THE CHANGING HEALTHCARE WORKPLACE: AN EXPLORATORY CASE STUDY OF DECENTRALIZED NURSING LAYOUTS

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ABSTRACT

This study explored communication and work patterns of nurses in a patient floor layout using the evidence based design concept known as decentralized nursing station layouts. The patient floor was a 16 bed intensive and cardiac care unit (ICCU) of a local community hospital. The sample consisted of 16 nurses regularly working at the ICCU together with a number of clinicians and other patient care team members who frequent the unit.

The study found that despite the decentralized nursing layout, nurse interactions clustered around a new locus resulting in a de facto hub within the unit. Furthermore nurse travel in the course of their work was observed to range widely through many different locations within the unit. The most frequent locations visited were to workstations other than the one they used as a “Home” for a particular shift. However, nurses did use the dispersed work stations to locate themselves closer to their patients.

The study established various baselines useful for future studies comparing patient floor nursing station typologies which included finding an average of 31% of nurse time spent with patients.

To my dearest family

especially Ate Sophia and Ella Bella

who made me smile when no one else could

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. INTRODUCTION

1.1 Healthcare Industry Challenges

The healthcare industry is huge, growing, and investing enormous resources as it addresses its many challenges. In 2005, healthcare spending reached almost $2.0 trillion or close to $7,000 per person (Catlin, Cowan, Heffler, & Washington, 2007). In the same year, the industry was estimated to account for 16% of gross domestic product (GDP) and to reach 20% of GDP by 2015 (Borger et al., 2006). Some other alarming statistics describing the challenges facing the healthcare industry are (Lavizzo-Mourey, 2004):

- 98,000 patients die each year from medical errors
- 30 percent of healthcare costs are attributable to poor patient care
- 55 percent of patients in a Harvard study were dissatisfied with quality of healthcare
- 62 percent of Americans believe the healthcare system will get worse

These problems are further compounded by the impending shortage of available health professionals, e.g., physicians and nurses (Cooper & Getzen, 2002; Janiszewski Goodin, 2003).

There is evidence indicating that a sizeable portion of healthcare expenditures go towards infrastructure and facilities. For instance, healthcare construction projects initiated in 2006 exceeded $39 billion (Romano, 2007), and other studies estimate $200 billion will be spent within the next ten years (Nelson, West, & Goodman, 2005). The

Nelson, West and Goodman study also found the market driving factors for hospital design and construction to be:

- Competition for patient market share;
- Technology innovation and diffusion;
- Efficiency and cost effectiveness;
- Regulatory compliance.

While many of these challenges will involve changes to health policy, research findings suggest the design of the hospital environment itself can positively contribute to the intersecting problems of improving patient and staff satisfaction and quality of care. The industry has come to refer to this growing body of knowledge as "evidence-based design." Simply put, evidence-based design refers to design that is supported by research with the goal of creating environments that are "therapeutic, supportive of family involvement, efficient for staff performance, and restorative for workers under stress" (Center for Health Design, 2007).

This research study explores one aspect of the hospital's built environment: the design of nursing units on patient floors. Specifically, it examines the influence of a decentralized nursing stations on care givers' communication and interaction patterns which are important factors contributing to quality of care.

1.2 Rationale behind Centralized and Decentralized Nursing Stations

This next section is divided into two parts to present and compare the different rationale supporting nursing unit layouts with

centralized and decentralized nursing stations.

1.2.1 A Background of Nursing Station Typologies

Historical and conventional design wisdom suggests that a patient floor should be laid out where the nursing station has clear sight lines to the patient rooms and vice versa. This is to facilitate easy observation of all patients from a central location (Page, 2004). Functionally, this configuration transforms the nursing station into, "the hub of the nursing unit for both simple and complex communications in a multitude of care delivery processes" (Page, 2004). It also becomes the location where health professionals, e.g., physicians, respiratory therapists, and the unit secretary interact to plan and synchronize their delivery of patient care (Hamilton, 1999).

In a paper for the US Institute of Medicine (IOM), the authors of *Keeping Patients Safe: Transforming the Work Environment of Nurses* (2004) reported on the work by Bobrow (1978), Bobrow and Thomas (2000), Cox and Groves (1990), Hamilton (1990), and James and Tatton-Brown (1986), which studied the different patient floor configurations both historically and currently in use. The authors formulated a typology based on the common characteristics of the configuration as follows:

- Simple open or nightingale form – consists of an open ward without individual patient rooms. Patient beds face inward toward a single walkway with a nursing station located in the middle […]

- Duplex or Nuffield – Has corridor characteristics but is split into two sections containing up to 20 beds each. Each section has its own nursing station. […]
- Racetrack or double corridor – Patient rooms are farther apart, with cross-over hallways connecting the two corridors at the ends and completes the loop or "racetrack." […]
- Courtyard – Sometimes referred to as a "complicated racetrack, this design has an open courtyard for ventilation in the middle of the unit […]
- Cruciform or cluster – A modern corridor ward plan that has more barriers, walls, doors, and toilets erected between nursing station and patients. The shape is manipulated to group as many patients as possible around the nursing station […]
- Radial – A circle design that permits a "fishbowl" view of each patient room from the nursing station. […]
- Triangle – The space in the middle of the triangle balances the support space and the number of beds (usually around 30 beds) […]

The common feature of the aforementioned typologies is the location of the nursing station in a central position with patient beds spreading outward. This centralized location also simplified access to the building systems and unit equipment, e.g., pneumatic tube systems, telephones, documentation, medication, supplies, by grouping them in a central location.

1.2.2 The Evidence Supporting Decentralized Nursing

Stations

While historically nursing unit design, as noted above, has been built around the concept of centrality, current design trends favor more decentralized nursing unit designs. These are believed to reduce nurse fatigue, increase time with patients, and decrease noise levels.

Reduce Staff Fatigue

As reported by Ulrich (2005) quoting an unpublished study by Hendrich at Ascension Health, which is the largest non-profit health system in the US, nurses can walk as much as 6.0 km per day in a triangle configuration unit with a centralized nursing station. In contrast, nurses working in essentially the same unit but with decentralized nursing stations walked 2.9 km per day. So the use of decentralized nursing stations reduced travel by more than 50%. Hendrich described nurse behavior in the centralized layout as "hunting and gathering" for charts, medication, equipment, etc. as they traveled in the course of their work.

Increase Time with Patients

McCarthy (2004) quotes another study by Hendrich that found nurses spend about 30% to 40% of their shift by the patient. Hendrich's group examined video footage and found these ratios again attributable to the unit layout. More time with patient has been linked to fewer patient falls which result from patients rising from bed unassisted (Page, 2004).

Decrease Noise Level

Central nursing stations have been described as a hub of interaction where various health professionals congregate (Page, 2004). In a descriptive study of noise levels in a general surgical ward, there was a positive relationship between noise level and number of hospital personnel present (Christensen, 2005). An article in The Lancet (McCarthy, 2004) quotes a study where noise level at bedside near a nursing station would go as high as 113 dB, which is equivalent to noise levels generated by a jackhammer. Excess noise levels in a hospital can induce headaches, cause irritability, prolong wound healing, and increase sensitivity to pain (Biley, 1994). Furthermore, noise has been found to contribute to nurse burnout in critical care nurses (Topf & Dillon, 1988). Not surprisingly, a study of a general surgical ward found a positive relationship between noise level and number of hospital personnel present (Christensen, 2005).

This small body of evidence suggests that decentralized nursing stations would help reduce staff fatigue, increase time with patients, and reduce noise. However, as previously stated, nursing stations are a hub of communication and interaction. How might the absence of a central nursing station affect patient care delivery? To understand this question better, to the following sections explore the relationship of communication and teamwork to effective care delivery.

1.3 Teamwork and Healthcare

1.3.1 Does teamwork affect patient care?

The complexities of healthcare delivery today need to be met with increasing specialization among health professionals who must

collaborate and communicate closely to be effective (Hall & Weaver, 2001).

Studies have shown that physicians and other healthcare professionals working together as teams can improve patient outcomes (Grumbach & Bodenheimer, 2004). Furthermore, those patient care teams with greater cohesiveness were associated with improved clinical outcome measures and more satisfied patients (Grumbach & Bodenheimer, 2004). Becker (2007) cites research showing benefits of nurse-physician and interdisciplinary teams to include improving patient care (Kaissi, Johnson, & Kirschbaum, 2003; Liedtka & Whitten, 1997) and strengthening overall healthcare delivery (Wood, Farrow, & Elliott, 1994). Furthermore, a UK study for their National Health Service stated, "The best and most cost-effective outcomes for patients and clients are achieved when professionals work together, learn together, engage in clinical audit of outcomes together, and generate innovation to ensure progress in practice and service."(Borrill et al., 2001)

In their experience at Kaiser Permanente, a non-profit American healthcare system providing care for 8.3 million patients, health professionals found that, "Communication failures are an extremely common cause of inadvertent patient harm."(Leonard, Graham, & Bonacum, 2004) A study in Australia on two hospitals found inadequate communication associated with "17% of system problems, and, of these, 84% were deemed potentially preventable. About 50% of all adverse events detected by general practitioners were associated with communication difficulties. Within intensive care units 2% of the

activity consists of verbal communication between nurses and doctors; but accounts for 37% of error reports" (Coiera, Jayasuriya, Hardy, Bannan, & Thorpe, 2002).

Kaiser Permanente attributes these errors to the inconsistencies between the classic model of patient care delivery, where medical care is structured around the performance of an individual expert, and the increased complexity of healthcare delivery today. Simply put, one individual can no longer process all the knowledge required and hone the skills necessary to deliver effective care: patient care depends on a team of professionals. It is the effective functioning of this team as one unit that leads to quality patient care.

1.3.2 Characteristics of Communication Patterns in the Healthcare Setting

The nature of much communication in the hospital has been characterized as frequent and short (Becker, 2007). The conversations occur everywhere in the hospital, e.g., in corridors, around nurse stations, break rooms, and medication rooms, essentially wherever other health professionals might be. Observational studies have found clinical staff turn to each other for support and information despite the presence of various information technology solutions, e.g., paging systems, voice mail. Studies, that have compared the functional characteristics and use of formal (planned or scheduled) communication versus informal communication, found that informal communication occurred more often with tasks requiring groups to think through solutions (Kraut, Fish, Root, & Chalfonte, 1993).

Studies by Coerea and Tombs (1998) and Parker and Coiera (2002), for example, found that staff preferred telephone calls and chance face-to-face encounters or what the study referred to as "synchronous forms of communication" as their means of interaction.

Technology, by itself, does not seem likely to reduce the importance of face-to-face communication. The challenge is to understand which communication gaps may be better filled with personal contact and which ones with IT communication strategies. (Coiera, 2000).

1.4 Informal Communication and Communities of Practice

The environment that healthcare professionals work in can be understood within the framework of communities of practice (Lesser & Everest, 2001; Lave & Wenger, 1991; Wenger, 1999). "[The] defining feature of communities of practice (as opposed to, say, project teams) is that they are seen to emerge spontaneously from the (largely informal) networking among groups of individuals who have similar work-related activities and interests" (Swan, Scarbrough, & Robertson, 2002). As Swan, et al. point out, communities of practice emerge spontaneously from networking among groups, in contrast to formally constituted teams. Three crucial characteristics are (Wenger, 2007):

- Domain – its identity is defined not by location but by the commitment to a shared purpose or interest of its members, e.g., an intensive care unit interested in caring for their patients;

- Community – in pursuit of their interests, members engage each other with discussion and activities, help, and information sharing, e.g., clinical team formulating a treatment plan; and,
- Practice – involves a "shared repertoire of resources," e.g., technical skills, emotional support, wherein the community interacts regularly and over time in pursuit of their interests, e.g., nurses sharing lunch and discussing ways they helped their patients.

Within the Royal College of Physicians and Surgeons of Canada, the idea of communities of practice has been gaining ground as a viable model for physicians to interact, brainstorm, share information, and make decisions which contribute to learning practice. "It is likely that working together in this way creates the best environment for learning that enhances professional practice and professional judgment" (Parboosingh, 2002). Becker (2007) noted that "[i]nformal communication plays an important role in co-worker relationships that, in turn, affect work effectiveness and commitment." Feldman (1987) found that "employees had an easier time accessing information and soliciting feedback from team member once they were a trusted member of the team."

1.5 Communication and the Physical Setting

Studies have shown that communication is important in health settings, but little research has been done examining the details and factors that influence it. Almost none have considered the role of physical design. More work has been done in the corporate office

setting. Thomas Allen's work in diverse R&D settings, for example, found that face-to-face interaction was significantly influenced by physical distance. After about 50 meters, the likelihood of interaction declined dramatically (Allen, 1977). Frequency of communication, especially with people outside one's immediate team, was significantly related to more innovative engineering design solutions. More recently, Becker and Sims (2004) in a series of case studies of dot.com companies found communication patterns varied significantly in traditional closed offices, open plan cubicles, and team-oriented clusters. Communication in the team-oriented clusters, which were characterized by 4-12 people working together without walls or panels physically separating them, was more frequent and of shorter duration. Employees reported having a better understanding of their other team members, greater clarity about the team's direction, and the ability to make more informed decisions faster since communication was unplanned, opportunistic, and frequent with other team members. Respondents also reported that working in an open environment where they could overhear and see what others were doing contributed to their own on-the-job learning.

In one of the few studies that have examined how a change in the physical layout of a hospital facility influence interaction patterns for clinical staff as well as patients, Becker (in press) cites a study of a 1,860-bed acute-care general hospital in Hong Kong (Gilleard & Tarcisius, 2003) in which the researchers describe the potential of a medical unit's physical design to transform how a multi-disciplinary care team interacts informally. Becker writes that the researchers

"found that introducing alternative workplace strategies to a pediatric ward of doctors and allied health professionals (e.g., clinical psychologists, physiotherapists, social workers, and dietitians) significantly improved communication patterns, helped resolve conflict, increased cooperation, and produced higher-quality service from the patients' perspective. Of particular relevance is that, because specialists were no longer physically isolated, the transfer of knowledge, both tacit and explicit, became easier. Clinical judgments formerly confined within the boundaries of medical disciplines became more holistic. Communication among the various disciplines and with patients was also enhanced. Information about the social background of patients and their families, which was discovered to be important in formulating rehabilitation plans, was more easily incorporated into discussions and treatment plans. Improved communication increased mutual trust, making it easier to resolve conflicts immediately through compromise and collaboration." In another recent study of nursing unit layouts, Dutta (2008) found that frequency of interactions dropped significantly after nurses moved from a centralized to a decentralized nursing unit layout.

While poor physical design may be a barrier to communication, good design may provide an opportunity to improve it (Becker and Parsons, in press). Research at Cornell University's International Workplace Studies Program found that "…work processes benefit from a better understanding of others skills and knowledge, as well as a free exchange of information and opinions. More open work areas with a high degree of visual contact have been shown to be more effective

than more closed offices and workspace" (Becker & Sims, 2001). Furthermore, research in lab based organizations (Wineman & Serrato, 1997), found that organizations with more integrated spatial layouts, i.e., located closely to each other and with high degree of visual access, demonstrated a significantly higher number of face to face informal communications.

1.6 Research Questions and Hypotheses

This next section ties in the literature reviewed with the objectives of the study. Evidence based design suggests that the decentralized nursing layouts concept will improve quality of care as well as provide a more supportive environment for patient care teams. This is accomplished by breaking up the central nursing station into individual nursing work stations scattered throughout the unit and situated closer to the patient rooms (Ulrich, 2005). The rationale being, nurses will have quicker access to their patients and time spent traveling to and fro will be invested as time with their patients. However research presented in previous sections also suggests there may be an unanticipated consequence of the dissolution of the central nursing station. More specifically, the research suggested communication behavior will be negatively impacted which could lead to poorer patient outcomes and lower staff satisfaction.

Therefore, this thesis seeks to answer two broad questions: 1) "How do nurses communicate in a decentralized layout?" and 2) "How do nurses travel or navigate in a decentralized layout?" The following hypotheses were formulated to find answers to these questions.

How do nurses communicate in a decentralized layout?

The decentralized nursing layout concept effects a change in the nurse workplace. Because of previous behaviors exhibited in a centralized layout such as nurses preferentially turning to each other for support and knowledge exchange (Kraut, Fish, Root, & Chalfonte, 1993) and the nature of nurse work (IOM, 2004) the following hypotheses were formulated:

1.6.1 Nurses interact most with other nurses; and infrequently with doctors and other caregivers.

1.6.2 In the absence of the central nursing station, nurse interactions with other clinicians will generate a new locus.

How do nurses travel or navigate in a decentralized layout?

Due to the newness of the design concept, there is an absence of studies on how decentralized nursing layouts affect work patterns. The underlying assumptions of the design suggest the strategic positioning of the nurse work stations will result in greater operational efficiencies (Ulrich, 2005). To test these assumptions while recognizing the nature of nurse work (IOM, 2004) the following hypotheses were formulated:

1.6.3 Nurses will spend large portions of their time visiting other pods and work areas on the nursing unit.

1.6.4 Nurses will choose "Home" workstations close to their assigned patients.

1.6.5 Nurses will spend large portions of their time in patients' rooms.

CHAPTER 2. METHODS

Research Design

The researchers determined an exploratory case study (Yin, 2003) was the most appropriate design for the research for because of a lack of historical data about behavior in a decentralized nursing layout and the inability to effect a controlled intervention. Furthermore, an exploratory case study was deemed the most appropriate for answering questions about how the nurses used the space as well as why they used it in the way they did. The following units of observation were observed.

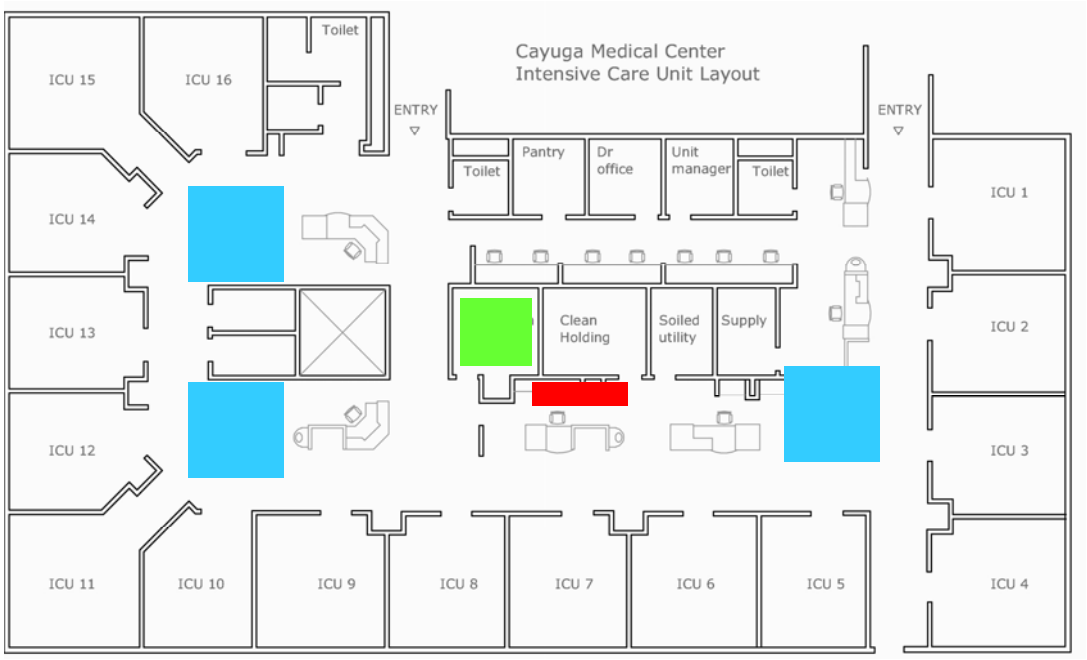
- Individual Nurses
    - Location within the layout
    - Activity at that location, i.e., Work related or Non work related
    - Duration of activity
    - Interaction with clinicians recorded by role and gender
- Bed Occupancy and Unit Staffing
- Time Spent in Patient Rooms

Site Selection

The research site was a newly renovated 16 bed Intensive and Cardiac Care Unit (ICCU) at a 300 bed local community hospital. The site was chosen for ease of access as well as its adoption of a relatively decentralized nursing station design. The unit was laid out in the shape of a rectangular race track with the 16 patient rooms on the

outer edge and the 8 nursing stations distributed along the inner edge. The nursing stations or pods surrounded the various unit support areas, such as the Medication Room, Supply Rooms, and Doctors' Work Area/Corridor. (See Figure 1)

Figure 1 Floor Plan of Intensive and Cardiac Care Unit (ICCU)



During the data collection, 15 of the 16 patient rooms and 7 of the 8 nursing pods were in use.

Special Systems and Technologies (from Figure 1)

Areas in Blue – These nursing pods had patient monitoring systems installed that enabled users to check real time vital statistics of patients in the unit.

Area in Green – This room had a secure medication dispensing unit for the floor. Medication from the unit could only be accessed by nurses and pharmacists. Certain medications required the presence of a second nurse to confirm the order. Less controlled medications were

stored in cabinets in the room. A digital combination lock installed on the door provided an additional layer of security. The room had large security glass windows that provided visual access and blocked auditory access to the room.

Area in Red – This area had a pneumatic tube system installed in the wall. The system was used to transfer and deliver a variety of small packages, e.g., biological specimens, orders, to other hospital departments.

Sample Size and Selection

The sample consisted of the regular ICCU (e.g., nurses, doctors, respiratory therapists, ward clerks, aides and technicians) and ICCU visitors (e.g., patient family, other clinicians such as occupational therapists).

All observations were limited to the day shift running from 7am to 3pm daily. This decision was made based on interviews with the subjects indicating that the day shift had more staff, and therefore more interaction, and was a better starting point for exploring the nature of interaction on the unit.

Observations were further limited to open areas within the unit. A special value of patient room was created within the activity variable to account for activities within patient rooms.

To gather information around the units of observation discussed earlier, individual nurses were followed or shadowed over the course of each observation period. Nineteen nurses worked in the unit. Each nurse was free to choose a station from any of the unoccupied nursing

stations at the start of their shift. This “Home” pod was theirs for the duration of the shift. Selection of the subject nurse, as described below, was then based on the pod each chose as “Home.” The decision to choose the subject nurse in this manner resulted from the inability to obtain a work schedule in advance of the observation periods. During pilot testing, the researcher did a convenience sampling of the pods. Once chosen, the researcher would identify the nurse using the pod and began shadowing them. Conscious effort was made to choose pods that had not been observed yet. After the pilot testing, the researcher chose pods using a random number generator to minimize any subconscious bias towards certain locations.

The unit was designed to have 8 nursing pods. Three of these were equipped with systems for tracking patient vital statistics throughout the floor (See Figure 1). During the data collection period, 7 of the 8 pods were in use. All fully functional nursing pods were arbitrarily assigned consecutive numbers from 1 to 7. The researcher determined the order of the pod observations by using the random number generator to create sequences of the seven numbers. The researcher proceeded to observe the nurse who chose the first pod in the sequence for a period of an hour. This hour constituted one Observation Period. Pilot testing showed that the recording of data on the PDA took extensive concentration, and the one hour observation period was found to be long enough to observe a dynamic use pattern and short enough to avoid fatigue and recording errors. The researcher avoided sampling the same pod twice in the same day.

Over the course of each site visit, the researcher proceeded to the

second pod in the sequence and so forth. If, after proceeding to the next pod on the list, the researcher found that a nurse had not chosen that pod, e.g., a doctor was working from that pod, then the researcher proceeded to the next pod in the sequence.

Data Collection

The researchers were interested in recording user behavior on a floor plan of the unit, a data collection technique known as a "behavior map": a map with "…descriptions of behavior and of participants and statements relating the behavior to its physical locus." (Ittelson, Proshansky, & Rivlin, 1970), However, we also wanted to collect data on how the nurse used the different areas on the unit over time. This form of data collection involves "shadowing" the nurse as she moves around the unit, and provides a more dynamic picture of behavior in space than the behavior map. The researcher followed or "shadowed" the subject nurse at a close enough distance to observe her activity without interfering with it. The method of collecting data was adapted from methodologies described in *Stalking the Urban Pedestrian* (Hill, 1984) and *Why We Buy* (Underhill, 1999). All nurses were informed of the nature of the study before it began, and all participation was voluntary. The researchers explained to the nurses that data collection was limited to their movement among different areas of the unit, interaction with other roles; e.g., "nurse" and not "Nurse Smith". Specific identifying information was excluded from the results. Given the often frenetic pace of their work, subjects appeared to rarely notice the researcher's presence.

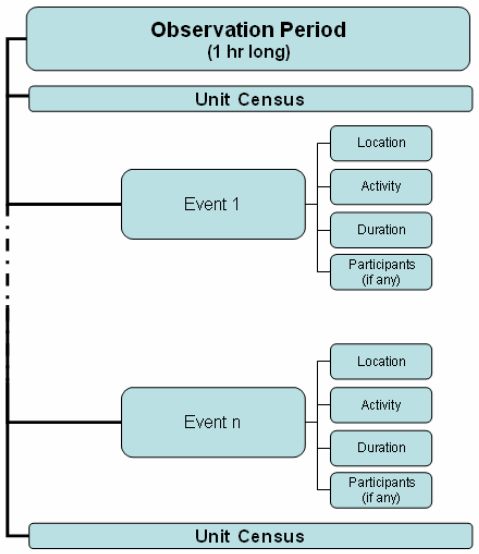
The recording method was conceptualized and refined over several weeks at the final research site. The specifics are delineated in the next section (Section 0). This time also served as a training period wherein the researcher familiarized himself with the different people, roles, and work in the unit.

As previously discussed, an observation period lasted for one hour per nurse subject. Data was collected over different times of the day and different days of the week in order to develop a representative sample. It was not possible to observe every pod (and every nurse) for identical periods of time. The number of hours observed in a day varied from 1 to 5 hours.

Secondary data sources included unscheduled onsite interviews with team members other than the subject to determine standard operating procedures, such as patient and room assignment, and analysis of the unit layout.

The Observation Period

Figure 2 Flowchart of Observation Period



The observation period was comprised of two recording activities: the unit census and the behavior mapping log.

The Census of Beds Occupied and Nurses on Duty

At the beginning and end of each observation period, the researcher noted the date and time of the observation. The researcher then walked through the unit and took a census of the beds occupied, the number of nurses, and the nurse roles, e.g., Charge Nurse, Flex Nurse.

The Behavior Mapping Log

After the census, the researcher proceeded to the first pod as determined from the sampling procedure discussed above. The researcher then noted the RN who chose the pod as their "Home" pod for that observation period. "Home" was defined as the pod where the subject nurse laid down files and other items necessary to carrying out their duties. The researcher also noted the nurse's assigned patients/patient rooms.

After this preliminary work, the researcher located the nurse in the unit associated with a target pod and started the timer. Timer data was recorded using the "Stop3Watch" application on Palm's Tungsten E2 PDA. Next, the researcher recorded the nurse's location, their activity at that location, the presence of any other participants, and, at the conclusion of the activity, its duration. The combination of location, activity, participants, and duration constituted what is hereinafter referred to as an Event. Changes to any of these four variables triggered a new event.

Events where the subject nurse entered a patient room required the

extra step of starting then stopping a second timer to accurately record the time spent with patients.

As the nurse subject traversed the unit, the researcher changed vantage points often to capture accurate data and to remain as unobtrusive to the subject as possible, lest the subject's behavior be influenced.

The Recording Instrument

Figure 3 The Recording Instrument

The Plan Layout Area

Location of the subject nurse was noted by drawing encircled numbers from "1" to "20" on the plan to approximate the subject's location where the event transpired. Numbers were written in sequence so that the order of the locations visited would also be captured. The exception would be for events transpiring at the subject's "Home" pod. These were recorded with a slash mark (/) through the "H" in the Event Log Area. The order of that event in the observation period would be signaled by the corresponding line number in the Event Log Area. When the researcher reached the 20th line, i.e., event 20, he flipped the page and started over from "1".

The researcher decided to use the "H" shorthand and to limit the numbers to "20" as the most efficient and least confusing way to capture location information accurately.

The Event Log Area

The Event Log Area consisted of 20 event lines. Each event line was in turn comprised of three areas: the Nature of Activity Area, the Participants Area, and the Event Duration Area (see Figure 3 The Recording Instrument). Particulars of the event were noted by making slash marks (/) through the corresponding boxes as explained below. Corrections in the observations were made by placing (\)to cross the wrong slash mark forming "X" and placing a slash mark in the correct item. This form and the use of slash marks made it possible to record very quickly the key elements of each event.

The Nature of Activity Area

There were three choices in this area: WORK, SOC, and PAT. WORK activities referred to activities wherein more than 50% of the event time is devoted to work related duties, e.g. charting, preparing medication. SOC activities referred to activities wherein more than 50% of the event time is devoted to non-work related duties, e.g., reading a book. PAT activities referred to activities occurring in Patient Rooms. Because the researcher did not enter patient rooms, he was unable to ascertain whether the activity in the room was work or non-work related. PAT activities coincided with use of the second stopwatch/timer as mentioned previously. They also triggered the use of a separate stopwatch to record the actual duration for the event.

The Participant Area

The Participant Area listed two letter abbreviations for the most common other types of staff ("roles"} that nurses interacted with over the course of their duties. These included other nurses, doctors, intensivists, aide and technicians, ward clerks, etc. In addition to the professional roles, the researcher also noted the participant's gender. When the nurse interacted with people not on the list (e.g., dietician, pharmacist), a field note was recorded to the side.

The Duration of Event Area

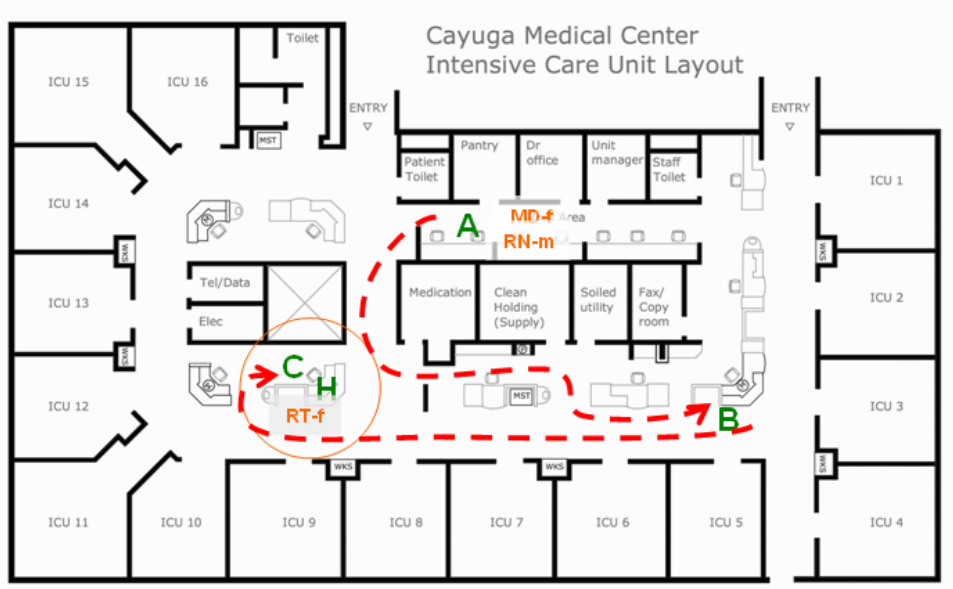
The Duration of Event Area was used to indicate over what length of time the event transpired after referring to the actual time elapsed as recorded by the PDA. There were initially three options to choose from: S (short), meaning events whose duration was less than or equal to 1 minute; M (medium), meaning events whose duration was between 1 and 5 minutes; and L (long), meaning events whose duration was greater than or equal to 5 minutes long.

During early pilot testing the researchers found many activities fell between 1 and 5 minutes. In the final version of the recording sheet used, M was split into two more categories: M(-), meaning events whose duration was greater than 1 minute but less than 3 minutes long, and M(+), meaning events whose duration was greater than or equal to 3 minutes but less than 5 minutes long. The minus and plus signs were written next to the boxed M in the record sheet.
Special care was taken to fill out the Plan Layout Area and the Event Log Area symmetrically and immediately after another, i.e., one event

always had a location, activity, duration, and participant. This pairing of location and event also ensured that the sequence of the events was also recorded.

Sample Observation Period

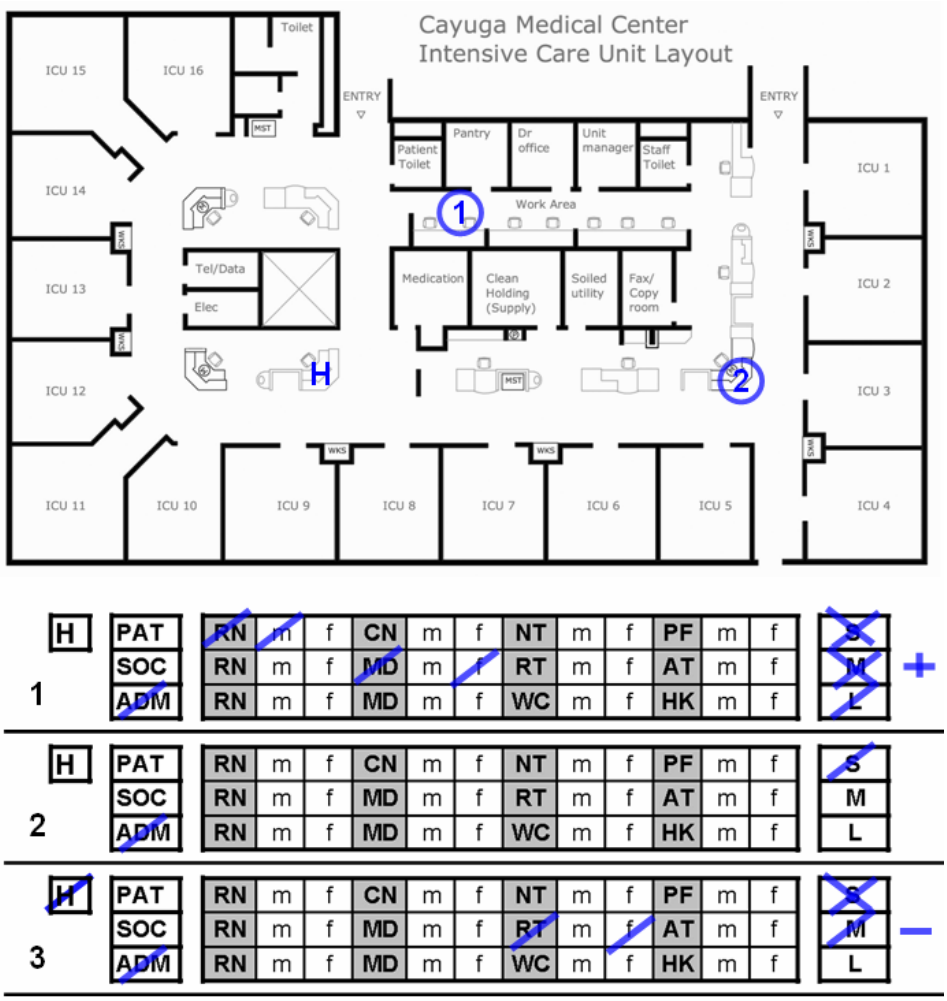
Figure 4 Theoretical Nurse in the Course of their Shift



Theoretical Nurse Observation

At the beginning of the observation period, the researcher identified the target pod, using the random numbers table. In Figure 4 the target pod is shown encircled in orange. The researcher then looked for the nurse who chose the target pod and found her at location "**A**" (her Home pod) discussing a patient with a female cardiologist and a male nurse. Six minutes later, the subject nurse then proceeded to location "**B**" to retrieve a chart she had previously left there. Less than a minute later, the subject proceeded to location "**C**" where she interacted with a female respiratory therapist. Figure 5 shows the recording instrument after 2 minutes of observation, with the researcher having noted down the details of events with slash marks in blue ink.

Figure 5 Sample Recording Instrument Annotated

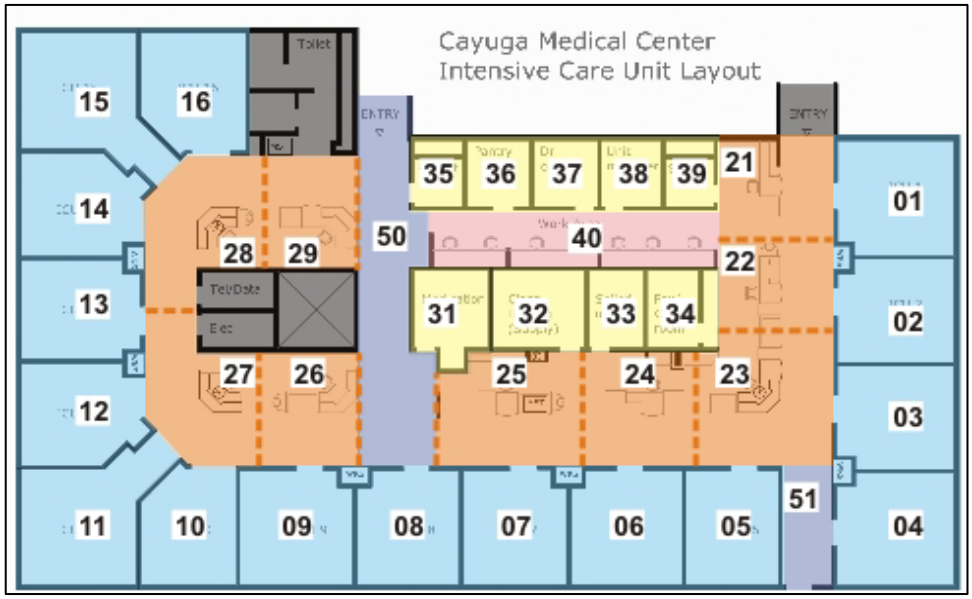


Recording the Observations of the Theoretical Nurse's Activities

The partially completed recording instrument above shows how the activities described in the previous section would be recorded. The researcher placed ① approximately where the first interaction occurred and noted the participants. A slash mark (/) was then recorded over "S" in the duration area. As the interaction progressed past 1 minute, the researcher then crossed out the "S" by placing (\) over the existing slash mark, forming "X". The researcher then placed

a slash mark (/) over “M” and placed a “-” beside it. When the interaction passed 3 minutes, the researcher placed a “|” over the existing“-”. As the interaction passed 5 minutes, the researcher crossed out (X) the “M” and then placed a slash mark (/) over “L.” After about 6 minutes, the nurse proceeded to the pod in the lower right to retrieve the chart they placed there. At this point the researcher placed ② and a slash mark (/) through “S.” The subject then proceeded to their Home pod and interacted with the respiratory therapist. At this point the researcher placed a slash mark (/) through “H,” notes the interaction with the respiratory therapist, and finally placed a slash mark (/) through “S.” The observation, but not necessarily the activity, concluded 1.5 minutes later at which point the researcher crossed out (X) the “S” and placed a slash mark (/) through “M” and a “–” next to it.

Figure 6 Coding the Layout



Code Assignment of the Locations in the Layout

The demarcation of one area from the next was determined by analyzing the floor plan. For most areas the demarcation was readily determined by the boundaries of each room's enclosing walls. The major departure from this method was for the nursing pods. For the nursing pods, imaginary lines were drawn through the midpoint between the edges of non-contiguous work surface to form a square shaped area around the pod (see Figure 6, Code 21-29). The Entryway corridors (Code 50-51), were the remainder of the floor plan not bounded by any of the previous rules. These areas provided ingress and egress to the unit from the rest of the building. Two special codes missing from the plan were 88, used when the subject left the floor and 99, used when the subject location was unnoted. The complete list of codes with a description of the area appears in Appendix xxx.

The Expected Home Pod

As previously mentioned, the unit's layout had decentralized nursing stations situated roughly in front of the patient rooms. This design feature was meant to shorten nurse travel, assuming the nurses chose a pod closest to their patients.

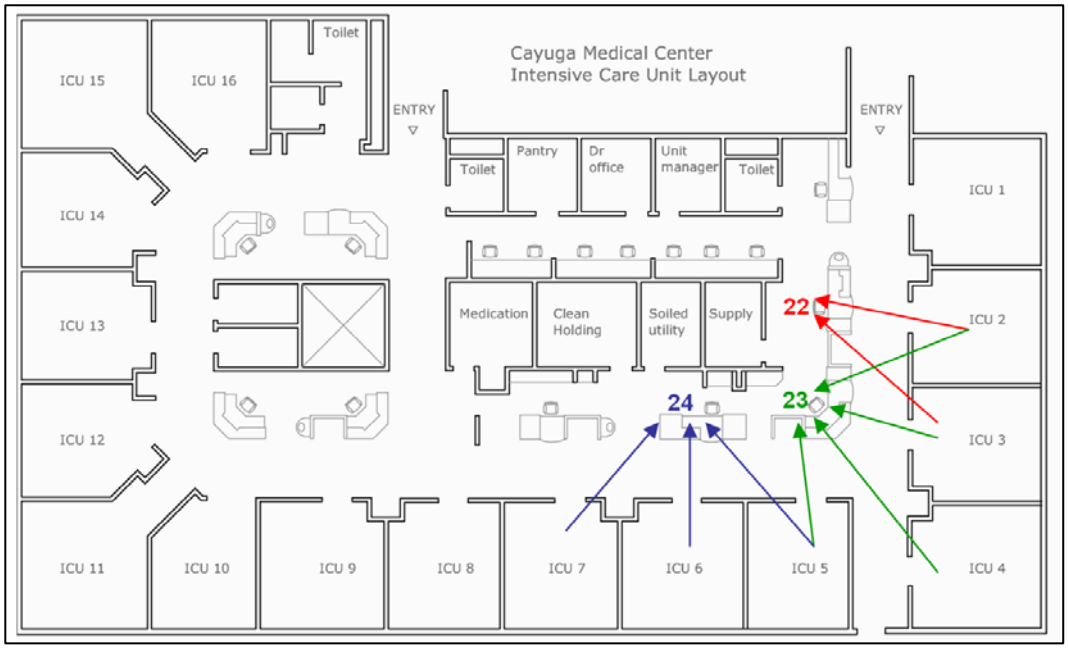
A key research question was whether or not nurses used the space this way in practice. In order to answer it, the researchers analyzed the plan to determine which pods were likely to be chosen "Home." Analysis of traffic patterns on the plan layout was used to determine which pods were "closest" to a specific patient room.

Table 1 Pod likely to be chosen Home

IF: assigned a patient in room…	THEN: Home POD is…
02, 03	22
02, 03, 04, 05	23
05, 06, 07	24
06, 07, 08	25
08, 09, 10	26
09, 10, 11, 12, 13	27
13, 14, 15, 16	28

Closest was defined as the shortest path of travel between a pod and patient room. Therefore the layout of the unit dictated which pods would be closest. This resulted in some pods being selected as Home more often than others. For examples please see Figure 7 below.

Figure 7 Floor Plan Showing "Home" Locations



Data Analysis

The research focused on how nurses used the new ICCU space over the course of their shift. More specifically, the researchers were interested in the nurse:

locations over the course of the observation period;

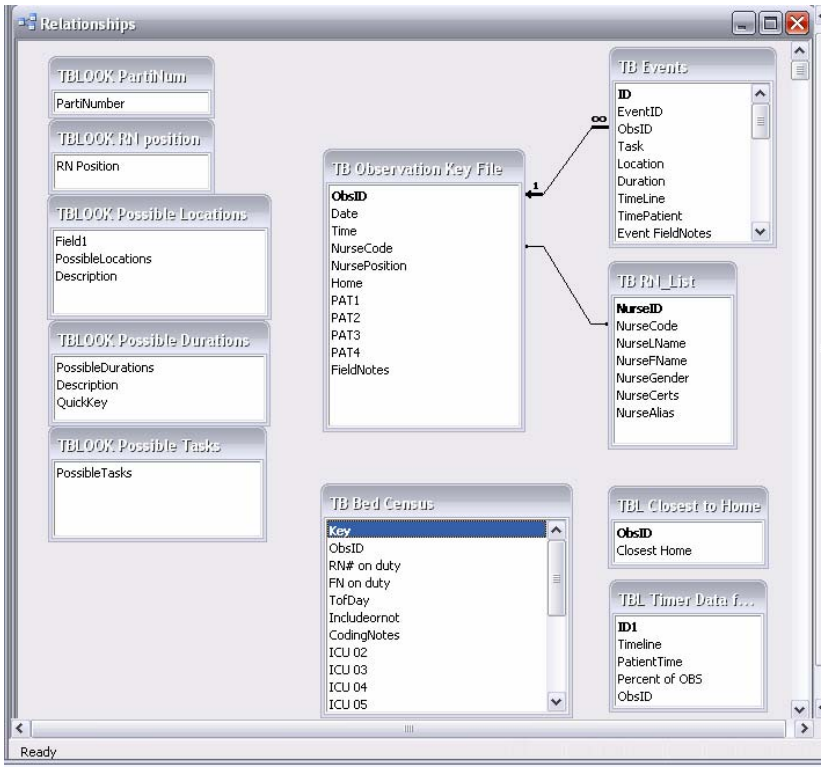
activities they engaged in;

duration of these activities;

interactions with other participants, e.g. nurses, doctors.

Organization and entry of the data was accomplished using the map shown in Figure 6 and Microsoft Access which is a relational database application. Data was entered into 11 discrete but related tables. Table relationships are shown below

Figure 8 MS Access Table Relationships



The parsing of the data into 11 tables facilitated the several levels of analysis from macro, e.g., per day, to the micro, e.g. per interaction. The relationships among tables were used to cross-check the data entry to minimize error, e.g., it was impossible to enter "77" as a Location Code as it did not exist.

Specific data pertaining to the different research questions were then drawn from the data by means of the MS Access query functions. The query results were then exported and subsequently analyzed in Microsoft Excel. From there, the data was compiled, manipulated and cross tabulated to show the frequencies of the following relationships:

The number of events per observation and as a whole;

The proportion of events with interactions, e.g., the nurse subject with a doctor, to events with no interactions, e.g., completing paperwork;

The proportion of activities, i.e., work, non work, and patient room, in non interactive events;

The proportion of interactive events with other patient care team roles, e.g., doctors, other nurses, and the different activities they perform together;

The location, e.g., pods, medication room, of interactions and the proportion of the different activities by role;

The subjective duration, e.g., Short (less than a minute), Long (over 5 minutes), of the events by role;

The subjective duration of events by role and location;

The actual duration (in minutes and seconds) over an observation and as a whole that nurses spent with patients;

The frequency of patient assignment to particular rooms; and

The frequency of nurse visits to locations other than their Home.

Descriptive statistics, e.g., frequency, mean, mode, were performed using the built in statistical package of MS Excel.

CHAPTER 3. RESULTS

The results are presented in two parts. Part 1 presents data on the overall pattern of interaction on the ICCU; who interacted with whom, where, and for how long. Part 2 presents data that shows nurses interaction and space use patterns over the course of a one hour observation period; that is, Part 2 focuses on the movement of nurses around the unit.

Part 1: Analysis of All Observed Events

Summary of Data

Table 2 Summary of Collected Event Data

Number of Events per Observation Period	
Mean	36.44
Standard Error	1.17
Median	35
Mode	32
Standard Deviation	8.3
Range	36
Minimum	19
Maximum	55
Total Events Recorded	**1822**

The data was collected by shadowing 16 nurses over 50 one-hour long observation periods from February 9th to March 24th 2007. A total of 1,822 separate events were recorded with an average of 36.44 events per observation. The minimum number of events observed in a period was 19 events, while the maximum was 55. The standard deviation was 8.3 events.

Non-Interactive vs Interactive Events

Table 3 Number of Interactive vs Non-Interactive Events

Events	Count	% Distribution
Individual	782	42.92%
Interactions	1040	57.08%
Grand Total	**1822**	**100.00%**

Non-interactive events are defined as those events where the subject was engaged in some activity by themselves. Interactive events were defined as those events where the subject nurse interacted with at least one other person. The person may have been another member of the patient care team or a number of other staff such as housekeeping or the patient's family. Participants were identified only by their role and sex. Of the 1,822 events recorded, 1,040 events or 57% of these were interactions; the remaining 782 events or 43% were non-interactive events.

Non-Interactive Events

Table 4 Non-Interactive Events Compared by Task

Task	Count of ObsID	% Distribution	% of All Events (n=1822)
Work	520	66.58%	28.54%
Non Work	19	2.43%	1.04%
Pat Rm	242	30.99%	13.28%
Grand Total	**781**	**100.00%**	**42.86%**

Of the 781 Non-Interactive Events, 520 events or 67% of these were directly related to regular nurse activities, e.g., charting, preparing medication. Nineteen events or 2% were non-work related activities; e.g., reading a book, taking a break. Of the 781 events, 242 events or 31% occurred in the Patient Room. To protect the privacy of the patient, the researcher refrained from observing or recording the

nurse's activity in the patient room. The activity from one event was unrecorded and marked as a missing value.

Interactive Events

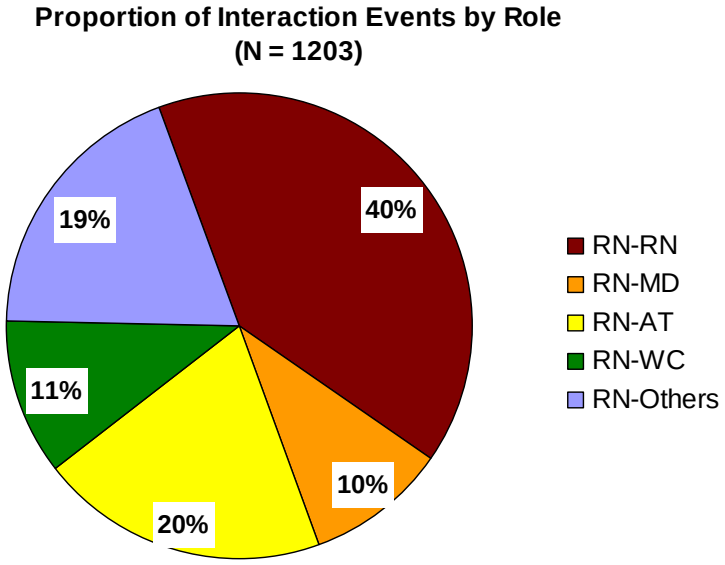
The Interactive Events were grouped by the role of the participant with which the subject nurse interacted. Specifically, the researcher looked at interactions involving one or more of each of the following roles:

- (RN) meaning the interaction involved one or more of the 19 nurses qualified to work regularly in the ICCU;
- (MD) meaning the interaction included one or more doctors such as intensivists, hospitalists, surgeons, and cardiologists who had patients in the unit;
- (AT) meaning the interaction included one or more of the various nurse's aides or technicians who were trained to operate various equipment such as mobile x-ray machines;
- (WC) meaning the interaction included one or more ward clerks who were responsible for much of the administrative work that supports the unit and patient care team; and,
- (Others) meaning the interaction included one or more other individuals such as family members, housekeeping, pharmacists, dieticians, and social workers.

It is important to note that adding the total number of interactions per sub-category will yield a sum of 1,203 instead of 1,040 interaction events. This resulted from some interactions involving more than one role at a time.

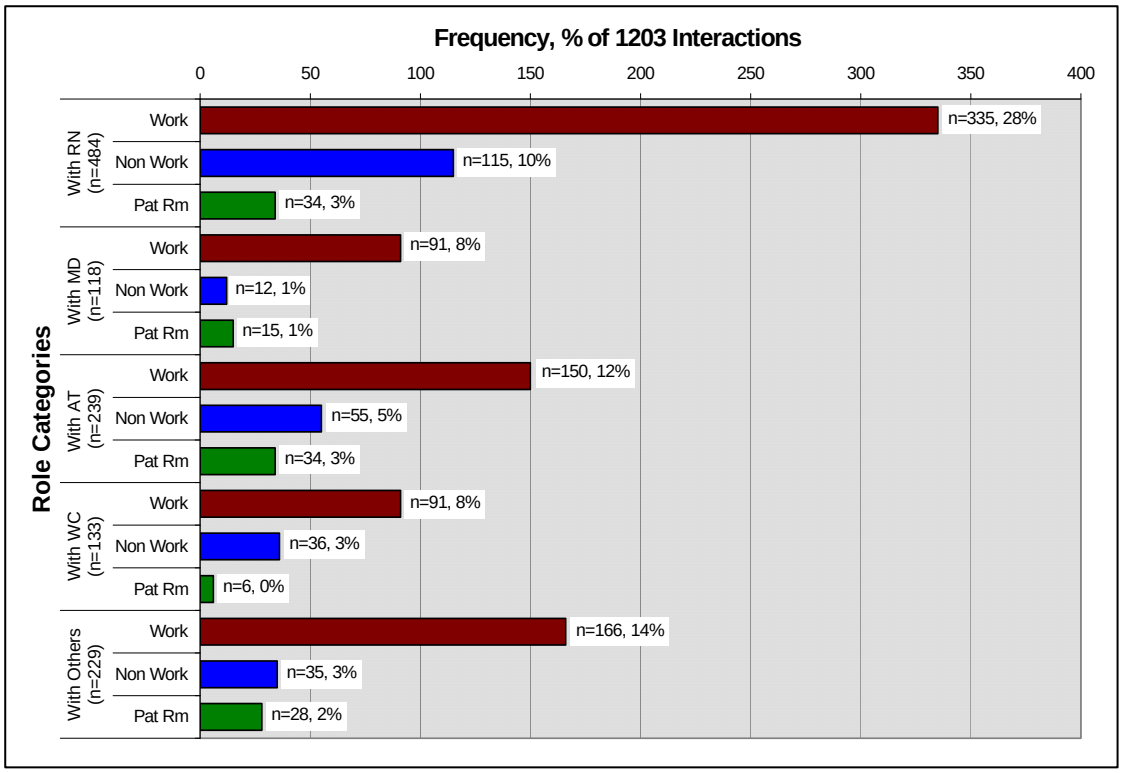
Interactions by Role Category and Task

Figure 9 Comparison of Interactions Across Role Categories



Of the 1,203 interaction events, 484 or 40% involved one or more nurses. This was the most frequent role category with which subject nurses interacted. This was followed by RN-AT (239 or 20%) then RN-WC (133 or 11%). Interactions with one or more other clinicians (229 or 19%), e.g., respiratory therapists, pharmacists, occurred almost as frequently as RN-RN. The least frequent interactions involved one or more doctors: RN-MD (118 or 10%).

Figure 10 Frequency of Nurse Interactions and Activities with Different Role Categories



Within each interaction role category, a majority of the activities were work-related.

Nurse interactions with other role categories within the patient room were noted either when the researcher observed the subject nurse had entered the patient room with another clinician, or when the clinician had entered after the subject nurse. The researcher was unable to observe if the nature of the activity in the patient room was work or non-work related.

Interactions by Duration

This next section presents data regarding the duration of the interaction events. Initially, three categories of duration were used: Short, events with durations less than a minute; Medium, events with durations a minute or longer but less than five minutes; and Long,

events with durations more than five minutes. During data collection, the researchers found a large number of events with durations between one and five minutes. In order to capture data more accurately, the Medium category was further divided into two shorter categories: Medium (-), events with durations longer than a minute but less than three minutes; and Medium (+), events with durations longer than three minutes and up to five minutes. Because the change was adopted after a few observations period had been accomplished, events with durations categorized as Medium were dropped from this portion of the results. This resulted in a total number of interaction events of 1,012 instead of 1,040.

The data collection with regard to interactions with different role categories remained the same as in the previous section.

Figure 11 Proportion of Interaction Events by Duration

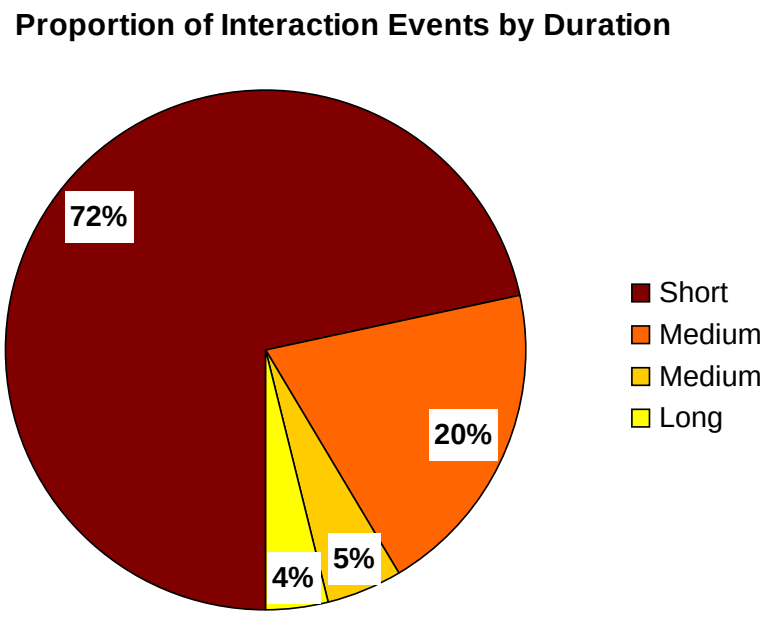


Table 5 Interaction Events Compared by Duration of Interaction

Duration of Event	# of Interaction Events Observed	% of 1012 Interactions
Short	724	71.54%
Medium (-)	201	19.86%
Medium (+)	48	4.74%
Long	39	3.85%
Grand Total	**1012**	**100.00%**

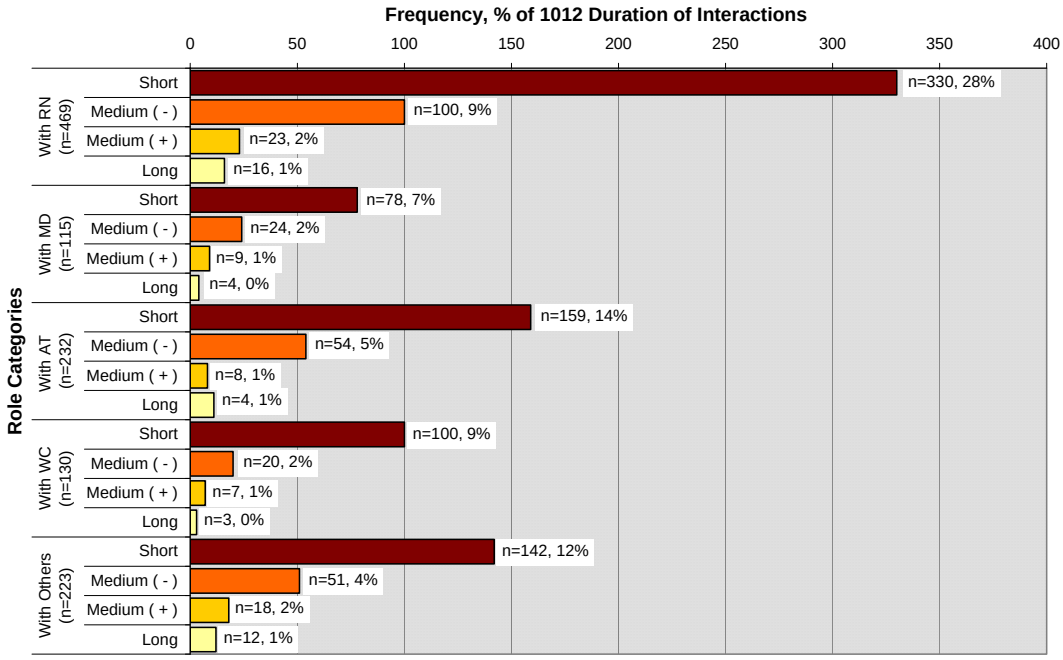
A total of 1,040 events of the 1,822 events observed involved the nurse subject interacting with at least one other participant. Of these 1,040 interactions, 28 interactions had durations coded as Medium. Because the researchers removed this code, these events were considered missing data points for this portion of the analysis.

The majority of the 1,012 interactions (724 or 72%) lasted less than one minute. The next most frequent duration of interactions (201 or 20%) lasted longer than 1 minute but less than 3 minutes Medium (-). Together these two duration categories accounted for 91% of all observed interaction events.

Interactions by Role and Duration

This next section presents data regarding interactions by role and duration. This was done to analyze the duration of interactions as nurses interacted with the different roles. (see Appendix xxx for detailed breakdown of interactions by roles and duration)

Figure 12 Frequency of Duration of Nurse Interactions with Various Role Categories



Within each role category, a majority of interactions were Short, i.e., lasted less than a minute. These ran from a range from 64% - 77%. The next most frequent duration were Medium (-), i.e., lasted more than a minute but less than three minutes. These ran a range from 15% - 23%. Together these two duration categories accounted for 87% to 92% of all interactions

Interaction Locations within the Unit

The next section relates the location of the interactions to the unit layout. Figure 13 below was the coding scheme used to relate the nurse subject's position over the course of the observation period to the unit layout

Figure 13 Unit Floor Plan Overlaid with Data Analysis Coding System

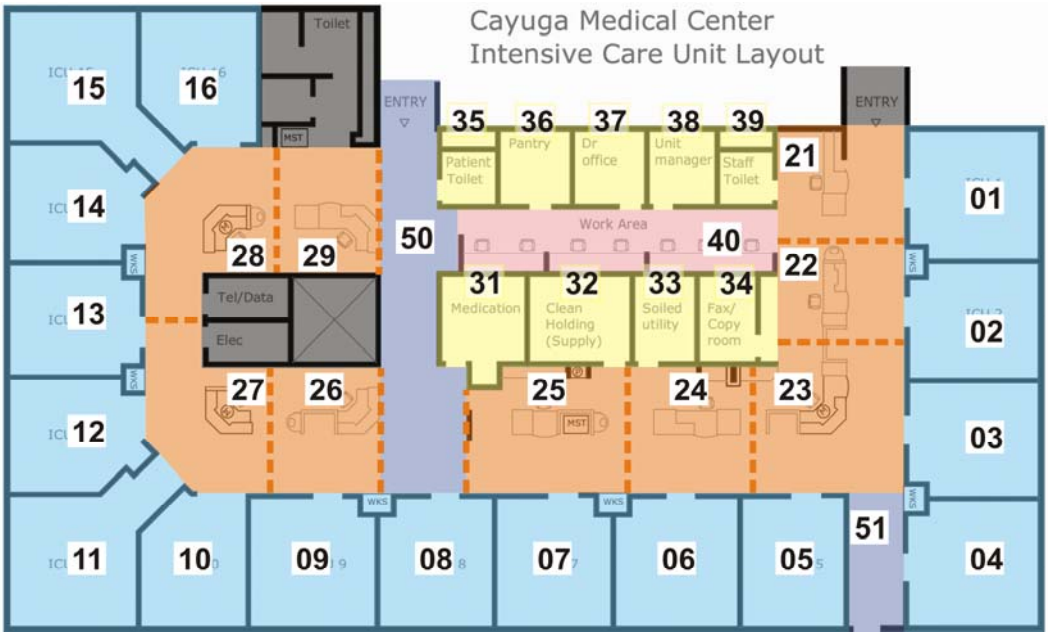
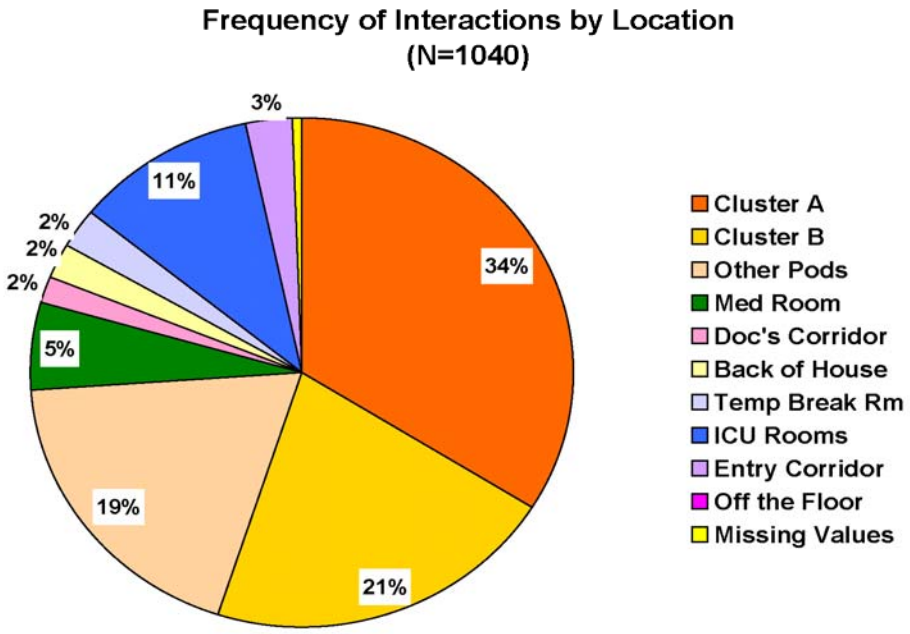


Figure 14 Comparison of Interactions Across Locations



Of the 1,040 interaction events, 768 or 74% occurred at the nursing pods, while 112 or 11% occurred in the patient rooms. Five percent of the interactions occurred in the Med Room. The remaining 10% occurred in various other locations (e.g., Doc's Corridor, Supply Rooms, Temporary Break Room).

Table 6 Location of the Most Frequent Interactions within the ICCU

Location Description	Location Code	Number of Interactions	% of 1,040 Interactions
Cluster A			33.85%
	23	131	12.60%
	24	221	21.25%
Cluster B			21.06%
	26	114	10.96%
	27	105	10.10%
Med Room			5.48%
	31	57	5.48%
Doc's Corridor			1.73%
	40	18	1.73%

Remaining Interactions in…

Location Description	Number of Interactions	% of 1,040 Interactions
Patient Rooms	112	10.77%
Other Pods	197	18.94%
Support Areas	85	8.17%

Table 6 summarizes interactions at key locations in the unit. Fifty-five percent of all interactions occurred at four pods (pods 23, 24, 26 and 27). These pods were located in two clusters of adjacent pods at opposite ends of the unit. Cluster A was comprised of pods 23 and 24, and Cluster B was comprised of pods 26 and 27.

The Doc's Corridor (see Figure 13, code 40) was the area adjacent to the Intensivist's office where one wall was a worksurface divided into a series of work areas. Clusters A and B, the Med Room, and Doc's Corridor accounted for 62% of all interactions.

Figure 15 Locations of Most Frequent Interactions

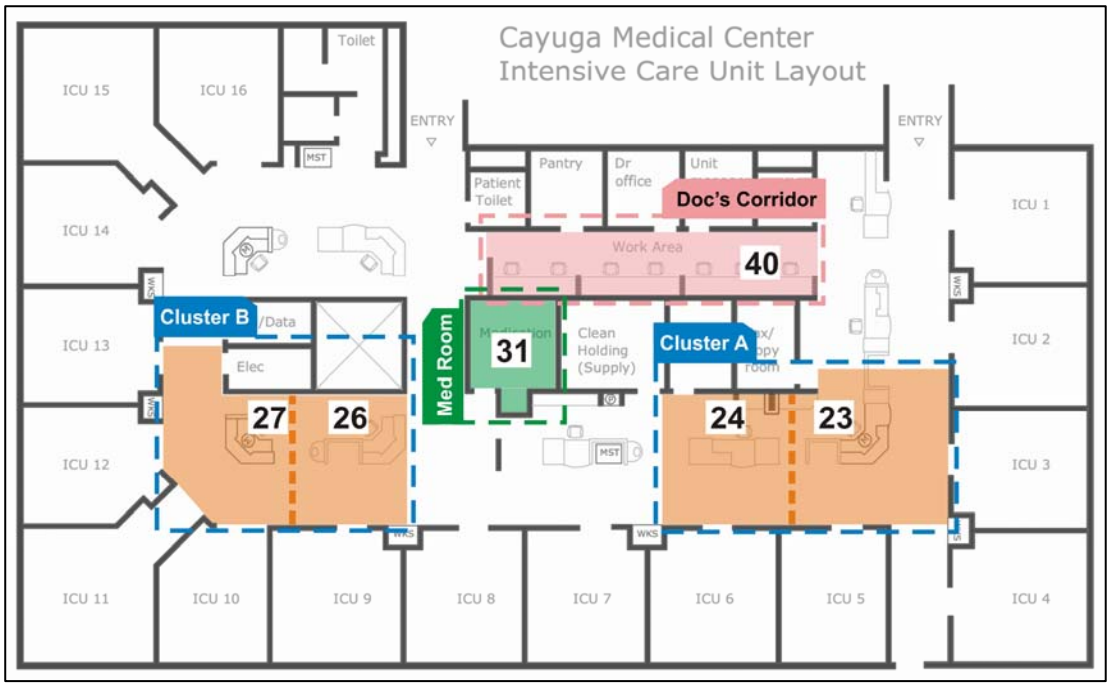


Figure 15 above was included to relate Table 6 to the locations of the most frequent interactions in the unit. (A complete breakdown of interactions by role, location and duration may be found in Appendix xxx)

Interactions by Role and Location within the Unit

This next section combines the previous two sections in order to analyze the specific locations where the nurses interacted with particular categories of patient care team roles (see Appendix xxx for detailed breakdown of interactions by roles and location).

Table 7 Interactions with one or more RN by Task in Key Locations

484 Interactions in this Category				
Location Description	**Task**	**with RN**	**% of Within Category**	**% of 1,040 Interactions**
Cluster A				
	Work	142	29.34%	13.65%
	Non Work	50	10.33%	4.81%
	Pat Rm	2	0.41%	0.19%
Cluster A Total		**194**	**40.08%**	**18.65%**
Cluster B				
	Work	60	12.40%	5.77%
	Non Work	24	4.96%	2.31%
	Pat Rm	0	0.00%	0.00%
Cluster B Total		**84**	**17.36%**	**8.08%**
Med Room				
	Work	42	8.68%	4.04%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Med Room Total		**42**	**8.68%**	**4.04%**
Doc's Corridor				
	Work	5	1.03%	0.48%
	Non Work	6	1.24%	0.58%
	Pat Rm	0	0.00%	0.00%
Doc's Corridor Total		**11**	**2.27%**	**1.06%**
Grand Total		**331**	**68.39%**	**31.83%**

The locations in Table 6 accounted for 68% (331 of 484 interactions) of the nurse interactions involving one or more nurses. Of that total, 40% occurred in Cluster A and 17% in Cluster B. The ratio of work to non work interactions ran from 2.5 to 3.5 in these areas. One hundred percent of RN-RN interactions in the Med Room were work related. Work and non-work RN-RN interactions in the Doc's Corridor were split almost 50-50.

Table 8 Interactions with one or more MD by Task in Key Locations

118 Interactions in this Category				
Location Description	**Task**	**with MD**	**% of Within Category**	**% of 1040 Interactions**
Cluster A				
	Work	39	33.05%	3.75%
	Non Work	7	5.93%	0.67%
	Pat Rm	0	0.00%	0.00%
Cluster A Total		**46**	**38.98%**	**4.42%**
Cluster B				
	Work	21	17.80%	2.02%
	Non Work	2	1.69%	0.19%
	Pat Rm	0	0.00%	0.00%
Cluster B Total		**23**	**19.49%**	**2.21%**
Med Room				
	Work	0	0.00%	0.00%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Med Room Total		**0**	**0.00%**	**0.00%**
Doc's Corridor				
	Work	5	4.24%	0.48%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Doc's Corridor Total		**5**	**4.24%**	**0.48%**
Grand Total		**74**	**62.71%**	**7.12%**

The locations in Table 7 accounted for 63% (74 of 118) of the nurse interactions involving one or more doctors. Of that total, 39% occurred in Cluster A and 19% in Cluster B. The ratio of work to non work interactions ran from 4 to 8.5 in these areas.

No RN-MD interactions were observed in the Med Room. All RN-MD interactions in the Doc's Corridor were work-related.

Table 9 Interactions with one or more AT by Task in Key Locations

239 Interactions in this Category				
Location Description	**Task**	**with AT**	**% of Within Category**	**% of 1040 Interactions**
Cluster A				
	Work	63	26.36%	6.06%
	Non Work	25	10.46%	2.40%
	Pat Rm	0	0.00%	0.00%
Cluster A Total		**88**	**36.82%**	**8.46%**
Cluster B				
	Work	48	20.08%	4.62%
	Non Work	10	4.18%	0.96%
	Pat Rm	0	0.00%	0.00%
Cluster B Total		**58**	**24.27%**	**5.58%**
Med Room				
	Work	5	2.09%	0.48%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Med Room Total		**5**	**2.09%**	**0.48%**
Doc's Corridor				
	Work	0	0.00%	0.00%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Doc's Corridor Total		**0**	**0.00%**	**0.00%**
Grand Total		**151**	**63.18%**	**14.52%**

The locations in Table 9 accounted for 63% (151 of 239) of the nurse interactions involving one or more nurse's aides or technicians. Of that total, 37% occurred in Cluster A and 24% in Cluster B. The ratio of work to non work interactions ran from 1.8 to 3.1 in these areas.

All interactions in the Med Room were work-related. No interactions in the Doc's Corridor were observed.

Table 10 Interactions with one or more WC by Task in Key Locations

133 Interactions in this Category				
Location Description	**Task**	**with WC**	**% of Within Category**	**% of 1040 Interactions**
Cluster A				
	Work	38	28.57%	3.65%
	Non Work	17	12.78%	1.63%
	Pat Rm	0	0.00%	0.00%
Cluster A Total		**55**	**41.35%**	**5.29%**
Cluster B				
	Work	20	15.04%	1.92%
	Non Work	4	3.01%	0.38%
	Pat Rm	0	0.00%	0.00%
Cluster B Total		**24**	**18.05%**	**2.31%**
Med Room				
	Work	1	0.75%	0.10%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Med Room Total		**1**	**0.75%**	**0.10%**
Doc's Corridor				
	Work	0	0.00%	0.00%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Doc's Corridor Total		**0**	**0.00%**	**0.00%**
Grand Total		**80**	**60.15%**	**7.69%**

The locations in Table 9 accounted for 60% (80 of 133) of the nurse interactions involving one or more ward clerks. Of that total, 41% occurred in Cluster A and 18% in Cluster B. The ratio of work to non work interactions ran from 1.7 to 2.4 in these areas.

All interactions in the Med Room were work-related. No interactions in the Doc's Corridor were observed.

Table 11 RN Interactions with one or more from the Others Category by Task in Key Locations

229 Interactions in this Category				
Location Description	Task	Others	% of Within Others	% of 1040 Interactions
Cluster A				
	Work	54	23.58%	5.19%
	Non Work	4	1.75%	0.38%
	Pat Rm	0	0.00%	0.00%
Cluster A Total		**58**	**25.33%**	**5.58%**
Cluster B				
	Work	38	16.59%	3.65%
	Non Work	18	7.86%	1.73%
	Pat Rm	0	0.00%	0.00%
Cluster B Total		**56**	**24.45%**	**5.38%**
Med Room				
	Work	14	6.11%	1.35%
	Non Work	0	0.00%	0.00%
	Pat Rm	0	0.00%	0.00%
Med Room Total		**14**	**6.11%**	**1.35%**
Doc's Corridor				
	Work	2	0.87%	0.19%
	Non Work	1	0.44%	0.10%
	Pat Rm	0	0.00%	0.00%
Doc's Corridor Total		**3**	**1.31%**	**0.29%**
Grand Total		**131**	**57.21%**	**12.60%**

The locations in Table 11 accounted for 57% (131 of 229) of the nurse interactions involving one or more individuals in Other category of roles. Of that total, 25% occurred in Cluster A and 24% in Cluster B. The ratio of work to non work interactions ran from 3.0 to 14.6 in these areas.

All interactions in the Med Room were work-related. In the Doc's Corridor, 0.9% of the interactions were work-related and 0.4% were non work-related.

Interactions by Role, Location and Duration within the Unit

This next section presents data regarding interactions by role, location, and duration. This was done in order to analyze the duration of interactions as nurses interact with the different roles as well as placing where in the unit these interactions occur.

Again although 1,040 interaction events were observed, interactions where the Duration was coded as Medium were dropped resulting in 1,012 interactions for analysis. The locations presented are the same as those shown in Figure 15

Table 12 Interactions with one or more RN in Key Locations by Duration

469 Interactions in this Category				
Location Description	**Duration**	**with RN**	**% of Within Category**	**% of 1012 Interactions**
Cluster A				
	Short	119	25.37%	11.76%
	Medium (-)	29	6.18%	2.87%
	Medium (+)	6	1.28%	0.59%
	Long	4	0.85%	0.40%
Cluster A Total		**158**	**33.69%**	**15.61%**
Cluster B				
	Short	63	13.43%	6.23%
	Medium (-)	16	3.41%	1.58%
	Medium (+)	4	0.85%	0.40%
	Long	1	0.21%	0.10%
Cluster B Total		**84**	**17.91%**	**8.30%**
Med Room				
	Short	23	4.90%	2.27%
	Medium (-)	11	2.35%	1.09%
	Medium (+)	1	0.21%	0.10%
	Long	2	0.43%	0.20%
Med Room Total		**37**	**7.89%**	**3.66%**
Doc's Corridor				
	Short	9	1.92%	0.89%
	Medium (-)	1	0.21%	0.10%
	Medium (+)	1	0.21%	0.10%
	Long	0	0.00%	0.00%
Doc's Corridor Total		**11**	**2.35%**	**1.09%**
Grand Total		**290**	**61.83%**	**28.66%**

The locations in Table 12 accounted for 62% (290 of 469) of the nurse interactions involving one or more nurses. Of that total, 34% occurred in Cluster A and 18% in Cluster B.

The frequency of Short interactions to Medium (-) interactions occurred from 2 to 9 times as often in the selected areas.

Table 13 Interactions with one or more MD in Key Locations by Duration

115 Interactions in this Category				
Location Description	Duration	with MD	% of Within Category	% of 1012 Interactions
Cluster A				
	Short	33	28.70%	3.26%
	Medium (-)	8	6.96%	0.79%
	Medium (+)	2	1.74%	0.20%
	Long	2	1.74%	0.20%
Cluster A Total		**45**	**39.13%**	**4.45%**
Cluster B				
	Short	16	13.91%	1.58%
	Medium (-)	6	5.22%	0.59%
	Medium (+)	1	0.87%	0.10%
	Long	0	0.00%	0.00%
Cluster B Total		**23**	**20.00%**	**2.27%**
Med Room				
	Short	0	0.00%	0.00%
	Medium (-)	0	0.00%	0.00%
	Medium (+)	0	0.00%	0.00%
	Long	0	0.00%	0.00%
Med Room Total		**0**	**0.00%**	**0.00%**
Doc's Corridor				
	Short	4	3.48%	0.40%
	Medium (-)	0	0.00%	0.00%
	Medium (+)	0	0.00%	0.00%
	Long	1	0.87%	0.10%
Doc's Corridor Total		**5**	**4.35%**	**0.49%**
Grand Total		**73**	**63.48%**	**7.21%**

The locations in Table 13 accounted for 63% (73 of 115) of the nurse interactions involving one or more doctors. Of that total, 39% occurred in Cluster A and 20% in Cluster B.

The frequency of Short interactions to Medium (-) interactions occurred from 2 to 4 times as often in the selected areas.

Table 14 Interactions with one or more AT in Key Locations by Duration

232 Interactions in this Category				
Location Description	**Duration**	**with AT**	**% of Within Category**	**% of 1012 Interactions**
Cluster A				
	Short	61	26.29%	6.03%
	Medium (-)	21	9.05%	2.08%
	Medium (+)	2	0.86%	0.20%
	Long	0	0.00%	0.00%
Cluster A Total		**84**	**36.21%**	**8.30%**
Cluster B				
	Short	47	20.26%	4.64%
	Medium (-)	11	4.74%	1.09%
	Medium (+)	0	0.00%	0.00%
	Long	0	0.00%	0.00%
Cluster B Total		**58**	**25.00%**	**5.73%**
Med Room				
	Short	4	1.72%	0.40%
	Medium (-)	1	0.43%	0.10%
	Medium (+)	0	0.00%	0.00%
	Long	0	0.00%	0.00%
Med Room Total		**5**	**2.16%**	**0.49%**
Doc's Corridor				
	Short	0	0.00%	0.00%
	Medium (-)	0	0.00%	0.00%
	Medium (+)	0	0.00%	0.00%
	Long	0	0.00%	0.00%
Doc's Corridor Total		**0**	**0.00%**	**0.00%**
Grand Total		**147**	**63.36%**	**14.53%**

The locations in Table 14 accounted for 64% (147 of 232) of the nurse interactions involving one or more aides and or technicians. Of that total, 36% occurred in Cluster A and 25% in Cluster B.

The frequency of Short interactions to Medium (-) interactions occurred from 2.3 to 4 times as often in the selected areas.

Table 15 Interactions with one or more WC in Key Locations by Duration

130 Interactions in this Category				
Location Description	**Duration**	**with WC**	**% of Within Category**	**% of 1012 Interactions**
Cluster A				
	Short	37	28.46%	3.66%
	Medium (-)	11	8.46%	1.09%
	Medium (+)	3	2.31%	0.30%
	Long	2	1.54%	0.20%
Cluster A Total		**53**	**40.77%**	**5.24%**
Cluster B				
	Short	20	15.38%	1.98%
	Medium (-)	3	2.31%	0.30%
	Medium (+)	0	0.00%	0.00%
	Long	0	0.00%	0.00%
Cluster B Total		**23**	**17.69%**	**2.27%**
Med Room				
	Short	0	0.00%	0.00%
	Medium (-)	0	0.00%	0.00%
	Medium (+)	1	0.77%	0.10%
	Long	0	0.00%	0.00%
Med Room Total		**1**	**0.77%**	**0.10%**
Doc's Corridor				
	Short	0	0.00%	0.00%
	Medium (-)	0	0.00%	0.00%
	Medium (+)	0	0.00%	0.00%
	Long	0	0.00%	0.00%
Doc's Corridor Total		**0**	**0.00%**	**0.00%**
Grand Total		**77**	**59.23%**	**7.61%**

The locations in Table 15 accounted for 59% (77 of 130) of the nurse interactions involving one or more ward clerks. Of that total, 41% occurred in Cluster A and 18% in Cluster B.

The frequency of Short interactions to Medium (-) interactions occurred from 3.2 to 14 times as often in the selected areas.

Table 16 Interactions with one or more Other roles in Key Locations by Duration

223 Interactions in this Category				
Location Description	**Duration**	**with Others**	**% of Within Category**	**% of 1012 Interactions**
Cluster A				
	Short	41	18.39%	4.05%
	Medium (-)	14	6.28%	1.38%
	Medium (+)	2	0.90%	0.20%
	Long	1	0.45%	0.10%
Cluster A Total		**58**	**26.01%**	**5.73%**
Cluster B				
	Short	37	16.59%	3.66%
	Medium (-)	14	6.28%	1.38%
	Medium (+)	4	1.79%	0.40%
	Long	1	0.45%	0.10%
Cluster B Total		**56**	**25.11%**	**5.53%**
Med Room				
	Short	3	1.35%	0.30%
	Medium (-)	9	4.04%	0.89%
	Medium (+)	1	0.45%	0.10%
	Long	1	0.45%	0.10%
Med Room Total		**14**	**6.28%**	**1.38%**
Doc's Corridor				
	Short	1	0.45%	0.10%
	Medium (-)	0	0.00%	0.00%
	Medium (+)	1	0.45%	0.10%
	Long	1	0.45%	0.10%
Doc's Corridor Total		**3**	**1.35%**	**0.30%**
Grand Total		**131**	**58.74%**	**12.94%**

The locations in Table 16 accounted for 59% (131 of 223) of the nurse interactions involving one or more individuals of other roles. Of that total, 26% occurred in Cluster A and 25% in Cluster B.

The frequency of Short interactions to Medium (-) interactions occurred from 0.3 to 3.4 times as often in the selected areas.

Part 2: Analysis of Events per Hour Long Observation Period

In Part 1, data was presented regarding all the events as a whole. Part 2, presents data on a per hour long observation period in order to capture the dynamic nature of nurses' work patterns as they move about in the ICCU space over time.

Collected Timer Data

Table 4 and Table 6 presented data regarding the number of events in the patient rooms. Actual time was recorded with electronic timers measuring how much time the nurse subject spent in the patient room over an hour's observation period.

Table 17 Time Spent by Nurses in Patient Rooms)

Timer Data	Unit	
Total Time in Observations	(hours:minutes:sec)	50:31:21.0
Amount of Time Subjects were in Patient Rooms	(hours:minutes:sec)	15:40:16.3
Average Time Spent in Patient Room	% of Observation Time	30.62%
Range of Time Subjects were in Patient Rooms		
Minimum	% of Observation Time	0.00%
1st Quart	% of Observation Time	12.92%
Median	% of Observation Time	27.25%
3rd Quart	% of Observation Time	46.99%
Maximum	% of Observation Time	78.26%

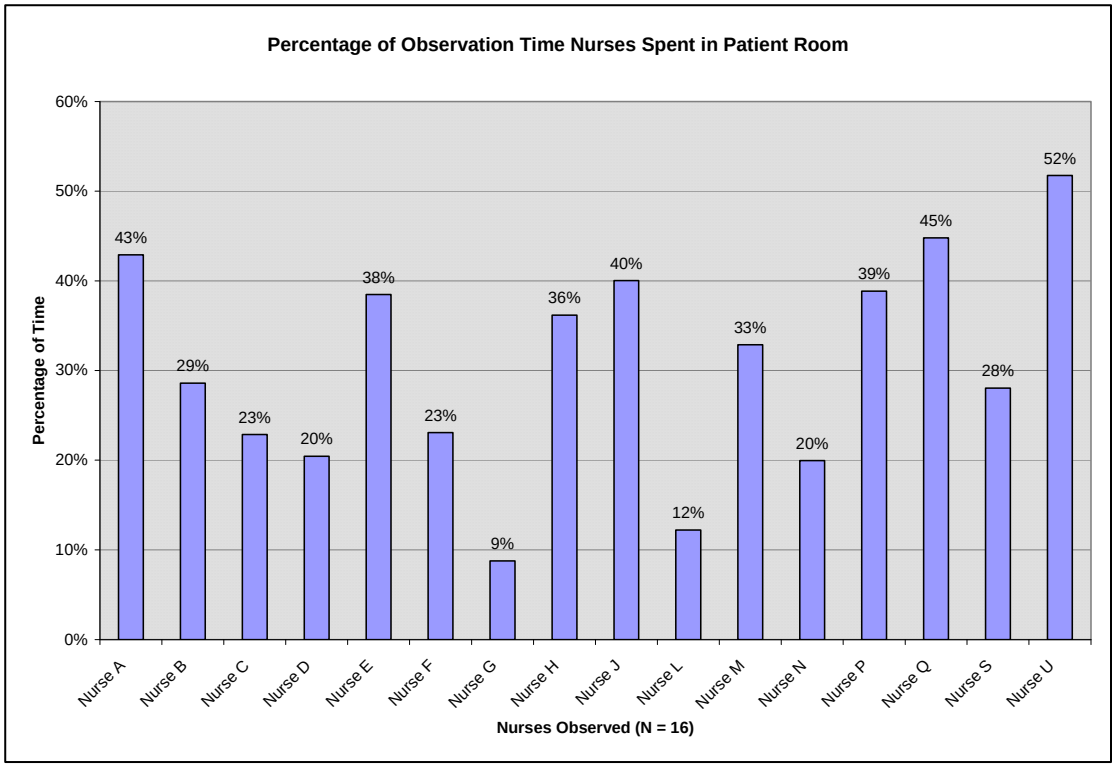
Observations were conducted over a total of 50 hours, 31 minutes, and 21.0 seconds. Of this total time, the subject nurses spent 15 hours, 40 minutes and 16.3 seconds in the patient rooms. Expressed as a percentage of the observation period, the least amount of time spent in the patient room was 0% and the maximum was 78.26%.

To account for the fact that some nurses were observed more than others over the course of the study, the amount of time each nurse spent in the patient room was added and then divided by the number of observations periods for that nurse to get an average time for each nurse, i.e.,

Adj. Time for Nurse A = (NurseA Obs_1 + NurseA Obs_2 + …+ NurseA Obs_n)/n

These adjusted times were then used to calculate an average time per observation period for each nurse.

Figure 16 Percentage of Time Nurses Spent in the Patient Room



After adjusting for the number of times each nurse was observed, the amount of time a nurse spent in a patient room varied from 9%-52%. Four nurses spent more than 40% of their time in a patient room and eight over 30% of their time in a patient room. The average time a nurse spent in a patient room was 31% (~19minutes)

with a standard deviation of 12%.

Events Recorded in Patient Rooms vs. Time Spent in Patient Room

From Part 1, 242 Non-Interactive Events and 112 Interactive Events were observed in the Patient Rooms respectively, or 354 events out of the total 1,822 events observed. Further analysis of the data showed that 63% lasted less than a minute and 73% of events lasted less than three minutes.

Nurse Visits to Assigned Patients vs. Unassigned Patients

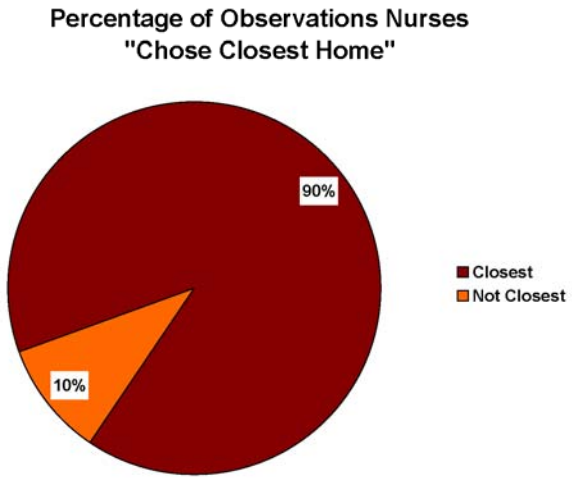
Table 18 Number of Patients Assigned to a Nurse in a Shift

Number of Patients	
Mean	2.51
Standard Error	0.12
Median	2
Mode	2
Standard Deviation	0.77
Minimum	1
Maximum	4

Of the 354 (non-interactive and interactive) events where the destination was a patient room, the researchers found 91% of these events involved nurses entering patient rooms where they had been assigned patients; while 9% of these events involved nurses entering patient rooms occupied by a patient not assigned to that nurse (i.e., the nurse was assisting another nurse with their patient).

Nurse Selection of their Home Pod for a Shift

Figure 17 Percentage of Observations Nurses "Chose Closest Home"



In each of the 50 observations, the subject nurse chose a "Home" pod, defined as the pod where they lay down files and other items necessary to carrying out their duties over the course of their shift. From interviews with the Unit Manager, researchers found that nurses were free to choose "Home" from currently available pods. To facilitate their work, the expectation was that nurses should choose a home pod closest to the rooms where the majority of their assigned patients for that shift were located. To determine the logical "home" pod in relation to patient rooms, an analysis of the shortest paths on the plan between each pod and patients was conducted. (See Methods chapter for more information.)

Researchers found that nurses chose the pods that were closest to their assigned patients 90% of the time.

In interviews with the Unit Manager, the researcher found that every effort was made to assign the nurses patients who were in adjacent rooms. This was found to be true in 80% of the observations. Of the remaining 20%, 4% of the time the nurses were assigned

patients more than three rooms apart.

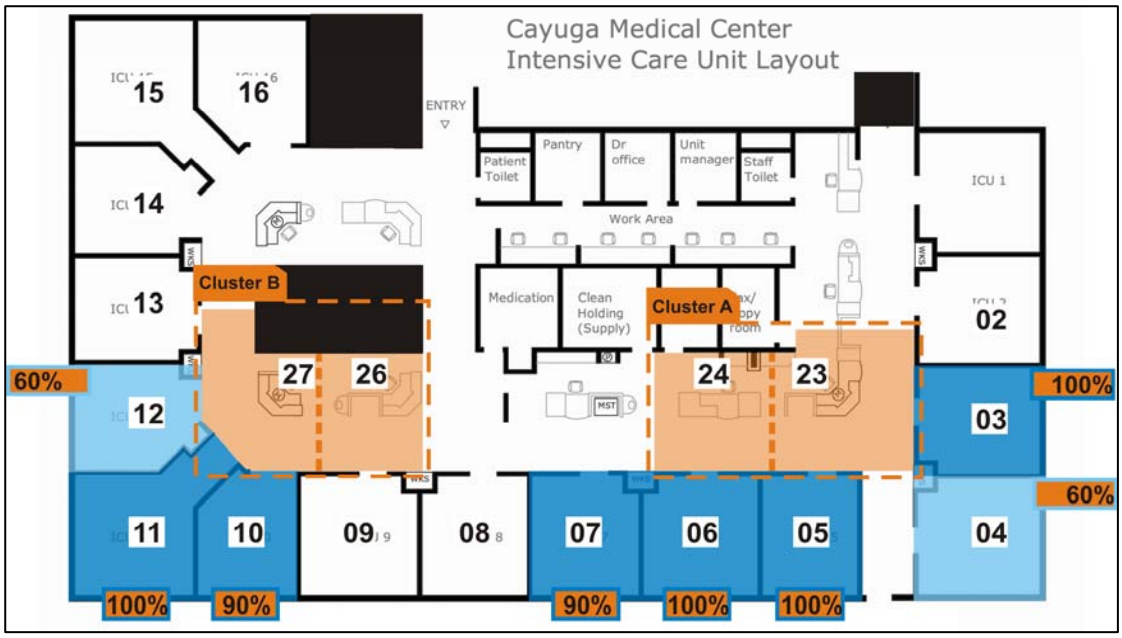
Patient Room Utilization

From interviews, the researcher found that room usage in the unit was determined on a day to day basis by the Charge Nurse and the (Nurse) Unit Manager. The analysis in this section was performed to examine whether certain pods attracted more interaction because they were more often occupied by nurses due to the adjacent patient rooms, i.e., the patient rooms were always occupied even when unit was less than fully occupied.

The researcher collected a total of 75 bed census reports over the data collection period. These were taken at the beginning and end of every observation period. Less than full occupancy occurred in 10 of the 75 censes taken. In 10 of the reports, rooms 03, 05, 06, and 11 were occupied 100% of the time, while rooms 07 and 10 were used 90% of the time, and rooms 04 and 12 were used 60% of the time.

Figure 18 below illustrates which rooms were assigned patients when the unit was functioning at less than full occupancy, where full occupancy was defined as 10 of the 15 patient rooms filled. Clusters A and B which had the most interactions were included in the figure to relate their position to the rooms in use.

Figure 18 ICCU Patient Room Utilization when < 10 Patients in the Unit



Nurse Interactions with One or More Nurses

In Part 1Figure 10, data was presented regarding nurse interactions with other nurses throughout all 1,822 events. In contrast, Table 19 below presents the data on a per observation level. The data is presented to more closely examine nurse behavior over an observation (hourly) period.

Table 19 Average Number of Interactions with Another Nurse (RN)

% of Interactions	
Mean	20.80
Standard Deviation	9.07
Range	39
Minimum	6
Maximum	45

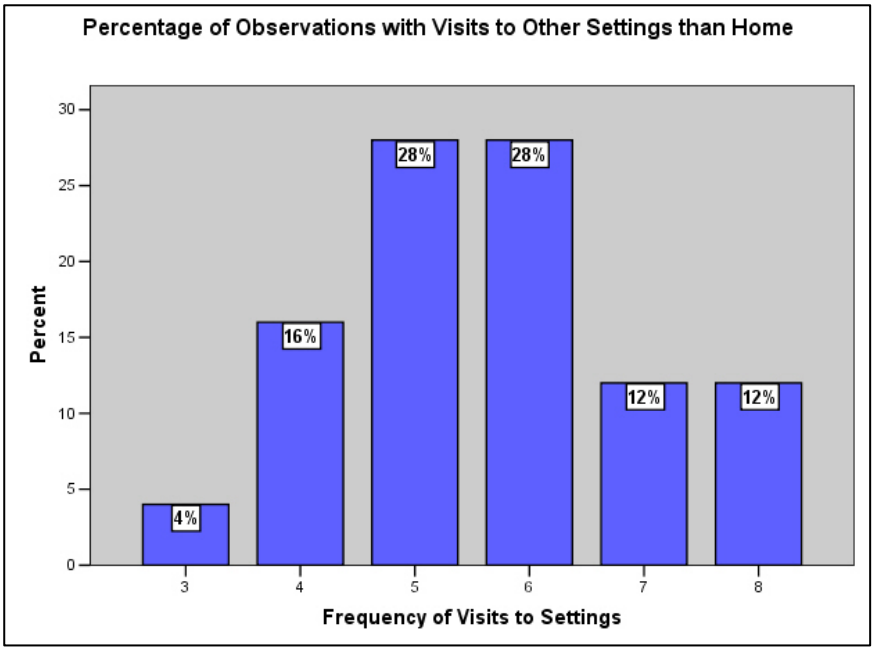
When analyzed per observation period, the average number of subject nurse interactions with one or more nurses was 21 and ran from a minimum value of 6 to 45.

Locations Visited

A key question of the study was to determine the number of settings nurses visited over the course of their shift. Locations in the unit were grouped into the following settings:

- Cluster A (Pods 23 and 24)
- Other Pods (Pods 21 – 22 and 25 – 29)
- Med Room
- Doc's Corridor
- Patient Rooms
- Temp Break Room
- Back of House
- Entryway Corridors
- Off the Floor

Figure 19 Percentage of Observations with Visits to Other Settings than Home

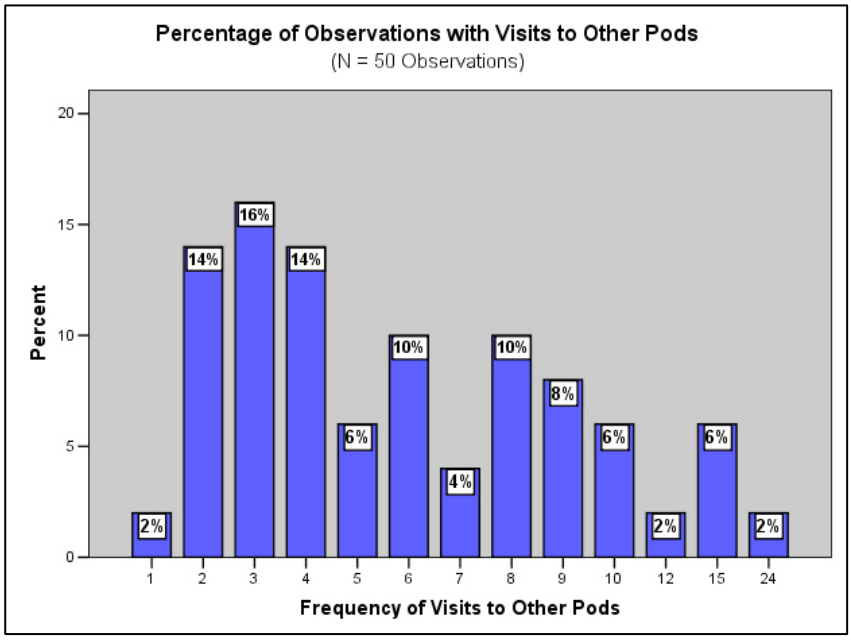


The number of settings visited in an observation period ranged from 3-8 with a median of 6. In 56% of the observations, nurses visited 5-6 settings.

Frequency of Nurse Visits to Other Pods

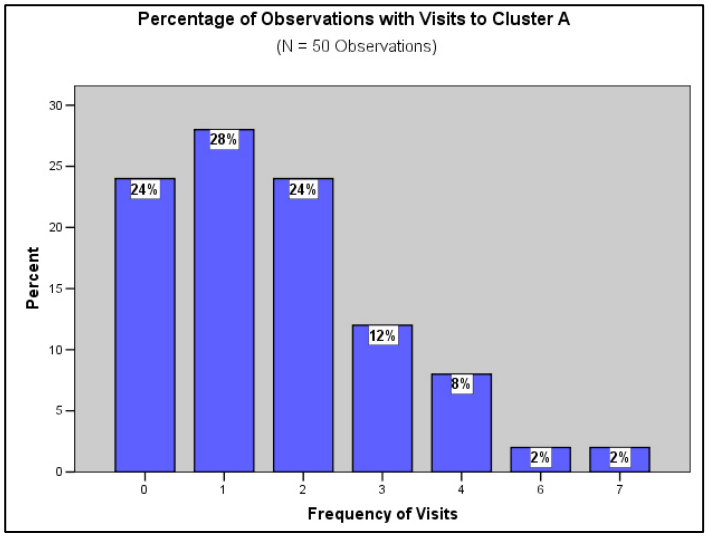
One of the key questions of this study was how nurses used pods and where interactions occurred. Of particular interest was how often nurses who had selected a "home" pod spent time in other pods.

Figure 20 Percentage of Observations with Visits to Other Pods



Nurses visited pods other than their own home an average of 6 times. Visits ranged in frequency from 1 – 24 times, and 44% of nurses visited from 2 – 4 times. Over an eight hour shift, this equates to an estimated 48 visits.

Figure 21 Percentage of Observations with Visits to Cluster A



Looking more closely at the data, 76% of all nurses observed visited Cluster A (Pods 23 – 24) at least once with an average of 1.7 times in an hour.

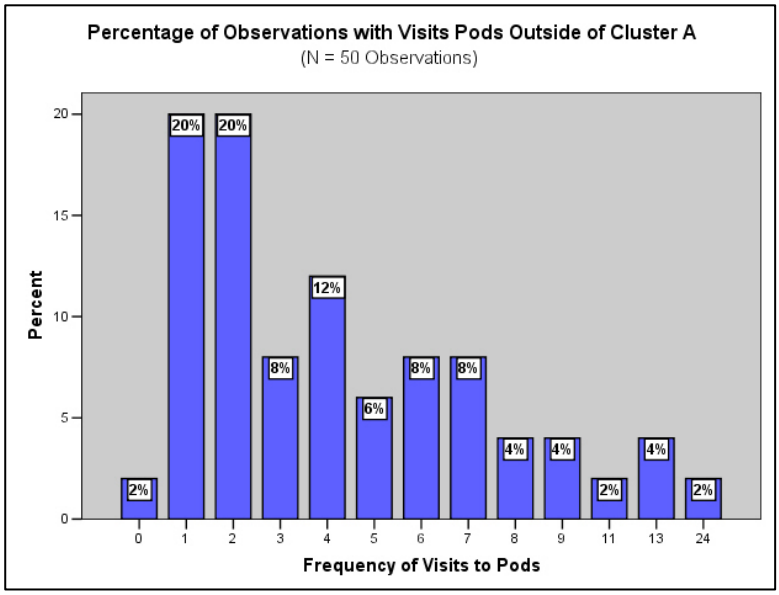


Figure 22 Percentage of Observations with Visits to Pods Outside of Cluster A

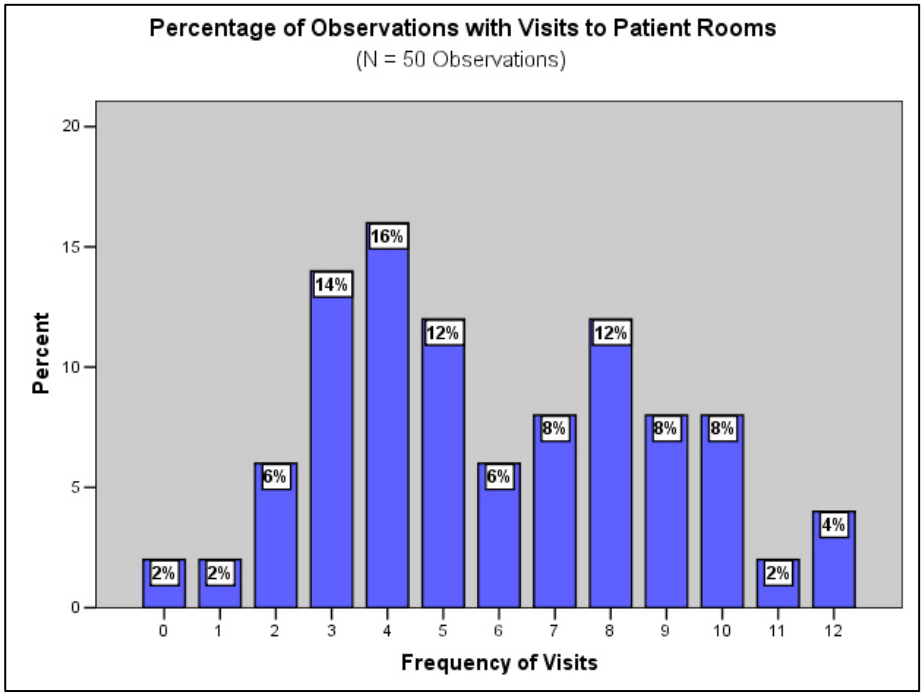
Visits to pods outside of Cluster A had a greater range and ran from 0 – 24, with an average of 6.26 in an hour.

The total number of events resulting in visits to a pod was 399. Of these visits, 29% (116 of 399) were non-interactive events while 71% (283 of 399) were interactive.

Frequency of Nurse Visits to Patient Rooms

This last section is presented to provide a baseline for future studies.

Figure 23 Percentage of Observations with Visits to Patient Rooms



Nurses visited patient rooms at least once in 98% of the observations with an average of 5.9 times in an hour. In 42% of the observations, nurses visited patient rooms at from 2 – 4 times in an hour.

Summary of Results

- Overall, 57% of events were Interactive, 95% of which were work related. Seventy-two percent of interactive events lasted less than 1 minute and 91% lasted less than 3 minutes.
- Overall, 88% of observed events were work-related with 69% happening outside of patient rooms and 19% inside.
- Overall, 74% of all interactions occurred at nursing pods, 34%

occurred at Cluster A and 21% at Cluster B.

- The most frequent interactions of RNs involved one or more RNs and occurred in 47% of the observed interactions.
- The least frequent interactions of RNs involved one or more doctors and occurred in 11% of the observed interactions.
- Interactions with doctors occurred most frequently in a at nursing pods.
- On average RNs visited 6 of the 9 nursing pods over the course of an hour's observation period, with a range from 3-9.
- Over an observation period, RNs interacted with other clinical staff an average of 56% of the time, ranging from 19% to 96%.
- Over an observation period, RNs interacted with other RNs most frequently. The average number of interactions was 21 times. The minimum number was 6 and the maximum was 45 with a range of 39.
- RNs visited patients an average of 7 times during an observation period. The minimum number of visits was 1 and the maximum was 15 visits.
- In an hour long observation period RNs, on average spent 19 minutes in the patient room. The minimum was 5 minutes and the maximum was 31 minutes, with a range of 26 minutes.
- Of all RN visits to a patient room, 47% lasted less than 1 minute and 76% less than 3 minutes. Most events in patient rooms were Non-Interactive.

CHAPTER 4. DISCUSSION

4.1 Summary of Findings Regarding Each Hypothesis

The goal of the case study was to explore and describe the nature of work and communication patterns on a patient floor layout using relatively decentralized nursing stations. The hypotheses were formulated based on the literature about nurse work, the rationale supporting decentralized layouts, and the potential interaction of the two.

- Hypothesis 1,"Nurses interact most with other nurses; and infrequently with doctors and other caregivers," was supported.
- Hypothesis 2, "In the absence of the central nursing station, nurse interactions with other clinicians will generate a new locus," was supported.
- Hypothesis 3, "Nurses will choose a station closest to their patients," was supported
- Hypothesis 4, "Nurses spend large portions of their time visiting other pods and work areas on the nursing unit," was supported.
- Hypothesis 5, "Nurses will spend a large percentage of their time in patient rooms," was not supported.

The following sections discuss how the patient care teams, work processes, the decentralized nursing station layout, and the specific features of the unit interact with each other to shape communication and interaction patterns on the ICCU.

<u>The ICCU Workplace</u>

The different interactions and work patterns observed in the

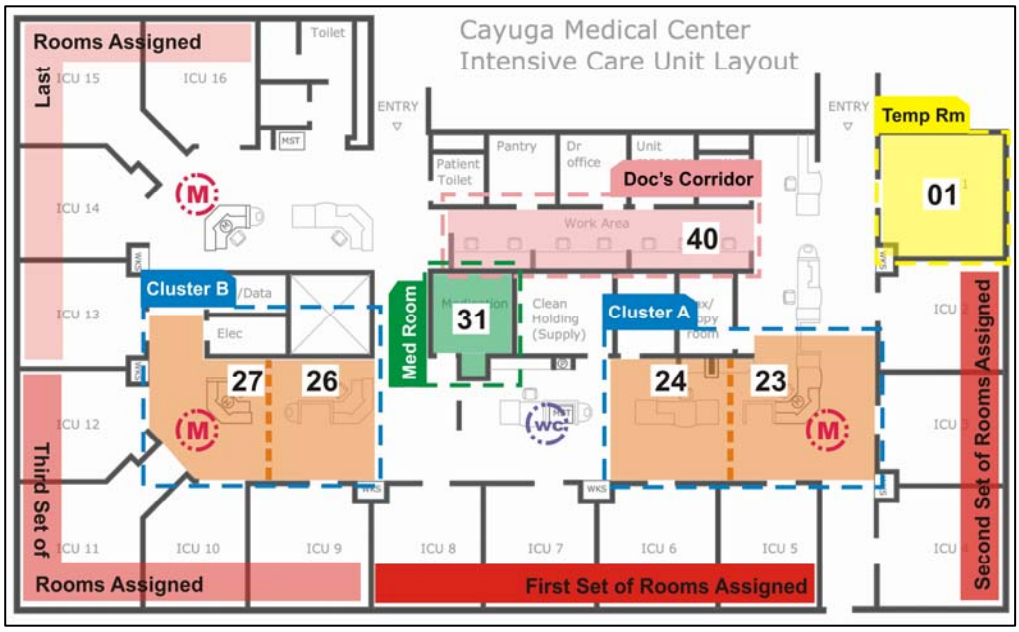
ICCU can be described using the concepts of affordances and activity magnets.

Affordances, as defined by Gibson (1986), refer to features of the environment that support particular behaviors; e.g., patient monitors afford nurses the ability to monitor multiple patients, but do nothing for pharmacists. More broadly applied to the unit, affordances that supported informal communication and interactions will be discussed.

Becker and Steele (1995) found that the physical design, work processes, staff, and technology were all critical aspects of high performance workplaces. They reasoned that there are physical features of the workplace, e.g., water coolers, copiers, etc. and social factors, e.g., particular people or specialized organizational roles, that encourage interactions. They called these social and environmental features, "activity magnets" and viewed them as critical elements of an organization's ecology.

4.1.1 Location of Activity Magnets and Affordances

Figure 24 ICCU Layout Showing Locations of Affordances and Activity Magnets



4.1.1.1 The Ward Clerk

The unit ward clerk was responsible for various administrative duties for the unit, e.g., fielding phone calls, tracking down people and equipment, sending and receiving laboratory tests. The ward clerk also compiled a roster of patients and room assignment, and assigned nurses for that shift. This roster would then be posted at each of the nursing stations to inform other nurses which nurses were responsible for which patients in what rooms. In this study, the Ward Clerk was informally assigned (regularly selected) Pod 25, which was located between the two nursing pod clusters with the highest interactions. While it seemed likely that the Ward Clerk would act as a major social affordance, in fact nurse interaction with ward clerks was only the third most frequent interactions observed. One explanation for this is that ward clerks often used the unit intercom to speak with nurses, reducing the need for face-to-face interaction that was the focus of this study.

4.1.1.2 Patient Monitors

Three nursing stations in the unit were equipped with patient monitors that afforded clinicians the ability to check the vital statistics of any patient in the unit. This attracted nurses and other clinicians to these stations because they could quickly check up on patients elsewhere in the floor as they moved around. The researcher observed that interactions at these locations involved clinicians sitting in front of monitor with clinicians standing behind the monitor in the corridor. From Figure 24, these stations are marked with the encircled “M.”

Two of these locations were also part of nurse stations pod clusters where the highest frequencies were observed.

4.1.1.3 Med Room

The Med Room was a room used to store and prepare medication. The room was secured by a digital lock on the door. The activity magnet was inside the room in the form of a medication dispenser modeled after banking ATMs. It attracted interactions because some medications required a second nurse's presence for the machine to dispense. This room had the additional feature of being acoustically private. Because the significance of this room as an interaction node was not recognized when formulating the research, no data was collected about interaction patterns in it. Future studies need to include all such "ancillary" rooms, including break rooms, conference room, utility rooms, etc.

4.1.1.4 Patient Acuity

Through informal interviews, the researcher found that patients transferred to the unit were assigned rooms based on their acuity level and room availability. The patients requiring the most attention were placed nearest Cluster A, then B, and then finally in the back of the unit (See Figure 24 for approximation of patient assignment procedure). Thus patient acuity acted as a form of social affordance, since more activity occurred around rooms occupied by patients than by unoccupied rooms.

4.1.1.5 Cluster A

The most frequent interactions occurred consistently at Cluster A (Pods X,X). In most of the observation periods the charge nurse, who was the nurse team leader during an eight hour shift, chose home in one of the pods in Cluster A. In addition to a patient monitor, a whiteboard with information about patients and the daily unit staffing assignments were also located in Cluster A. This combination of social and physical activity magnets generated the highest frequency of interactions. The strongest magnets were a combination of room assignment based on patient acuity, location of patient monitors, and the ward clerk.

Cluster A became a de facto Hub for the new layout. A combination of factors may have contributed to this result:

- Close proximity of many activity magnets and affordances;
- Presence of the duty roster and patient assignments; and
- Frequent choice by the shift charge nurse of one of the two pods.

One implication of this behavior for future practice may be that it is difficult, and perhaps undesirable, to use or expect more decentralized nursing station designs to result in the elimination of a central communication hub. Revisiting the site at a later time, after the clinicians have spent more time in the unit, should be undertaken to verify if the pattern still holds.

4.2 Effect of the Affordances and Activity Magnets on Nurse Activity

One goal of the more decentralized layout was to locate the

nurses closer to their patients. The data indicated that nurses took advantage of this by selecting home pods closest to their assigned patients. The data also showed that individual time in the patient room was brief and infrequent, but accounted for an average of 31% of their time over the course of an hour. Comparing the average time with patients in this study to work by Hendrich (McCarthy, 2004), it seems the average time with patients in a centralized versus decentralized layout was about the same. With respect to decentralized units reducing fatigue by reducing the amount of walking, the data showed that nurses frequently traveled among other pods and different settings in the course of their work. No data on actual walking distances was collected, but it does not appear that the decentralized pods resulted in nurses spending most of their time in a single pod closest to their patients. They were constantly moving about the entire unit.

4.2.1 Interactions with Doctors

The data showed that nurses interacted with doctors the least. Furthermore these interactions occurred at nursing stations more often than in the Doc's Corridor or other corridors or spaces. In the previous centralized layout, doctors regularly sat at the centralized nursing station, where they more often interacted with nurses (Dutta, 2007). The low frequency of interactions in the MD corridor suggests that this kind of space may be an effective feature for affording doctors a place to write their notes, orders, etc. with minimal disturbance. This was, in fact, the intent of providing them a dedicated workspace.

The unintended consequence, however, was to reduce the already infrequent opportunities for nurses to interact with doctors, thus maintaining the social and professional distance and reducing the opportunities for opportunistic communication between what the literature notes should be an integrated team.

4.3 Conclusions

The goal of the ICCU redesign to locate nurses closer to their patients was achieved. Furthermore, the nurses effectively used this feature of the new layout by choosing pods closest to their patients. However, nurses continually moved around the unit interacting with other nurses and clinical staff in a wide variety of pods and other settings on the unit. This suggests that despite locating nurses closer to patients, they still travel widely throughout the unit. Furthermore this study found nurses in the decentralized layout spend approximately 31% of their time with patients. This is equivalent to other research on average time spent with patients (Wong, et al., 2003). However, this study did find a large variability (standard deviation of 12%) which was not observed in the study by Wong, et al. Finally, the study found that despite the unit's decentralized layout, nurses in this study adopted a de facto Hub where interactions occurred most frequently. In effect, they recreated the behaviors typically found in a centralized nursing station layout.

While the study can not categorically demonstrate whether the layout improves or impedes patient care, it suggests that, the optimum layout would be a hybrid design with features of both centralized and

decentralized units. For instance paired nursing stations instead of individual nursing stations may be more supportive of communication. By distributing these around the unit, benefits from closer proximity to patients may also be realized. Such an approach has the potential to better support the development of a dynamic community of practice (Wenger, 2007) by facilitating informal communication within and across diverse clinical staff.

4.4 Limitations

The study reported on here was exploratory, designed to test a new data collection technique using a PDA to shadow a nurse and record in real time interaction patterns in space. Without comparative data from ICCU units with centralized nursing layouts, it is not possible to determine the extent to which the design might affect observed communication patterns. To do this going forward, an important first step is the development of a nursing unit design typology. Currently none exists. This makes it difficult to compare units from within the same or different hospitals.

Secondly, this study focused on the nursing pods and corridors associated with them. In fact interaction occurred in a wider range of settings. Going forward, *all* the places where clinical staff can interact need to be included in future studies, including break room, medication room, and other specialized rooms and spaces.

The study did not collect data on patient acuity levels, except in the form of room assignments, with higher acuity patients assigned rooms closer to the de facto "hub" on the unit. Yet patient acuity

appeared to be a potentially important form of social affordance, and should be considered in future studies.

4.5 Future research

In addition to the limitations suggested above, future research might explore the following kinds of questions this study did not:

- Do nurses in pods closest to their assigned patients spend more time with their patients than those who select pods further from their assigned patients?
- How much of the nurse's time is involved in "teaming" or helping another nurse with their patient?
- What was the average distance traveled?

Further research directions might also examine other aspects of the communication more closely. For instance Coiera (2000) found clinicians preferred synchronous face- to -face communication when communicating with team members. How might the affordances in a decentralized layout affect this behavior?

Another direction might be closer examination of the specific work activities, e.g., patient care, documentation, transit, or combinations of activities done in teams versus individually similar to research in Australia (Westbrook, et al., 2007).

The increasing adoption of various health informatics solutions, like EMR, CPOE, and PBX, hoping to improve quality of care suggests an urgent need to include the impact of IT in the ecology of the workplace. Coiera (2004) argues that "we don't design technology, we design sociotechnical systems." (Coiera 2004).