### **Nursing Unit: Design and Evolution**

"Over all the coursing sun form follows function, and that is the law." Those words, written in 1896 by Louis

Sullivan, have largely been ignored in hospital design (Garfield, 1971). Because of a serious shortage of manpower and accelerating costs, critical reappraisals of the design of wards and the nursing unit, the most important subsystem of the hospital, is being done today with more of Sullivan's philosophy in mind (Garfield, 1971).

The proximity and visibility of staff members to patients and of staff members to each other are basic design variables and objectives that must be optimized for functional efficiency (Garfield, 1971). It is impossible to achieve both of these in the linear spaces and linear working corridors of the conventional single-corridor and double-corridor ward designs. These layouts disperse and scatter the nursing team members randomly over the entire ward, out of sight of the leader, out of sight to each other, and sometimes unfortunately out of sight of patients. Such linear dispersion goes against teamwork efficiency, and the occasional regrouping of the team at the distant nurses' station is incompatible with the proximity of patients (Garfield, 1971). In such linear designs, form is not following function, it is fighting function.



## **Behavior at a Typical Nurses' Station**

A nursing station is not only a place where nurses chart, mix medications, discuss patient status and order tests, it is also a social world unto itself, the life center of the patient unit (Goldstein, 1979). Social and functional requirements of nursing stations vary, not only in different hospitals, but in different units of the same hospital.

John Zeisel (1981), stated that the best way of determining design requirements of spaces is to observe how the existing spaces are being used. He classified these behaviors into four different categories which can also be used to examine how individuals use nursing stations. These four classifications are adaptive behavior, job performance behavior, interpersonal behavior and personal behavior. The nursing station is a focal point for job related functions and social interactions. Designers must recognize the need to provide barriers for certain activities and the need to eliminate barriers for others (Goldstein, 1979).

## Traffic Link Distances in Common Nursing Unit Designs

One of the first attempts to develop a generally-applicable design evaluation scheme based upon the concept of functional efficiency was reported in 1960 by Pelletier and Thompson. They identified sixteen areas on a typical nursing unit and recorded the number of trips between each pair of areas (each pair being referred to as a "link").

"It was found that more than 91 per cent of the traffic on the unit could be accounted for by only 14 links involving seven of the 16 areas. These links are considered to be the prime determinants of unit efficiency" (Freeman, 1967).

The weights (relative trip frequencies) of these 14 links were combined with distance measures for the units to be evaluated, the result being referred to as the "Yale Traffic Index." This index was then used to make comparative evaluations of units with similar facilities but different layouts. Based upon evaluations with this index of a number of alternative nursing unit designs, the following conclusion was drawn:

"Inpatient unit efficiency is not directly related to unit size. In fact, within the range of sizes considered, the design of the inpatient unit is the most important factor in determining the efficiency of the unit" (Freeman, 1967).

Because of its unique attempt to evaluate functional efficiency in a quantitative manner and to generalize study results beyond a case study, this study is highly regarded

among those reported in the literature. However the limitations and omissions in the study seriously detract from its general value, and errors in logic render specific findings useless in application (Freeman, 1967).

Some of the effects on traffic link distances and nursing teamwork of various nursing unit designs are as follows: 1) the single corridor design results in long inefficient traffic links and disperses the nursing team over distances that interfere with proximity and visibility of staff and patients. The result is a congested corridor that sometimes interferes with the team nursing function; 2) the double corridor design reduces the distances of some of the traffic links but disperses the team even more than the single corridor. The duplication of the corridor reduces congestion, but interferes with proximity and visibility of staff to patient and staff to each other; 3) the obstructed circle design, is better than the double corridor in reducing some traffic links but worse in visibility of staff to patient and staff to each other. The obstructed circle concept is that the patient rooms are designed along the periphery of the circle and the central area of the circle houses the utility rooms, elevators etc. acting as the central core of the nursing unit; and 4) the

visibly open circle is the best design for minimizing traffic links and maximizing proximity and visibility. The visibly open circle has the patient rooms designed along the periphery of the circle and the nurses' station in the center. The view from one side to the other side of the circle is not obstructed. This visibly open circle concept can be incorporated into a rectangular, square, or hexagonal design (Gainsborough and Gainsborough, 1964).

Plans for construction of hospital units pose a number of questions. Improvements over existing designs are needed, especially for the single and double corridor designs. It has been shown that physical design of the nursing units has an effect on the behavior of the individuals and groups working in the nursing unit (Lippert, 1972). In addition, the geometry of the nursing unit affects nurses' travel on the unit; however, the number of patients typically visited and the order in which they are visited also has an effect on travel. Nurses' travel distance is probably the most important variable which needs to be addressed in more studies. Judstrup and Gross (1966) estimated that travel comprises about 17% of a nurses time. Ronco ( in Freeman, 1967) found that the amount of travel

was one of the main sources of dissatisfaction of nurses in several hospitals in the Boston suburbs.

Nurses travel within the nursing unit is an important issue which has not been given enough importance in research. Few studies present usable data on nurses travel (Lippert, 1969), and there is little information on the patterns of travel by individual nurses to the bedsides of their patients. Nurses travel is a function not only of distances between different working locations in the nursing unit but also of the frequency of trips required, as shown by Thompson (1959).

Interest in the effects of functional location upon traffic patterns and costs in hospitals can be traced to the influence of Federick W. Taylor during the early part of this century (Freeman, 1967). In an article published in 1913 by Professor W. Gilman Thompson of Cornell University, the successes of Taylor's methods in the manufacturing industry are discussed and a suggestion is made that some of these methods should be applied to human work within hospitals. As an example of how this might be done, he described a series of studies in which he observed the

traffic patterns and walking distances of nurses in several studies. By attaching pedometers to the nurses, he recorded the number of miles walked in carrying out various duties and attempted to relate these distances to the arrangement of facilities on the nursing unit. Thompson's results were, of course, so closely related to the specific designs of the nursing units which were studied that they did not have general application.

A study reported in 1960 attempted to determine whether increases in the amount or quality of nursing care resulted in corresponding improvements in patient welfare (USPHS Grant, 1960, in Freeman, 1967). The major findings were that, when the size of the nursing staff was increased without increasing the patient load, the members of the staff did not redistribute their time in such a way that more time would be allocated to those nursing activities which were thought to be of most benefit to the patients. Even though this study did not consider the effects of alternative physical designs, it did suggest that potential benefits of design changes, which tended to reduce nursing labor, may not have been fully realized, since nurses did not automatically adjust their activity patterns in the most beneficial manner.

The review of literature has presented the evolution of hospital design, especially ward designs, as well as the nursing staff and nursing station physical relationships within the wards. It has been shown that there is a need for practical procedures to be developed and tested which could be used by designers to create conceptual solutions to existing single and double corridor ward problems concerning travel frequencies of nurses to their patients. Results of this present study will attempt to add to the literature in this area as well as propose conceptual solutions to the problems inherent in one single corridor ward hospital. This type of ward design is so prevalent today from the hospital building boom of the 50's and 60's; therefore any design solutions which could alleviate problems of delivery of health care services to patients should be of benefit to the field. The next chapter will discuss the methodology that will be used to collect the information for the case study.

## CHAPTER 3

### Methodology

Nurses' travel distances within the nursing unit, discussed in the previous chapter, was the subject of research in the 1970's. The design of efficient work environments to improve productivity has been in the literature from the 1980's on. There has been a change in focus in research in the last two decades away from health care issues, possibly because of the downsizing of hospitals. There does not seem to be as much funding to research this area because of the increase in the cost of construction and health care costs.

The focus of this study was to ascertain if there were problems for the nurses on the single corridor ward at Montgomery Regional Hospital in Blacksburg, Virginia and to propose conceptual design solutions to optimize the existing layout. A better layout or working conditions could give nurses more time to attend to their patients' needs. The case study focused on the patient ward on the fourth floor



in Montgomery Regional Hospital which houses mainly elderly, surgical and non-surgical patients.

The procedure used in this study consisted of four steps, each corresponding to an objective in the research. Objective 1 was to explore the amount of time nurses spent traveling to and from patient rooms. Hypothesis 1 was that nurses would spend more time travelling and less time with patients in the surgical and non-surgical wards on the fourth floor. The procedure for collecting this information was to record the amount of time nurses took to travel from the nurses' station to patient rooms and other functional areas on the ward. Data were collected on two wards--one the single corridor ward with private rooms on the fourth floor, and the other, a ward with semi-private rooms located behind the nurses station on the same floor. Data were collected for half a month (fifteen days), four times a day chosen at random, for an hour each time. The hour was split in half-hour sessions in each type of ward setting (See Figure 13)

Objective 2 was to document the amount of time nurses spent with patients. This information was collected at the

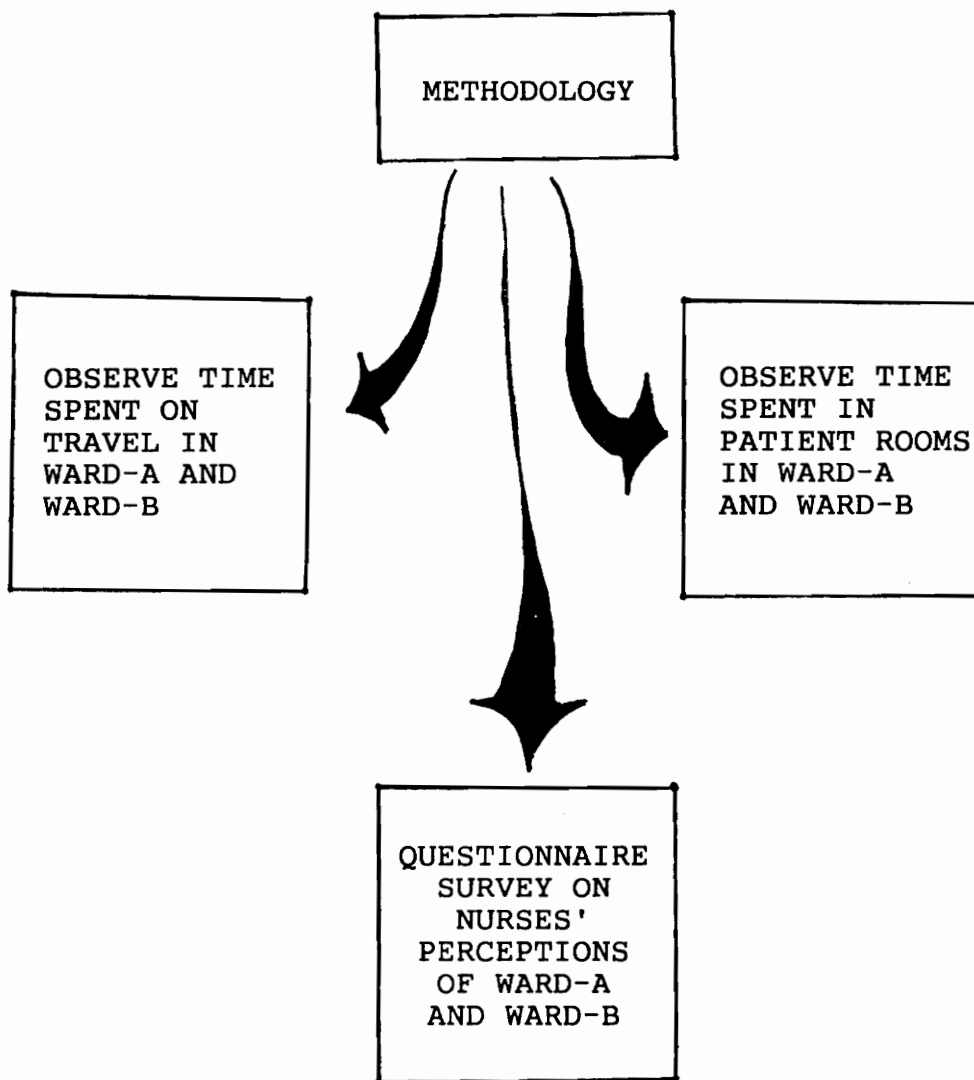


Figure 13: Overview of Methodology

same time as the data for Objective 1. Hypothesis 2 was that nurses would spend the same amount of time with patients in both ward type settings.

Objective 3 was to assess perceptions of nurses as to physical environment factors that could impede delivery of services to patients. This was determined from a survey of the nursing staff from all three shifts on the fourth floor ward both from the private type setting and the semi-private type setting at Montgomery Regional Hospital. Hypothesis 3 was that the time spent in travelling within the patient Ward-A or Ward-B had no relationship to the job satisfaction experienced by the nurses.

Objective 4 was to propose conceptual design alternatives to problem areas that surfaced through the research. Once particular problems were identified through the procedures outlined in Objectives 1-3 above, conceptual designs and other recommendations were created to address those problems.

In selecting the hospital and nursing unit in which travel frequency and survey data were collected, four criteria were used: 1) willingness on the part of the officials of the hospital to cooperate, as well as have an interest in the results of the study. Studies carried out by other researchers have proven that without cooperation and willingness from officials, such data collection would be meaningless and difficult (Freeman, 1967); 2) the nursing unit had to be a single corridor design with patient rooms located on both sides of the centrally located corridor. In addition, the nursing unit had to have a centralized nursing station to provide the opportunity to observe nursing traffic in various situations, such as from the patients rooms to the nurses' station, from the nurses' station to various functional points within the ward, then to the patients rooms and back to the nurses' station; 3) the hospital should have more than one type of ward that could be studied to gather data from different types of layouts; and 4) the hospital should be located near the University for ease of collecting information.

All the criteria described above were met by Montgomery Regional Hospital in Blacksburg Virginia. The hospital was built in 1971. The ward that was chosen was an inpatient

unit on the fourth floor of the hospital that houses medical (non-surgical) patients and surgical patients. The semi-private room type setting, a second ward situation located behind the nurses' station and close to the first ward, made data collection easier.

The hospital is accredited by the Joint Commission on Accreditation of Hospitals. It participates in the Blue Cross Plan and Medicare program. In addition to inpatient care, Montgomery Regional Hospital provides facilities and services including a pathology laboratory, pharmacy, oncology, premature nursery, out-patient, postoperative recovery, intensive care and emergency departments.

The hospital building is in the shape of a "T" with the fourth floor of the building housing a 46-bed nursing unit for only medical patients with one or two beds per room (See Figure 14). The average length of patient stay is seven days. The services listed for Montgomery Regional Hospital are similar to other health care institutions, as Montgomery Regional Hospital is a typical facility in the single "T" shaped corridor design type.

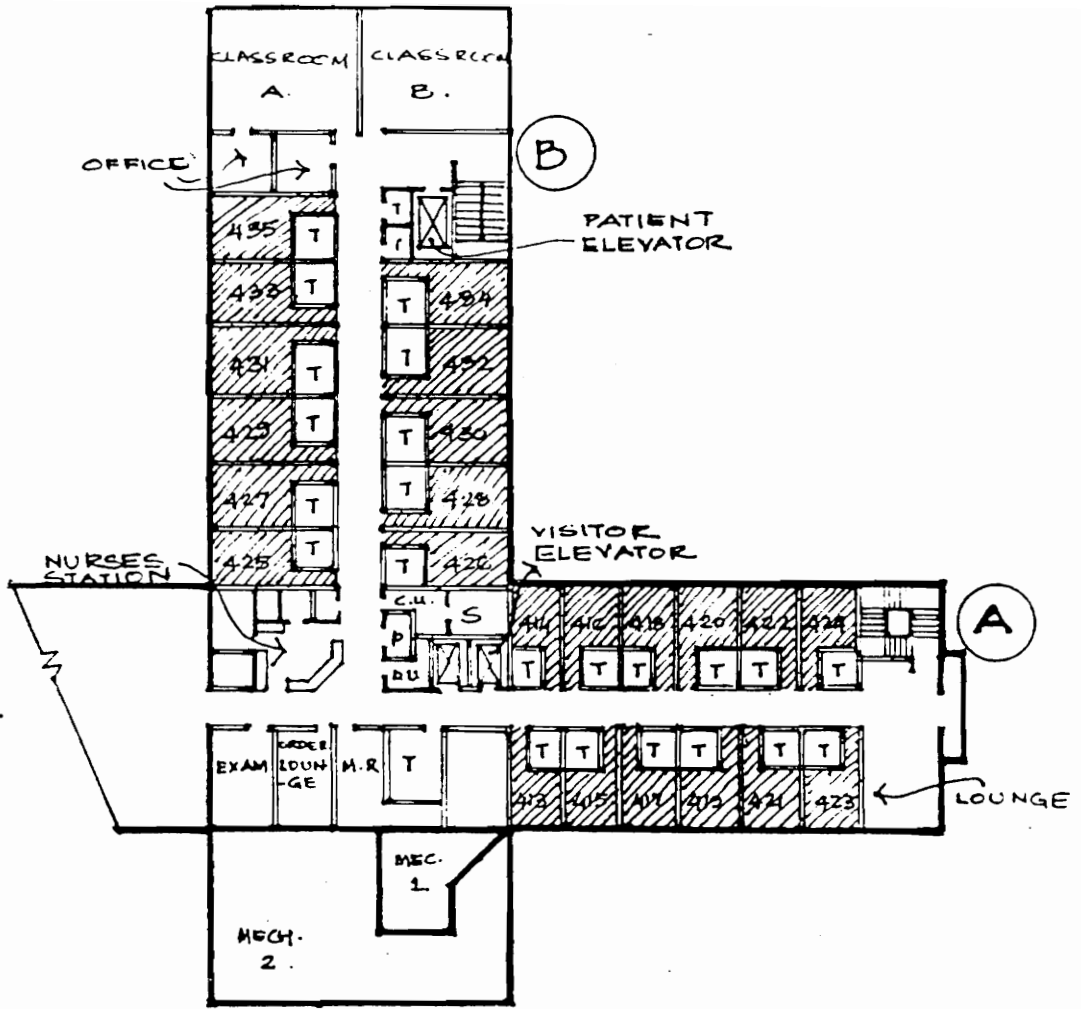


Figure 14: Fourth Floor Patient Ward in Montgomery Regional Hospital.

As part of this study the nursing station was observed as to any influence the location might have on the travel time between functional points and patient rooms on the floor. The case study attempted to identify problems faced in this particular single long corridor ward design. In addition, alternative renovation solutions were provided to alleviate these problems.

### **Preliminary Observations**

During the early part of February 1991, preliminary observations were made on the second floor nursing unit of the Montgomery Regional Hospital by ten seniors in an interior design class conducting a design/research project (See Figure 15). This preliminary observation was carried out for several reasons. First it allowed the researcher to become thoroughly familiar with the function of a nursing unit and its personnel. This familiarity was essential for the data collection portion of the subsequent case study.

The student observers identified the amount of time nursing personnel took to respond to patient calls and then reach the patients. The starting and ending point of the trips were also identified. This sort of data was found to

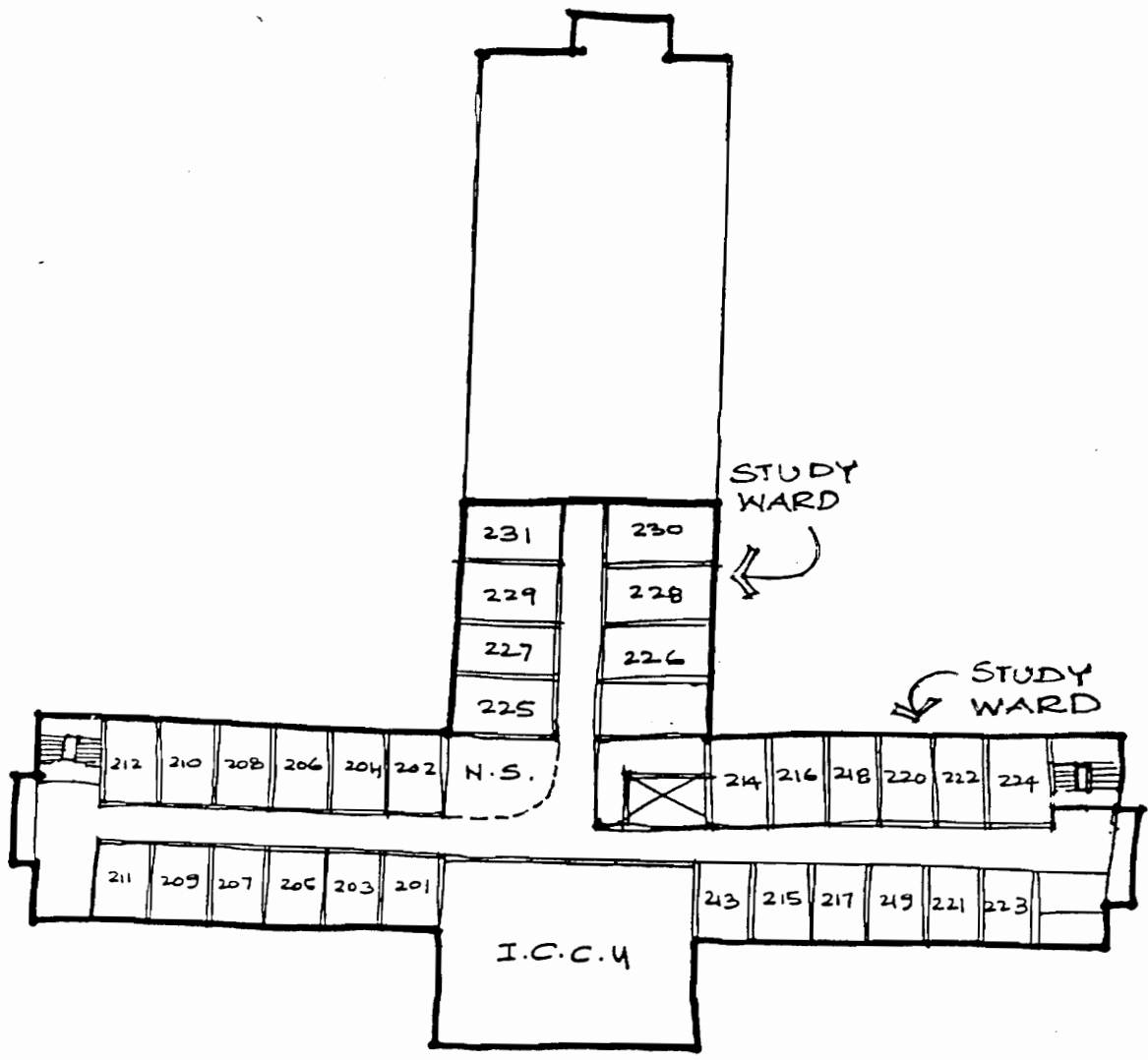


Figure 15: Montgomery Regional Hospital Ward, 2nd. Floor



be easy to collect from a single location near the nurses' station.

The second reason for the preliminary observation was to determine if there was enough data to support the problem statement concerning nursing travel within long corridor wards, as well as to identify the main functional points within the ward. The observations also helped with the identification of various other potential problem areas which could affect the nurses' travel within the nursing unit.

The major functional areas observed in the preliminary study of the hospital were as follows: 1) **Nurses' Station** - including the chart room and the ward clerk's area. It also included a telephone and a panel of lights for the nurses' call system. This is the main area where the nursing personnel share and exchange information; 2) **Supply Room** - containing supplies such as tissues, napkins, certain pieces of medical equipment, and wheelchairs, etc; 3) **Medication Room** - the area where medications are prepared for patients as well as stored; 4) **Linen room** - storage for clean bed sheets, pillowcases, towels and similar cloth items; 5) **Kitchen** - where ice for drinking water and special-order

foods are kept, and **6) Patient rooms** - where the patient beds are located as well as some equipment for patient care. These areas were considered the main functional areas in the ward for observation in the final study. These functional areas are similar to those in many other nursing units in hospitals, as discussed in the earlier literature review chapter.

The preliminary observation period allowed for several methods of data collection to be tried for potential use in the final case study. This was done to increase the effectiveness of the final study, as only two nursing units were to be studied.

The first method used was a questionnaire of the nurses to help identify the problem areas the nurses faced within the ward. This also helped to identify the areas within the ward that the nurses found difficult to access. The second method used in the preliminary data collection was an interview with several members of the nursing staff. This also helped in the identification of problem areas within the ward. Interviews with visitors brought additional problem areas into focus. The third method of preliminary data collection was observation of the nurses within the

ward. This included documenting: 1) the amount of time the nurses took to reach a patient room, 2) the functional points the nurses used in attending to the patients, 3) the amount of time the nurses spent in the nurses' station versus involvement in patient care, and 4) the various activities performed by the nurses within the ward. These observations were conducted around the clock for seven days, 16 times per day for five to ten minutes each time. These preliminary observations helped to refine the data-collection procedure for the final case study.

The main conclusions that were drawn from the preliminary study were that 1) the signage on the second floor of the hospital was inadequate, 2) because of the inadequate signage nurses were being disturbed by visitors asking for directions on the ward, 3) the waiting area was not in an appropriate location and needed to be relocated and 4) the waiting lounge needed to be made larger to accommodate more visitors.

#### **Data Collection for the Final Case Study**

The first phase of data collection for the final phase of the thesis research was conducted between July 2-16, 1991

on the fourth floor nursing unit at Montgomery Regional Hospital (refer back to Figure 14). Data were collected each day of the week. The times for this data collection were taken from a table of random numbers. Four time periods covering each shift were chosen each day. Data were collected for a period of one hour each, one half-hour on each ward. In the previous preliminary study, it was determined that periods of observation longer than 10 minutes were needed to obtain an accurate picture of the nursing functions and potential problems on the ward. Nurses' travel was studied in each of the two perpendicular wings of the patient ward on the "T" shaped nursing unit (refer back to Figure 14). In recording the nurses' travel, a time form was developed for easy documentation (See Appendix-B).

Two methods of data collection were used: 1) the questionnaire, a quasi-qualitative method of data collection, (See Appendix-A) and 2) the travel observations which examined the time the nurses spent travelling to functional areas and patient rooms from the nurses' station-a more quantitative method of data collection (See Appendix-B).

The observations tracked two nurses travel times to patient rooms and functional areas within the patient ward, located on the fourth floor. These observations helped establish the main functional points the nurses used to travel to and from the patients rooms and the nurses' station. These observations also helped determine the total amount of time spent travelling from the nurses' station to other points on the ward. The data helped to establish the optimum location of the functional areas and nurses' station in relation to the patients' rooms within the ward.

The second method was the written survey of nurses to access their perceptions of the physical environment and the factors that could impede delivery of services to patients. The questionnaire helped determine the actual features within the ward that affected nurses' activities, in terms of flexible layout. This questionnaire also helped to determine the physical characteristics within the ward that inhibited the nurses in the delivery of patient care. Questions regarding their attitudes towards their physical work environment were also analyzed.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### Description of Data Analysis

Data were analyzed using the "Number Cruncher" statistical program (1987) to test differences between the two groups to support or reject each of the hypotheses. T-tests were used in the analysis, and were tested at the 0.05 significance level.

The data were collected using a standard form of matrix drawn to record the amount of time the nurses took to travel to and from the nurses' station to patient rooms, as well as to and from the nurses' station to other functional areas on the ward, i.e. utility room, medicine room, linen room and pantry (See Figure 16). Two nurses in each ward were observed for a time period of one half hour each.

The assumptions made were: 1) rooms were assigned to patients at random, irrespective of illness, 2) the

TIME: \_\_\_\_\_  
DATE: \_\_\_\_\_

NO. OF PATIENTS \_\_\_\_\_

NURSE NO. \_\_\_\_\_

TIME SHEET FOR PATIENT WARD

TO FROM	N.S.	PT.R.	M.R.	L.R.	U.R.	TOTAL
N.S.						
PT.R.						
M.R.						
L.R.						
U.R.						
TOTAL						

- LEGEND :
- 1) N.S. - Nurses' Station
  - 2) PT.R. - Patient Room
  - 3) M.R. - Medicine Room
  - 4) L.R. - Linen Room
  - 5) U.R. - Utility Room

Figure 16: Matrix Used to Record Travel Time

probability that any patient would call for a nurse was the same for each patient, 3) the two nurses observed during the data collection had an equal opportunity of responding to patient calls and going to a patient's room, and 4) for every nurse the time it took to walk from the nurses' station to the patient's room was the same.

The travel time was documented in seconds for maximum accuracy of results. Two nurses were observed at the same time. The amount of time both these nurses spent travelling between the functional areas of the ward was recorded for every half-hour period selected from a table of random numbers. All these half-hour recorded times were added together to calculate the total amount of time two nurses spent travelling during a particular half-hour period. It was observed that these travel times were directly dependant on the number of patients present in the ward during any given time of data collection. Hence the total travel time travelled by two nurses for each half-hour was divided by the number of patients present in the ward for any particular time. This gave the total amount of time the nurses spent per patient in the ward for one half-hour period of data collection. Only one-half of this time was



taken into consideration to get the travel time spent by one nurse per patient (see example given below).

Eg.            **a** = Total travel time in Ward-A

**b** = Total number of patients present in Ward-A

Therefore **TOTAL TIME** spent in travelling by the two nurses per **PATIENT** is **a/b**. The calculation of the **TOTAL TIME** per **PATIENT** per **NURSE** would be **a/2b**.

This method of calculating the total travel time spent by a nurse for each patient was carried out for each half-hour of the data collection for both Ward-A and Ward-B. Analyzing two wards increased the validity of the results and gave a basis of comparison. Ward-A and Ward-B housed both surgical and non-surgical patients, but Ward-A consisted of private rooms and Ward-B consisted of more than one patient per room. The size of the wards also varied. Hence a comparison of the total time nurses spent travelling and the affect of the length of the corridor on the travel time was made. In addition to this, the amount of time the nurses spent in the patient rooms was also documented for the same time periods. The total amount of time the nurses spent in patient rooms for each half hour of the data

collection was added and divided by the number of patients on the ward at the times of the data collection. This total time for each period of the data collection was then averaged to give the total amount of time the nurse spent per patient room. This procedure was used to find the average amount of time the nurse spent on both Ward-A and Ward-B.

Ward-A and Ward-B are independent variables in the study as each ward layout is different. Ward-A is a private room ward with only one patient present in each room while Ward-B has a semi-private room setting with two patients per room. The nurses' travel time on the other hand is a dependant variable, dependant on the number of patients present in the ward, the length of the corridor, the type of illness the patient had, and type of facilities that were available to assist patients among other things. A paired T-test was performed comparing the nurses' travel time values in Ward-A to the travel time values in Ward-B which related to the first hypothesis in this study, that nurses spent more time travelling and less time with patients in the surgical and non-surgical wards on the fourth floor. In addition to the statistical analysis of the data, the observations were also analyzed quantitatively. A matrix

**Table 1: Average Time Spent by Nurses with Patients in Ward-A.**

<b>TO FROM</b>	<b>N.S.</b>	<b>PT.R.</b>	<b>M.R.</b>	<b>U.R.</b>	<b>TOTAL</b>
<b>N.S.</b>	0.00	6.76	0.55	0.27	7.58
<b>PT.R.</b>	8.06	4.94	2.37	1.70	17.07
<b>M.R.</b>	0.70	3.18	0.00	0.00	3.88
<b>U.R.</b>	0.00	1.30	0.25	0.00	1.55
<b>TOTAL</b>	8.76	16.18	3.17	1.97	30.08

**Note:** Time given in seconds to the nearest hundredth of a second.

**LEGEND :** 1) N.S. - Nurses' Station  
 2) PT.R. - Patient Room  
 3) M.R. - Medicine Room  
 4) L.R. - Linen Room  
 5) U.R. - Utility Room

**Table 2: Average Time Spent by Nurses with Patients in Ward-B.**

<b>TO FROM</b>	<b>N.S.</b>	<b>PT.R.</b>	<b>M.R.</b>	<b>U.R.</b>	<b>TOTAL</b>
<b>N.S.</b>	0.00	5.43	0.78	0.62	6.83
<b>PT.R.</b>	6.55	2.34	2.01	0.82	11.72
<b>M.R.</b>	0.73	2.98	0.00	0.00	3.71
<b>U.R.</b>	0.00	1.08	0.14	0.00	1.22
<b>TOTAL</b>	7.28	11.83	2.93	1.44	23.48

**Note:** Time given in seconds to the nearest hundredth of a second.

- LEGEND :**
- 1) N.S. - Nurses' Station
  - 2) PT.R. - Patient Room
  - 3) M.R. - Medicine Room
  - 4) L.R. - Linen Room
  - 5) U.R. - Utility Room

was developed similar to the form used for the data collection. This matrix helped to give a visual comparison of the average amount of time spent by each nurse per patient in various individual trips in Ward-A (See Table-1) and Ward-B (See Table-2).

The second phase of the data collection was the questionnaire. The questionnaire was given to all the nurses working on the fourth floor of Montgomery Regional Hospital. The analysis of the questionnaire was done mathematically using descriptive statistics, in particular comparing means, a measure of central tendency. By calculating the average responses for each question, with a range of response from 1 to 5, the average tendency was calculated. The responses were also numbered to find the percentage of positive and negative responses to each of the questions in the survey.

### **Description of Results**

The questionnaire examined the nurses perceptions of the patient ward layout, patient rooms, nurses' station and utility rooms. It also looked at the other possible problems nurses faced within the ward. The questionnaire was given to all 20 nurses assigned to the fourth floor

ward. Of the 20 questionnaires, 16 were returned, for a response rate of 80%.

From the survey it was determined that the nurses' station in both wards was in the best possible location, considering the present layout of the ward. More than 75% of the nurses agreed that the location of the nurses' station, utility room and medicine room were in an appropriate position (See Table-3). 62.5% of the nurses felt that the linen room and the linen cart were not in an appropriate location (See Table-4). Interesting suggestions were given, including adding a small linen room, medicine room and a secondary nurses' station on the other end of the patient corridor. These suggestions were directed to Ward-A as the length of the corridor of Ward-A was longer than Ward-B. The length of corridor in Ward-A was 134 feet from the nurses' station to the end of the corridor and the length of the corridor in Ward-B was 103 feet from the nurses' station to the outside wall of the classroom located at the end of the ward (Refer back to Figure 11). In addition to the length of the corridor the functional areas were closer to the nurses' station in Ward-B than Ward-A. More than 60% of the nurses found it difficult to serve the patients located in the rooms at the end of Ward-A

**Table 3: Location of Nurses' Station, Medicine Room and Utility Room.**

Question # 1, 2, 3 : Is the nurses' station, medicine room, utility room located in the best possible location?

Response	Rating	Nurses' Station		Medicine Room		Utility Room	
		#	%	#	%	#	%
Strongly Agree	1	1	6%	1	6%	1	6%
Agree	2	12	75%	10	63%	11	69%
Uncertain	3	0	0%	1	6%	0	0%
Disagree	4	2	13%	4	25%	4	25%
Strongly Disagree	5	1	6%	0	0%	0	0%

**Note:** Responses are shown with the actual number first and the percentage second for each column.

**Table 4: Location of the Linen Room/Linen Cart.**

Question #4: Is the linen room located in the best position to assist you in serving patients' needs?

Response	Rating	Linen Room	
		#	%
Strongly Agree	1	0	0%
Agree	2	4	25%
Uncertain	3	1	6%
Disagree	4	10	63%
Strongly Disagree	5	1	6%

**Table 5: Accessibility to Patient Rooms, Ward-A.**

Question #5: How easy is it to serve patients who are located in rooms numbered 421-424?

Response	Rating	Patient Room Ward-A	
		#	%
Very Easy	1	0	0%
Easy	2	3	19%
Doesn't Matter	3	1	6%
Not Easy	4	10	63%
Almost Impossible	5	2	13%

**Note:** Responses are shown with the actual number first and the percentage second for each column.



(refer back to Table 5) and 43% of the nurses found it difficult to attend to patients in the rooms at the end of Ward-B (See Table 6). The length of the corridor appears to affect the nurses perceptions of the layout of the ward, as it affects the physical stress caused by walking to and from patient rooms to nurses station, inhibiting the nurses performance in patient care.

Fifty percent of the nurses felt that the present layout of the ward was good for their activities, however 37% found the layout inefficient in supporting their activities on the ward (See Table 7). Several nurses suggested alternative designs to reduce the length of the corridor and bring the patient rooms closer to the nurses station. Fifty-six percent of the nurses responded negatively to the ease of communication between nurses and patients because of the present layout of the ward (See Table 8). Even though 50% of the nurses agreed that the layout was efficient, 43% of the nurses said that they spent more than 51% of their time in travelling to and from the nurses' station to patient rooms, medicine room and other functional areas (refer back to Table 8). In addition to this, 37% of the nurses said that they spent at least 41% to

**Table 6: Accessibility to Patient Rooms, Ward-B.**

Question #6: How easy is it to serve the patients who are located in rooms numbered 431-435?

Response	Rating	Patient Room Ward-B	
		#	%
Very Easy	1	0	0%
Easy	2	3	19%
Doesn't Matter	3	3	19%
Not Easy	4	7	44%
Almost Impossible	5	1	6%

**Table 7: Efficiency of Fourth Floor Ward.**

Question #7: Do you feel that the set up or layout of the 4th floor assists in your daily work related activities?

Response	Rating	Ward Layout	
		#	%
Strongly Agree	1	0	0%
Agree	2	8	50%
Uncertain	3	2	13%
Disagree	4	6	38%
Strongly Disagree	5	0	0%

**Note:** Responses are shown with the actual number first and the percentage second for each column.

**Table 8: Communication between Nurses and Patients.**

Question #11: The location of nurses' station offers ease of communication between nurses and patients?

Response	Rating	Location of Nurses' Station	
		#	%
Strongly Agree	1	0	0%
Agree	2	4	25%
Uncertain	3	3	19%
Disagree	4	9	56%
Strongly Disagree	5	0	0%

**Note:** Communication refers to the relationship between the nurses' station and patients.

**Table 9: Time Spent Travelling to Patient Rooms.**

Question #15, 16: Approximately what percentage of your time on the ward do you spend in in travelling and in patient rooms?

Response	Time in Travelling		Time in Patient Room	
	#	%	#	%
Up to 10%	0	0%	0	0%
11% - 20%	0	0%	0	0%
21% - 30%	1	6%	1	6%
31% - 40%	2	12%	4	25%
41% - 50%	6	37%	6	38%
More than 51%	7	43%	5	31%

**Note:** Responses are shown with the actual number first and the percentage second for each column.

50% of their time in patient rooms, while another 31% of the nurses felt that they spent more than 51% of their time in patient rooms (refer back to Table 9).

From this data it is shown that the nurses' station is in the best possible location in the existing ward layout (refer back to Table 3). In spite of the nurses positive response that the ward layout was efficient, the nurses spent more than 51% of their time in travelling and less than 50% of their time in patient care. It appears that the length of the corridor of the patient ward does have a significant impact on the nurses' perceptions. A secondary nurses' station, linen room and medicine room at the far end of the patient ward could help overcome this problem.

Even though 75% of the nurses responded positively to the location of the nurses station on the ward, 67% of the nurses felt that the design of the nurses station needed to be changed. The main problem they experienced within the nurses' station was inadequate storage space. The other problem that surfaced was the overlap of the doctors' and nurses' activities within the nurses' station. It was shown in the survey that 42% of the nurses felt that any

improvement in the visual appearance of the interior environment of the ward would improve their attitudes and perceptions of their work environment. They felt this would indirectly improve their performance in patient care as well.

The other factor on the ward that inhibited work activity was the insufficient nursing staff scheduled for patient care. In addition, the facilities provided for patient care were insufficient. The location of the elevator also appeared to interfere with the functional areas around the nurses' station. By decreasing the travelling distance from the nurses' station to the patient rooms and decreasing the distance of the functional areas to the patient rooms, a more efficient layout could result for the nurses to serve their patients better.

The paired T-test was used to analyze statistically the observation data. This analysis examined the amount of time the nurses spent travelling in Ward-A (private room setting) compared with Ward-B (semi-private room setting). Jydstrup and Goss in 1966 found that nurses spend at least 17% of their time travelling to and from the nurses' station. The

**Table 10: Observed Travel Time in Ward-A and Ward-B.**

Mean		T-Value	SD		P-Value
Ward-A	Ward-B		Ward-A	Ward-B	
30.08	23.48	4.999	5.04	8.15	0.01 *

\*  $p < 0.05$  Level of Significance

mean time a nurse spent in travelling to and from patients rooms in Ward-A was found to be 30.083 seconds and in Ward-B was 23.483 seconds, with a mean difference of 6.6 seconds per patient. The data were significantly different at the 0.01 probability level (refer back to Table 10).

The null hypothesis considered for the analysis was that the nurses' travel time in Ward-A would be equal to nurses' travel time in Ward-B. The T-value was found to be 4.995 at the 0.05 level of significance (refer back to Table 10). The P-value of 0.01 was found to be much greater than the critical value of 0.05, hence the null hypothesis is rejected and the alternative hypothesis is accepted that the time spent by nurses travelling in Ward-A is different from the travel time in Ward-B (refer back to Table 10). The standard deviation is a measure of the average deviation of each score from the mean. The scores (travel time) deviated from the mean by 5.036 in Ward-A and 8.15 in Ward-B.

The main objectives set for this study were to 1) explore the amount of time the nurses spent travelling to and from patient rooms. Hypothesis 1 was that nurses would spend more time travelling and less time with patients.

Observations helped to establish the fact that the average amount of time the nurse spent travelling in Ward-A was 30.0833 seconds per patient. Hence the average amount of time one nurse spent per patient was approximately half a minute. That is the nurses almost spent 20% to 27% of time travelling in Ward-A and Ward-B. This was much more than the time Jydstrup and Goss found in their study conducted in 1966.

As discussed in Chapter 1, the changing trends in the health care industry including an increase in outpatient care and a corresponding increase in the severity of inpatient cases has had a significant impact on the health care industry. The severity of cases that nurses' are dealing with could be an influencing factor as to the amount of time nurses spend travelling within the ward.

In this study it was observed that the amount of time nurses spent travelling on Ward-A with all 12 patients was 20%. At the same time nurses spent 27% of their time travelling with all 21 patients on Ward-B. The amount of time the nurses spent travelling in a semi-private room type setting was more than the private room type setting (See

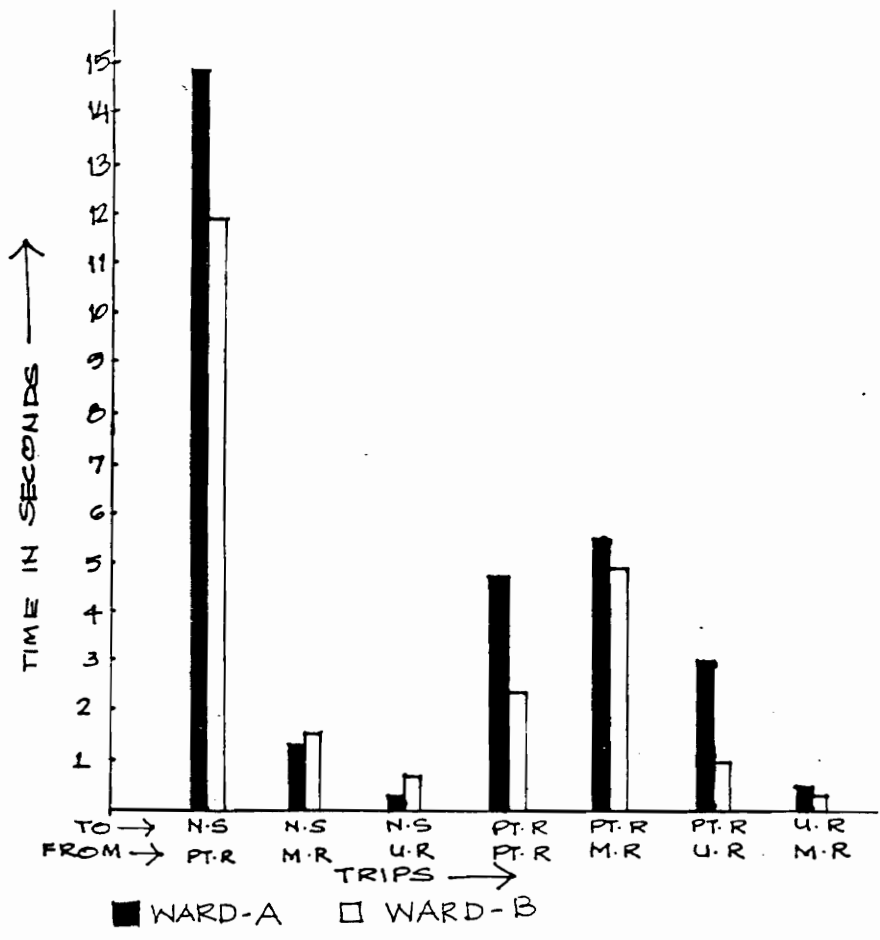


Figure 17 and, 18). The average amount of time the nurses spent in Ward-A patient rooms was 21.39 sec., while the amount of time spent with patients in Ward-B was 36.08 sec. From these results the average time each nurse spent travelling in Ward-A was more than the average time spent by each nurse per patient room. The average time spent travelling in Ward-B was less than the average time spent by each nurse per patient room (See Table 11). Since Ward-B was a semi-private room setting, there were more than one patient present in each room. So the total amount of time the nurses spent in patient rooms was more, as the nurses attended to two patients at the same time. In addition to this, the total length of the corridor of Ward-B was shorter than Ward-A. From these results, Hypothesis 1 was accepted for Ward-A and Hypothesis 1 is rejected for Ward-B.

Objective 2 was to document the amount of time nurses spent with patients. Hypothesis 2 was that the nurses would spend the same amount of time with patients in both types of ward settings. It was also observed that the amount of time the nurses spent in patient rooms was also dependant on the total number of patients present in the ward. The average amount of time a nurse spent on average per patient room in Ward-A was 21.39 sec., and the amount of time spent by each

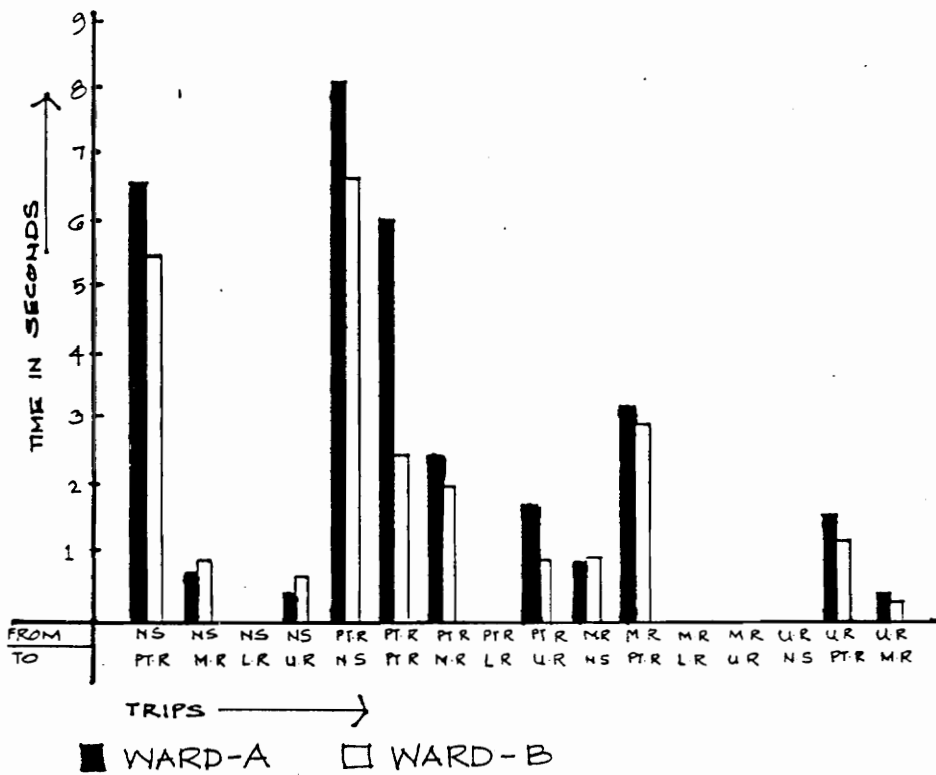
**Table 11: Time Spent in Patient Rooms and Time Spent Travelling**

	<b>Time Spent in Patient Rooms</b>	<b>Time Spent in Travelling</b>
Ward-A	21.39 sec.	30.08 sec.
Ward-B	36.08 sec.	23.48 sec.



- LEGEND :**
- 1) N.S. - Nurses' Station
  - 2) PT.R. - Patient Room
  - 3) M.R. - Medicine Room
  - 4) L.R. - Linen Room
  - 5) U.R. - Utility Room

**Figure 17:** Comparison of the Combined Time Spent in Ward-A and Ward-B.



- LEGEND :
- 1) N.S. - Nurses' Station
  - 2) PT.R. - Patient Room
  - 3) M.R. - Medicine Room
  - 4) L.R. - Linen Room
  - 5) U.R. - Utility Room

Figure 18: Comparison of Individual Time Spent in Ward-A and Ward-B

nurse per patient room in Ward-B was 36.08. Thus Hypothesis 2 is rejected that the nurses spent the same amount of time in both Ward-A and Ward-B.

Objective 3 was to assess the perceptions of nurses as to physical environment factors that may impede delivery of services to patients. Hypothesis 3 was that the time spent travelling within patient Ward-A or Ward-B had no relationship to the job satisfaction experienced by the nurses (See Table 12). The Hypothesis 3 could not be tested in this study. The results of the survey could not show that job satisfaction was dependent on the amount of time the nurses spent with the patients, nor could it prove its dependency on the physical characteristics of the patient ward and the number of nursing staff present on duty. A whole separate study evaluating the determinants of job satisfaction will have to be done to prove Hypothesis 3.

One of the problem areas brought out in the survey was inadequate linen storage space as well as storage space for large equipment like I.V.-poles, wheelchairs, stretchers etc. used in patient care. The design of the nurses' station was also not appropriate, as it did not help in

**Table 12: Nurses' Job Satisfaction**

Question #14: Overall how satisfied are you with your job?

Response	Rating	Job Satisfaction	
		#	%
Very Satisfied	1	3	19%
Satisfied	2	9	56%
Uncertain	3	2	13%
Dissatisfied	4	2	13%
Very Dissatisfied	5	0	0%

supporting the nurses routine activities and interfered with the doctors activities in the nurses' station. The nurses also indicated through the questionnaire that the design of the nurses station created a conflict between the doctors' and nurses' activities within that space.

### **Recommendations**

With the help of the overall results of the observations and questionnaire, design recommendations were made to improve the efficiency of the ward and to assist nurses in their activities related to patient care. The nurses response in the survey indicated difficulty in attending to patients in the rooms at the end of Ward-A. The provision of a secondary nurses' station at the end of Ward-A can reduce the amount of travel for the nurses (See Figure 19 and 20). This will also help in reducing the overall time the nurses spent in travelling to and from nurses station to patient rooms help to reduce the interference of the work patient rooms and make the rooms at the end of the Ward-A more accessible to the nurses.

The other problem found was the location of the linen cart on the corridor of Ward-A. It was observed that the

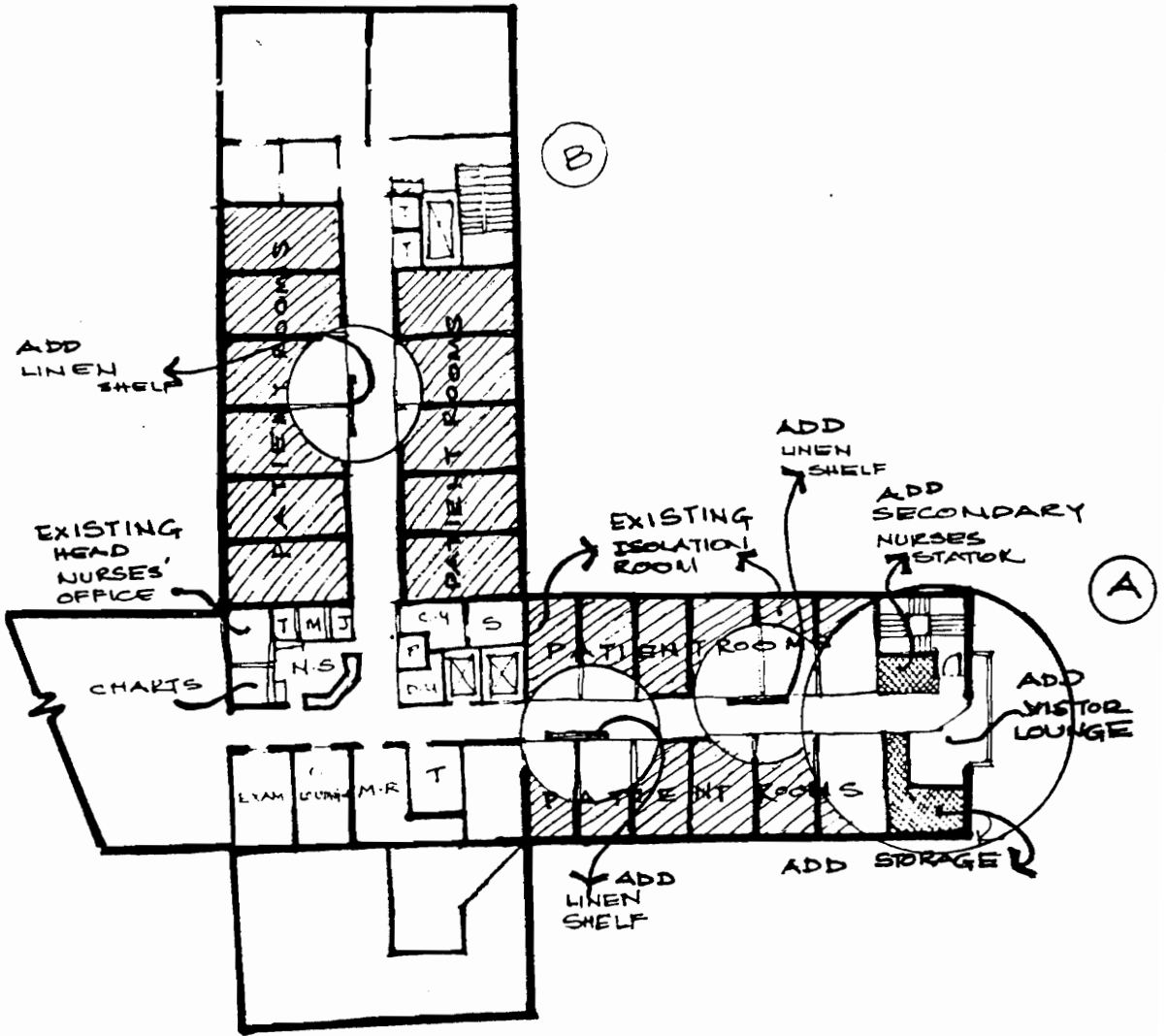


Figure 19: Conceptual Design Solution on 4th Floor Ward



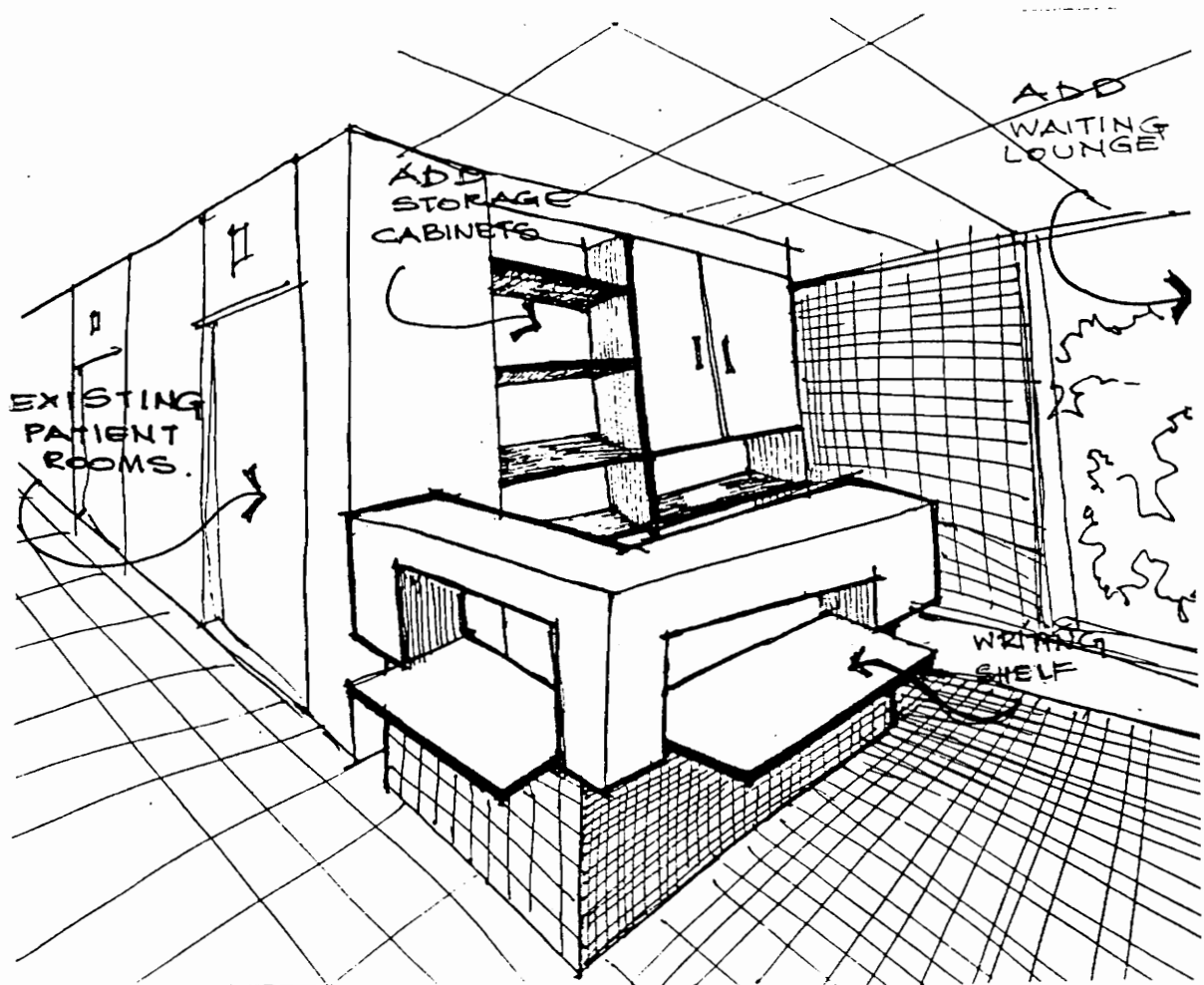


Figure 20: Secondary Nurses' Station for Ward-A.

linen room in front of the nurses' station was rarely used by the nurses attending to patients on Ward-A. Instead of having a linen cart blocking the corridor, small shelves could be located at one or two locations on the wall below the hand rail on the corridor of Ward-A. These shelves would not project in the corridor but be recessed in the wall. Another alternative would be to project these shelves 6" into the hallway (See Figure 21).

The design of the nurses' station did not adequately support the activities performed in it. Different activities overlap in the nurses' station. By conceptually zoning the nurses' station so as to segregate the functions of the different spaces and activities within the nurses' station, the station could work more efficiently for doctors and nurses. The design of the work counter with the glass partition could also be changed (See Figure 22). This design would help to reduce the interference of the work activities between nurses and doctors within the nurses' station. The overhead storage provided above the counter would increase the storage space in the ward (See Figure 22). These conceptual suggestions would help to improve the nurses' perceptions of the physical environment and assist the nurses in their routine activities needed in patient

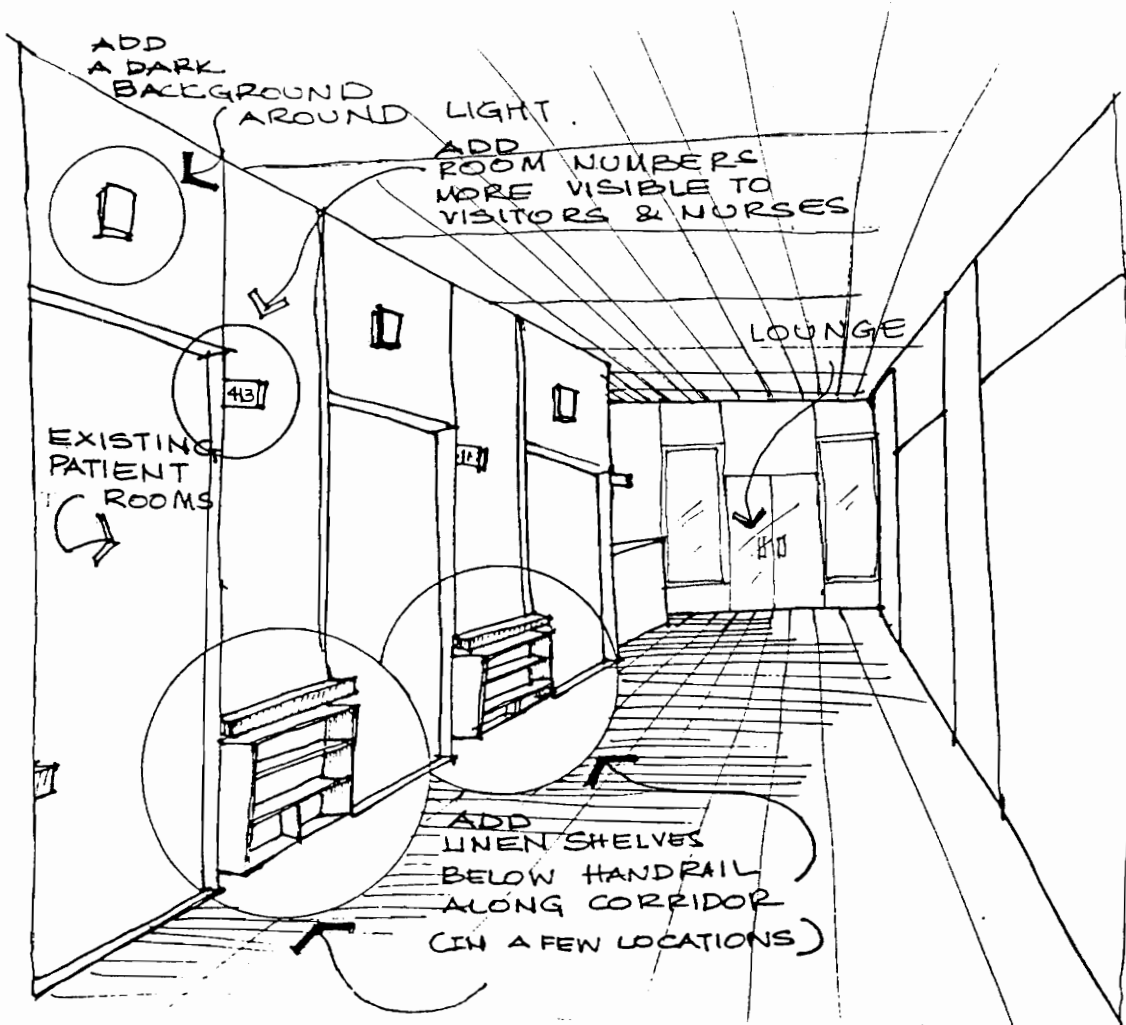


Figure 21: Linen Shelves Added in the Corridor.

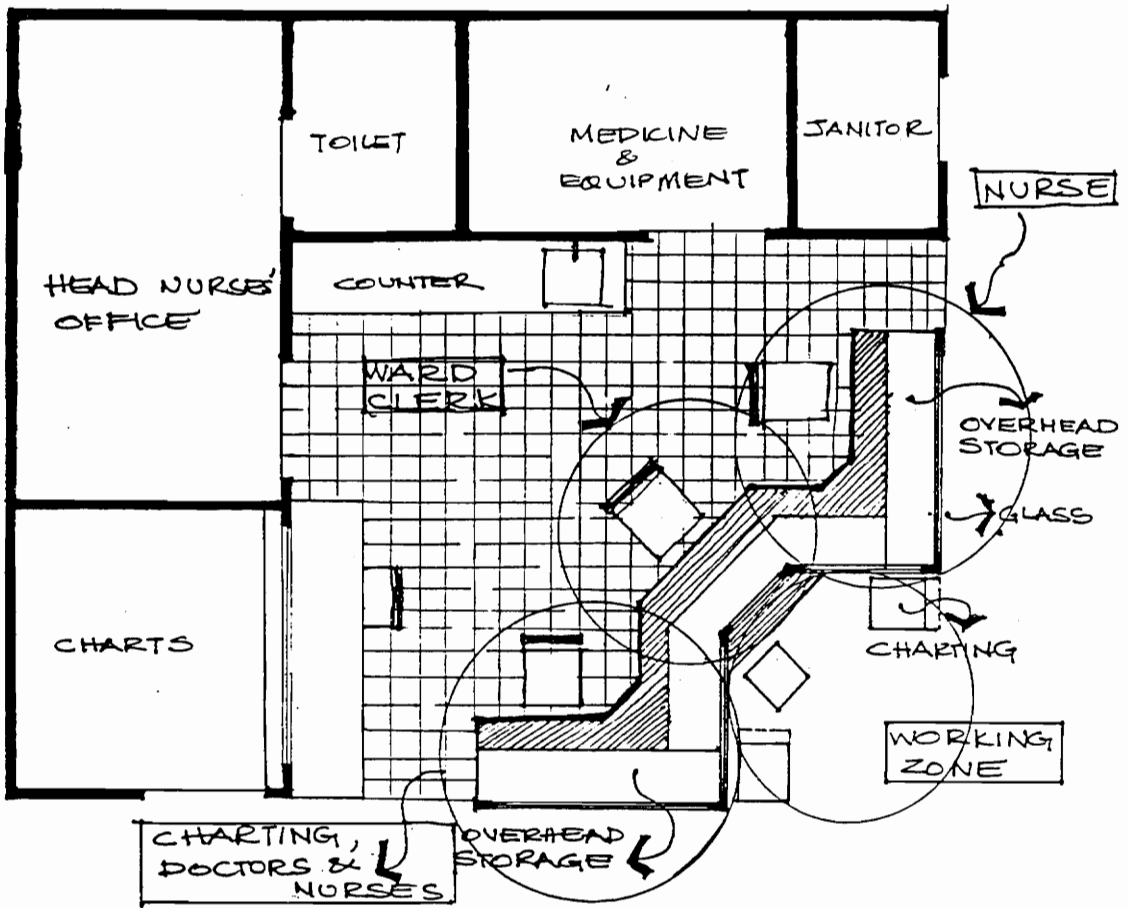


Figure 22: Detail of Nurses' Station Counter.

care. This was brought out in the study as being important to their overall job satisfaction.

It was observed that there was inadequate storage space on the ward for large equipment used in patient care. The visitors lounge was large, compared to its usage. The deck at the end of the corridor of Ward-A was always locked for security and safety reasons, making it also a waste of space. The visitors lounge was divided in such a way that the back side of the lounge was used for storage and the front combined with the open deck which could be used as a lounge to improve the function of the far end of the hall (See Figure 23).



Figure 23: Waiting Lounge Opposite Secondary Nurses' Station

## CHAPTER 5

### Conclusions

In the literature discussed in Chapter 2 it was found that travel time on the nursing unit may occupy one-sixth of a nurse's total time. In this study it was found that nurses' travel time on the nursing unit was one-fifth of the nurses' total time which was much more than the time found in previous studies.

The amount of time nurses spent travelling in Ward-A was more than the amount of time they spent in patient rooms while the nurses spent more time in patient rooms in Ward-B than in travelling. The length of the corridor in Ward-A was longer than the corridor in Ward-B. This seems to indicate that the length of the corridor in the ward does affect the amount of time nurses can spend with patients. The location of the functional areas also appeared to influence the time spent travelling from patient rooms to functional areas and back. On average the nurses spent more time travelling to and from patient rooms to functional

areas in Ward-A than in Ward-B. Again the length of the corridor may be a factor here.

Hence as Lippert (1969) said, the geometry of the nursing ward has an affect on the amount of time nurses spend travelling in the ward. It is important that designers understand the relationships between these three factors described by Lippert to reduce the unnecessary travel on the nursing units.

This study described one simple method of looking at the travel time the nurses use in their activities on the ward. In this study it was shown that the nurses spent 20% to 27% of their time on travelling from nurses' station to patient rooms, and functional areas on the ward. It was also shown that the nurses spent more time with patients in a ward type setting where there was more than one patient in each room. The total time the nurses spent travelling was less in the semi-private ward setting where at least two patients were present in each patient room, and more in a private ward setting where only one patient was present in each room. This was also shown in the study. As more than one patient was present in the same area the nurse could



attend to two patients at the same time, reducing the overall time spent travelling on the ward.

Since only one hospital was studied for this thesis the results cannot be generalized beyond the one hospital studied. Further studies could be done in other hospitals and the data compared to the results from this study. This study was important in understanding how to improve existing hospital layouts to improve nursing efficiency within the ward. After having completed the suggested design suggestions on the fourth floor ward of the Montgomery Regional Hospital a post-occupancy evaluation could be performed to study if there are any differences in nursing traffic patterns or travel time, spent in patient care within the ward. The results from the post-occupancy study would help to validate the current study and increase the potential of usability in the field.

Travel in nursing units exhibits wide variation due to layout. As discussed in Chapter Two, Lippert (1969) said layout varies because of the period in which a hospital is built, the class of care which is provided, regional construction differences, and unit size. Behavioral studies

involving nurses' activities may require an analysis of the layout on the nurses' travel patterns. This concept of nurses' travel time makes it possible to equate more than two layouts in terms of time, and study the factors influencing the nurses' travel in various ward settings. This method, however needs to be combined with other data collection techniques for a more complete picture of what is happening on the ward. The effect of large amount of travel on the ward and the generated physical stress on the nurses performance in the ward is a factor that needs to be studied further.

Other areas of research which could be examined include studying the relationship of employee satisfaction and patient satisfaction. Also studies could be conducted on the effect of nurses productivity and performance on the overall costs of the hospital. In addition to employee satisfaction, patient satisfaction is also very important. Studies evaluating nurses' attitudes and perceptions of the ward could help administrators in decision making concerning renovations of hospitals, attract more nursing personnel in the hospitals and also help in retaining the present nursing personnel. There is more to do than simply changing colors and fabrics to improve working conditions in these older

existing hospitals. Traffic and layout patterns must also be examined as in the current study and then improved to make any real difference in supplying improved patient care.

## Bibliography

- A smarter way of nursing? (1990). Nursing Times, 86(9), 64-70.
- Allen, T. J. & Gerstberger, P. G. (1973). A field experiment to improve communications in a product engineering department: The non-territorial office. Human Factors, 14(3), 487-498.
- Alexander, J. W. & Bauershmidt, A. D. (1987). Implications for nursing administration of the relationship of technology and structure to quality of care. Nursing Administration Quarterly, 11(4), 1-10.
- American Hospital Association, (1989-1990). Hospital statistics: 1989-1990. Chicago, Illinois.
- Ashley, H. M. (1989). Discharge holding area: Using inpatient beds more efficiently. Journal of Nursing Administration, 19(12).
- Baird, J. E. Jr. (1987). Changes in nurse attitudes: Management strategies for today's environment. Journal of Nursing Administration, 17(9), 38-43.
- Barnes, R. M. (1963). Motion and time study. (5th ed.). New York: Wiley.
- Becker, F. D. (1980). Employees need role in design of work place. Hospitals: Journal of the American Hospital Association, 54(22), 97-99.
- Berger, W. N. (1979). Nurse participation in nursing unit design for health care facilities. Journal of Nursing Administration, 4(1), 52-57.
- Bertz, E. J., DiMonda, R. & Sprague, J. G. (1976). Viewing the hospital as a working environment. Hospitals: Journal of the American Hospital Association, 50(20), 107-110.
- The BOCA basic building code. (1982). Illinois: Interstate Printers and Publishers, Inc.
- Brill, M., Margulis, S. T. & Konar, E. (1985). Using office design to increase productivity. Buffalo: Bosti and Westinghouse Furniture Systems Inc.

- Brookes, M. J. & Kaplan, A. (1972). The office environment: Space planning and effective behavior. Human Factors, 14(3), 373-391.
- Butler, C. & Erdman, A. (1946). Hospital planning. New York: F. W. Dodge Corporation.
- Carey, D. A. (1984). Home and nature links highlight hospices. Hospitals: Journal of the American Hospital Association, 58(4), 102-105.
- Chapman, L. J. & Campbell, D. T. (1957). An attempt to predict the performance of three-men teams from attitude measurements. Journal of Social Psychology, 46(2), 227-86.
- Clark, R. C. (1984). Marketing needs mold nursing-home mission for an older hospital. Hospitals: Journal of the American Hospital Association, 58(4).
- Cloverleaf design draws praises of doctors, nurses and patients (1964). Southern Hospital, 32(3), 21-26.
- Collins, D. F. (1984). Skilled nursing unit fashioned from acute care space. Hospitals: Journal of the American Hospital Association, 58(4), 100.
- Colloton, J. W. (1986). The changing environment. Journal of Nursing Administration, 16(4), 6-8.
- Cook, H. S. (1976). Interior design sets cheerful, calming mood. Hospitals: Journal of the American Hospital Association, 50(3), 87-89.
- Craig, J. S. (1963). Group corridor plan for nursing units. Canadian Hospital, 40, 42-end.
- Design for health (1989). Nursing Times, 85(21), 16-17.
- Edge, D. R. (1979). A hospital must study cost, codes, alternatives to decide on reuse or new building. Hospitals: Journal of the American Hospital Association, 53(4), 109-122.
- Eriksen, L. R. (1987). Patient satisfaction: an indicator of nursing care quality?. Nursing Management, 10(7).
- Ferris, G. R. & Rowland, K. M. (1985). Physical design implications for the performance evaluation process. Nursing Administration Quarterly, 9(3), 55-63.

- Fishback W. B. & Gecker, F. F. (1980). Cluster design meets special, shared needs. Hospitals: Journal of the American Hospital Association, 54(4), 112-114.
- Fox, R. C. (1989). The sociology of medicine. New Jersey: Prentice-Hall.
- Freeman, J. R. (1967). Quantitative criteria for hospital inpatient nursing unit design. Unpublished doctoral dissertation, Georgia Institute of Technology.
- Freidson, E. (1963). The hospital in modern society. London: The Free Press of Glencoe, Collier-MacMillan Limited.
- Gagneaux, V. & Shaver, D. V. Jr. (1977). Distractions at nurses' stations during intershift report. Nursing Research, 26(1), 42-46.
- Gainsborough, H. & Gainsborough, J. (1964). Principles of hospital design. London: The Architectural Press.
- Garfield, S. R. (1971). An ideal nursing unit. Hospitals: Journal of the American Hospital Association, 45(6), 80-86.
- Goldstein, R. J. (1979). Nursing station design using a social theory model. Journal of Nursing Administration, 9(4), 21-25.
- Goldwater, S. S. (1947). On hospitals. New York: The MacMillan Company.
- Goodwin, I. H. (1979). A guide to planning critical care units. Journal of Nursing Administration, 9(6), 21-25.
- Green, A. C. (1976). Changes in care call for design flexibility. Hospitals: Journal of the American Hospital Association, 50(3), 67-69.
- Grubbs, J. & Short, S. (1979). Nursing input to nursing unit design. Journal of Nursing Administration, 9 (4), 25-30.
- Hardy, O. B., Lammers, L. P. & Minkalis, A. C. (1976). Build less total space but achieve more usable space. Hospitals: Journal of the American Hospital Association, 50(6), 105-108.

- Helmer, T. F. & McKnight, P. (1988). One More Time: Solutions to the nursing shortage. Journal of Nursing Administration, 18(11), 7-15.
- Hitt, P. (1980). Horizontal design retained in expansion. Hospitals: Journal of the American Hospital Association, 54(4), 74-75.
- Hyman, R. (1979). Choosing art for your hospital: Some basic do's and dont's. Hospitals: Journal of the American Hospital Association, 53(6), 95-98.
- Jydstrup, R. A. and Goss, M. J. (1966). Cost of information handling in hospitals. Health Services Research, 235-271.
- Improving hospital wards (1959). Nursing Times, 55(2), 193-194.
- Kaplan, A (1972). The office environment: space planning and effective behavior. Human Factors, (10), 373-391.
- Lagemann, E. C. (1983). Nursing history: New perspectives, new possibilities. N. Y.: Teachers College Press, 1-12.
- Levitan, M. S. (1979). To reuse or reconstruct: that is the question. Hospitals: Journal of the American Hospital Association, 53(4), 93-106.
- Lippert, S. (1969). Travel as a function of nursing unit layout, with utility stops, (Report No. 115). Human Engineering Information and Analysis Service. Tufts University.
- Lippert, S. (1972). Nurses' travel. Journal of Nursing Administration, (2), 36-41.
- Llewelyn, D. R. (1960). Architectural problems of new hospitals. British Medical Journal, 2, 768.
- McLaughlin, H. P. (1961). Are circular units over-rated? Modern Hospital, 96(5), 81.
- McLaughlin, H. P. (1964). What shape is best for nursing units? Modern Hospital, 103(12), 84-89.
- Miller, M. A. (1983). The nurse as builder: Getting form to follow function. Nursing Management, 14(11), 42-44.

- Milne, D. (1986). Planning and evaluating innovations in nursing practice by measuring the ward atmosphere. Journal of Advanced Nursing, 11, 203-210.
- Monnig, R. L. (1983). Professional territoriality in nursing. In N.L. Chaska (Ed.), The nursing profession. New York: McGraw-Hill Book Company.
- Moors, J. S. (1963). Nursing unit design trends. Hospital Progress, 44(2), 69-72.
- Moores, B. & Thompson, A. G. H. (1986). What 1,357 hospital inpatients think about aspects of their stay in British acute hospitals. Journal of Advanced Nursing, 11.
- Moos, R. H. & Wandersman, A. (1981). Assessing and evaluating residential environments: A sheltered living environments example. Environment and Behavior, 13(4), 481-508.
- Morana, C. (1987). Employee satisfaction: A key to patient satisfaction. Perioperative Nursing Quarterly, 3(1), 33-37.
- Moritz, P. (1989). Nursing resources and the delivery of patient care: The national center of nursing research perspective", Journal of Nursing Administration, 19 (5), 12-17.
- Murray, M. (1980). Fundamentals of nursing. New York: Prentice-Hall Publications.
- Neergard, M. (1942). Elements of progressive patient care, 1962. (No. 930-C-I). Washington, D.C.: U.S. Public Health Service.
- New shape for hospital addition leads to new arrangement of nursing unit (1981). Modern Hospital, 114(6), 90-93.
- Number cruncher statistical system, version 5.01: [computer program]. (1987). Kaysville, Utah. Jerry L. Hintez.
- O'Connor, R. (1976). American hospitals: The first 200 years. Hospitals: Journal of the American Hospital Association, 50(1), 62-72.
- Oberlander, R. (1979). Beauty in a hospital aids the cure. Hospitals: Journal of the American Hospital Association, 53(6), 89-92.



- Parker, W. Jr. (1979). Flexible designs are key to reuse projects, Hospitals: Journal of the American Hospital Association, 53(4), 125-134.
- Palmer, J. S. (1983). Nightingale revisited. Nursing Outlook, 4(31), 229-233.
- Pelletier, R. J. & Thompson, J. D. (1960). Yale index measures design efficiency. Modern Hospital, 95(11), 73-77.
- Pfaff, J. (1987). Factors related to job satisfaction/dissatisfaction of registered nurses in long-term care facilities. Nursing Management, 18(8), 51-55.
- Pulley, L. C. (1969). The size and organization of nursing units. In Alden B. Mills (Ed.), Functional Planning of General Hospitals. New York: McGraw-Hill Book Company.
- Putsep, E. (1979). Modern Hospital. London: Lloyd-Luke Ltd.
- Rees, F. W. Jr. (1980). Mathematical modeling can identify departmental space needs. Hospitals: Journal of the American Hospital Association, 54(24), 109-112.
- Rempusheski, V. F., Chamberlain, S. L., Picard, H. B., Ruzanski, J., & Collier, M. (1988). Expected and received care: Patient perceptions. Nursing Administration Quarterly, 12(3), 42-50.
- Ryan, J. L. (1975). The nursing administrator's growing role in facilities planning. Journal of Nursing Administration, (6), 23-27.
- Schmitz, H. H., Ellerbrake, R. P. and Williams, T. M. (1976). Study evaluates effects of new communication system. Hospitals: Journal of the American Hospital Association, 50(11), 126-132.
- Simchuk, C. J. & Howard, S. L. (1986). Patient care centers keep nurses close to bedsides. Nursing Management, 17(11), 21-24.
- Simpson, K. (1985). Job satisfaction or dissatisfaction reported by registered nurses. Nursing Administration Quarterly, 9(3), 64-73.
- Snook, D. I. (1981). Hospitals: What they are and how they work. Aspen Publication, Inc., Maryland.

- Strugath, W. (1984). Seminar stresses renovation over construction. Hospitals: Journal of the American Hospital Association, 58(7), 106-108.
- Sundstrom, E., Burt, R. E., & Kamp, D. (1980). Privacy at work: Architectural correlates of job satisfaction and job performance. Academy of Management Journal, 23(1), 101-117.
- Thomas, J. & Bobrow, M. L. (1984). Targeting the elderly in facility design. Hospitals: Journal of the American Hospital Association, 58(4), 83-89.
- Thomas, M., Burton, M. and Cullen, C. (1982). Take a new look at your ward. Nursing Times, 78, 1068-1070.
- Thompson, J. D. and Goldin, G. (1975). The Hospital: A Social and Architectural History. New Haven: Yale University Press.
- Thompson, J. D. (1967). Organizations in Action. New York: McGraw-Hill.
- Thompson, W. G. (1913). Efficiency in nursing, Journal of the American Medical Association, 61(24), 2146-2149.
- Thompson, J. D. & Fretter, R. B. (1969). Economics of occupancy with varying mixes of private and other patient accommodations: A simulation. Health Services Research, 42-52.
- Trexler, B. J. (1987). Nursing department purpose, philosophy, and objectives: Their use and effectiveness Journal of Nursing Administration, 17(3), 8-14.
- Turner, W. A. and Carney, T. (1984). Circular nursing units and two-bed rooms keep patients in touch. Hospitals: Journal of the American Hospital Association, 58 (4), 122-123.
- Tusler, W. Jr. (1979). Could two-level process eliminate costly planning problems?. Hospitals: Journal of the American Hospital Association, 53(4), 85-90.
- Weisman, C. S., Alexander, C. S. & Chase, G. A. (1980). Job satisfaction among hospital nurses: A longitudinal study, Health Services Research, 15(4), 341-364.
- Wheeler, T. E. (1964). Hospital design and function. New York: McGraw-Hill Book Company.

- Wolf, G. A (1981). Nursing turnover: Some causes and solutions. Nursing Outlook, 29(4), 233-236.
- Young H. H. & Berry, G. L. (1979). The impact of environment on the productivity of intellectually challenged office workers. Human Factors, 21(4), 399-407.
- Young, S. R. & Thilliander, B. D. (1980). Patients, staff are focal point of new burn unit. Hospitals: Journal of the American Hospital Association, 54(4), 96-99.
- Zeisel, J. (1981). Inquiry by Design. Monterey, CA: Brooks/Cole Publishing Company.
- Zelner, L. & Badner, B. (1979). An engineer's approach to data collection and planning. Hospitals: Journal of the American Hospital Association, 53(5), 62-64.

APPENDIX-A

MONTGOMERY REGIONAL HOSPITAL

QUESTIONNAIRE

Please CIRCLE the appropriate number in response to the following questions concerning your patient ward:

- 1) Is the nurses' station located in the best position to assist you in serving patients' needs?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

- 2) Is the medicine room located in the best position to assist you in serving patients' needs?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

- 3) Is the utility room located in the best position to assist you in serving patients' needs?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

- 4) Is the linen room located in the best position to assist you in serving patients' needs?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

- 5) How easy is it to serve the patients who are located in rooms numbered 421-424?

Very Easy	Easy	Doesn't Matter	Not Easy	Almost Impossible
1	2	3	4	5

- 6) How easy is it to serve the patients who are located in rooms numbered 431-435?

Very Easy	Easy	Doesn't Matter	Not Easy	Almost Impossible
1	2	3	4	5

✓7) Do you feel that the set up or layout of the 4th floor assists in your daily work related activities?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

✓8) Do you feel the overall visual appearance of the ward affects your performance concerning patient care?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

9) Do you feel the present layout of the ward offers you work privacy within the ward?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

✓10) The location of the nurses' station offers ease of communication between nurses?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

✓11) The location of the nurses' station offers ease of communication between nurses and patients?

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

✓12) How would you classify your present working conditions?

Very Good	Good	Uncertain	Poor	Very Poor
1	2	3	4	5

✓13) How would you classify the floor layout of the ward?

Very Good	Good	Uncertain	Poor	Very Poor
1	2	3	4	5

14) Overall how satisfied are you with your job?

Very Satisfied	Satisfied	Uncertain	Dissatisfied	Very Dissatisfied
1	2	3	4	5

15) Approximately what percentage of your time on the ward do you spend each day traveling to and from patient rooms? (Please check one category.)

Up to 10%	11%-20%	21%-30%	31%-40%	41%-50%	More than 51%
_____	_____	_____	_____	_____	_____

16) Approximately what percentage of your time on the ward do you spend each day in patient rooms? (Please check one category.)

Up to 10%	11%-20%	21%-30%	31%-40%	41%-50%	More than 51%
_____	_____	_____	_____	_____	_____

17) Before going to final section of the questionnaire, are there any other comments you would like to make about the layout of the ward?

\_\_\_\_\_

\_\_\_\_\_

18) If you were asked to change any two things in the ward, what would you change to assist you in providing better care to patients? (Please circle the two letters you choose.)

- a) The location of nurses' station.
  - b) The location of functional areas, such as medicine room, utility room etc.
  - c) The design of the nurses' station
  - d) The visual appearance of the interior environment
  - e) Shorten the length of the corridor leading to patient rooms
  - f) The overall layout of the patient ward
  - g) Other, please describe \_\_\_\_\_
- \_\_\_\_\_

19) If you were asked what two things should be kept in the ward, what would you keep to assist you in providing better patient care? (Please circle the two letters you choose.)

- a) The location of nurses' station.
- b) The location of functional areas, such as medicine room, utility room etc.
- c) The design of the nurses' station
- d) The visual appearance of the interior environment
- e) Shorten the length of the corridor leading to patient rooms
- f) The overall layout of the patient ward
- g) Other, please describe \_\_\_\_\_

20) What factors in the ward inhibit your taking care of patients? Please rank order the following factors from 1 (most inhibiting) to 10 (least inhibiting).

- \_\_\_ Location of patient rooms in the ward.
- \_\_\_ Location of waiting area for visitors in the ward.
- \_\_\_ Location of the elevator in the ward.
- \_\_\_ Location of nurses' station in the ward.
- \_\_\_ Location of functional areas in the ward.
- \_\_\_ Wayfinding within the ward.
- \_\_\_ Storage area for equipment.
- \_\_\_ Number of nursing staff for patient care.
- \_\_\_ Facilities provided for patient care.
- \_\_\_ Other, please describe \_\_\_\_\_

21) Concerning the design of the ward, would make it easier for you to serve your patients better? Please rank order the following factors from 1 (most inhibiting) to 8 (least inhibiting).

- \_\_\_ Decrease the walking distance from the nurses' station to patient rooms.
- \_\_\_ Decrease the walking distance from the medicine room to the patient rooms.
- \_\_\_ Decrease the walking distance from the utility room to the patient rooms
- \_\_\_ Decrease the walking distance from the linen room to the patient rooms.
- \_\_\_ Eliminate obstacles in the corridor.
- \_\_\_ Improve the signage for people to find locations more easily.
- \_\_\_ Increase the number of personnel on duty.
- \_\_\_ Other, please describe \_\_\_\_\_

Thank you for taking the time to answer these questions.

APPENDIX-B

OBSERVATION FORM FOR WARD-A

TIME: \_\_\_\_\_

DATE: \_\_\_\_\_

NO. OF PATIENTS \_\_\_\_\_

TIME SHEET FOR PATIENT WARD-A

TO FROM	N.S.	PT.R.	M.R.	L.R.	U.R.	TOTAL
N.S.						
PT.R.						
M.R.						
L.R.						
U.R.						
TOTAL						

- LEGEND :
- 1) N.S. - Nurses' Station
  - 2) PT.R. - Patient Room
  - 3) M.R. - Medicine Room
  - 4) L.R. - Linen Room
  - 5) U.R. - Utility Room

TIME SPENT IN PATIENT ROOM'S:-



OBSERVATION FORM FOR WARD-B

TIME: \_\_\_\_\_

DATE: \_\_\_\_\_

NO. OF PATIENTS \_\_\_\_\_

TIME SHEET FOR PATIENT WARD-B

TO FROM	N.S.	PT.R.	M.R.	L.R.	U.R.	TOTAL
N.S.						
PT.R.						
M.R.						
L.R.						
U.R.						
TOTAL						

- LEGEND :
- 1) N.S. - Nurses' Station
  - 2) PT.R. - Patient Room
  - 3) M.R. - Medicine Room
  - 4) L.R. - Linen Room
  - 5) U.R. - Utility Room

TIME SPENT IN PATIENT ROOM'S:-

## VITA

Nandita Rastogi was born on March 4th, 1966 in Bombay, India. She received her undergraduate degree in Architecture from L.S. Raheja School of Architecture from Bombay, India in May, 1988. Upon completion of her undergraduate degree, she was employed as an architect for a major architectural firm in India. She was admitted in the Masters program in Housing, Interior Design and Resource Management at Virginia Tech in Fall of 1989. She plans to persue a Ph.D. degree in Interior Design and make a career in teaching.