IMPACT ON CARPET TILE IN A HOSPITAL PATIENT UNIT CORRIDOR: AN OBSERVATIONAL CASE STUDY

By

JULIANNA M. MITCHELL

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
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Julianna M. Mitchell

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Chair: Debra D. Harris
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Interior designers are generally responsible for the selection and specification of flooring materials for healthcare facilities. In turn, flooring materials and carpet may have a broad impact on the health, safety, comfort, and confidence level of patients, visitors, and employees. In order to manufacture and select carpeting that can properly support hospital occupants and activities, it is necessary to consider the factors which impact it. Similarly, a maintenance plan to properly care for carpeting must respond to actual use and wear, in addition to incorporating preventive measures for infection control and indoor air quality. This study examines use patterns and activities affecting carpet tile in a real-life setting.

Observations of a designated portion of a patient unit corridor were made in 2-hour increments between the typical peak hours of 7:00am and 11:00pm. A total of 31 time blocks were randomized over a 6-day period. Researchers documented the type and frequency of foot traffic and equipment carts, as well as use patterns in the form of paths traveled through the corridor area. Additionally, cleaning activities were documented in order to compare 1) actual carpet cleaning procedures, 2) documented hospital protocol, and 3) infection control guidelines and industry standard cleaning methods.

Results showed that the study corridor carpeting received over 2,900 foot traffic instances per day during peak hours alone, and that average foot traffic counts varied throughout the day. Further, this particular location within the hospital primarily served and supported healthcare professionals charged with patient care. However, unexpected use patterns of the particular spaces allocated to healthcare staff were revealed. Findings indicate that information such as equipment use and hospital census numbers should be examined when selecting appropriate floorcoverings or developing and implementing a maintenance plan.

A hospital-wide comprehensive carpet maintenance program should be developed and documented. Additionally, variation among housekeeping staff members suggests the need for further research regarding consistency and quality of regular facility maintenance practices. Further studies should also explore how wear and contamination of carpet tile affect people in the environment, especially with regard to physical health.

CHAPTER 1
INTRODUCTION

Interior designers are generally responsible for the selection and specification of flooring materials for healthcare facilities. In turn, flooring materials and carpet may have a broad impact on the health, safety, comfort, and confidence level of patients, visitors, and employees (Figure 1.1). Specifying carpeting requires consideration not only of appearance (e.g., color and texture), but of crucial factors such as durability, maintenance, and indoor air quality. In order to make appropriate decisions, designers should be informed about how materials are impacted and maintained by end users. This study examined use patterns and activities that effect carpet tile in a real-life setting.

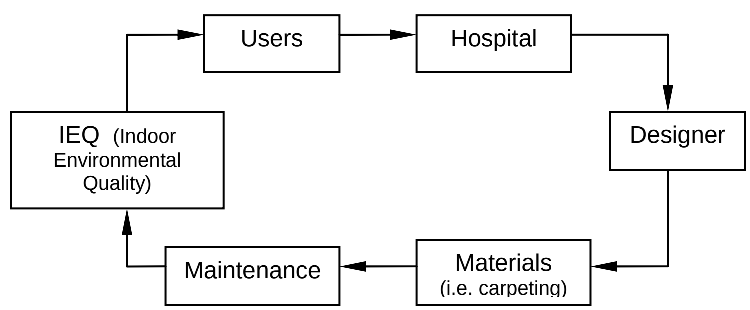


Figure 1.1: Relationships between factors involved in the research

Purpose

The purpose of this study is to determine the human impact on carpet tile in a patient unit corridor, including housekeeping activities, human traffic, and equipment carts. Specific questions answered include 1) what specific users and equipment contribute to traffic flow in a patient corridor; and 2) what are the consistency, frequency, and methods of regular cleaning of carpet tile in an acute care patient corridor?

Through this study, occurrences of and reaction to contamination incidents are isolated and explored. Further, a comparison between 1) actual carpet cleaning procedures, 2) documented hospital protocol, and 3) infection control guidelines and industry standard cleaning methods provides valuable information to manufacturers and specifiers of materials for acute care facilities. The conceptual framework for this study is shown in Figure 1.2.

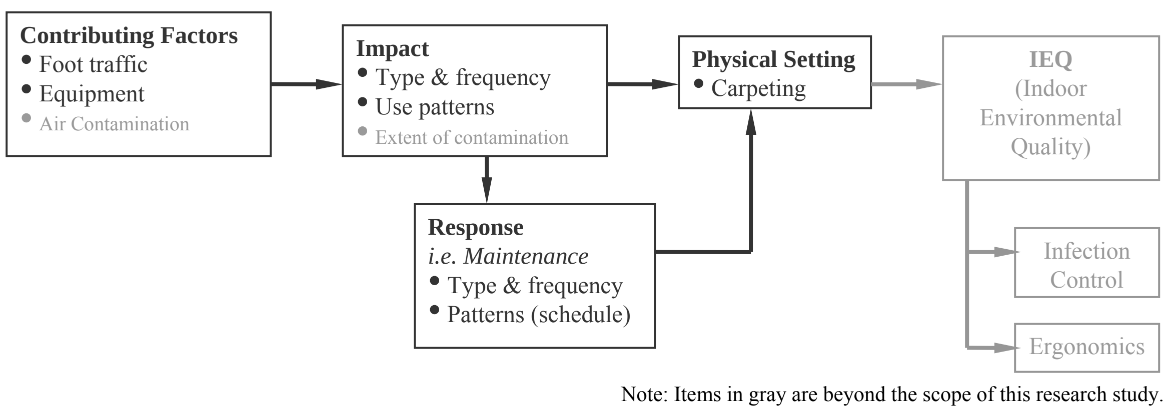


Figure 1.2: Conceptual framework

Significance of the Study

Interior designers—along with manufacturers of flooring materials such as carpet—continually question whether flooring finish materials are maintained properly once they are installed in hospitals and other facilities. First-hand information about how these products are actually being utilized and treated in their intended setting could lead to the development and selection of better, more suitable floor coverings for healthcare and other environments. Although findings in this case study are not generalizable to other hospitals or environments, they will provide useful information for the host site and contribute to the body of knowledge for interior design application and related industries.

CHAPTER 2
LITERATURE REVIEW

Indoor Environmental Quality

Concern in recent years about the relationship between the built environment and the health of occupants has lead to substantial research and advances in indoor air and environmental quality (American Society of Healthcare Engineering, 2004; Luedtke, Scholler, & Kennedy, 2000). In 2003, the American Journal of Public Health published an entire issue on the subject, "signal[ing] a timely recognition of the relevance to health and well-being of the indoor environments where people spend most of their time" (Samet & Spengler, 2003, p. 1489). Several major organizations, including the U.S. Green Building Council in its Leadership in Energy and Environmental Design Green Building Rating System, the American Society of Healthcare Engineering, and the Green Guide for Healthcare list indoor environmental quality as a key contributor to the well-being of a building's occupants (ASHE, 2004; Green Guide for Healthcare, 2005; United States Green Building Council, 2004).

The quality of the indoor environment has a profound affect on health and productivity. Moreover, risk of disease is increased by indoor air pollutants, contamination of surfaces by toxins and microbes, and contact between people in the environment (Samet & Spengler, 2003). In turn, the air and environmental quality of a building are dependent on: 1) the design of the physical space, 2) the building systems, and 3) the selection and maintenance of materials within (ASHE, 2004; Ayliffe, Babb, &

Taylor, 1999; Luedtke et al., 2000). Interior designers make decisions regarding each of these factors and are principally responsible for the specification of interior materials.

Carpeting and the Hospital Environment

The healthcare sector especially has a “collective fundamental mission to protect and enhance individual and community health” (GGHC, 2005). Fuston and Nadel (1997) assert that the design of healthcare facilities is likely the most critical of all interior spaces because of the extended durations spent in them by patients and employees alike. Hospitals require special consideration with regard to indoor environmental quality due to the susceptible population they serve, as well as their need to operate around the clock (McCarthy & Spengler, 2001). Moving into the twenty-first century, hospitals are becoming more holistically concerned with the “overall healthfulness” (McCarthy & Spengler, 2001, p. 65.14) of their occupants. Beyond treating illness, hospitals must offer non-toxic environments which promote wellness in addition to healing (Carpman & Grant, 1993; Fuston & Nadel, 1997).

Flooring materials in healthcare settings may have a broad impact on the environmental health of the building and the patients, families, and staff who spend large amounts of time there (Fuston & Nadel, 1997; Harris, 2000). Carpet, in particular, has implications for a range of issues critical in a healthcare setting, including indoor air quality, infection control, acoustic quality, light and reflected light, personal comfort, and safety (Harris, 2000; Radke, 1997; Weinhold, 1988).

Indoor Air Quality

The quality of the indoor air is one of the key determinants of environmental health (Fisk, 2001; Oliver & Shackleton, 1998). Indoor air quality (IAQ) has a significant influence on incidences of respiratory disease, symptoms of allergies, and asthma, transmission of infectious diseases, chemical sensitivity, and worker productivity (Fisk, 2001). Poor IAQ is caused by air pollutants from indoors and outdoors, which can include volatile organic compounds (VOCs), dust, and microbial contaminants such as mold, mildew, bacteria, and viruses (Fisk, 2001; Fuston & Nadel, 1997).

Carpet and carpet tiles are of notable concern for IAQ. Because carpeting covers an expansive horizontal surface, it is considered a “sink” that can often absorb harmful microbes and settling airborne particles and then re-emit them into the air (Ayliffe et al., 1999; Luedtke et al., 2000).

Carpet is known to accumulate and hold soils and dusts but there is little evidence that higher levels of airborne contaminants exist over carpet than any other interior surface (Anderson, Mackel, Stoler, & Mallison, 1982; Harris, 2000; Luedtke, Stetzenbach, Buttner, Erkenbrecher, & Kennedy, 1999). Concern remains, however, largely because carpet dust has been found to contain fungal, bacterial, and other biological debris that could potentially contribute to allergies, asthma and infection (Engelhart, Loock, Skutlarek, Sagunski, Lommel, Farber, 2002; Luedtke et al., 1999). Two separate studies examining carpeting in hospital settings found that carpeted floors had higher levels of surface contamination than did non-carpeted floors. Levels of airborne contaminants, however, varied less above carpet and remained the same or lower over carpeting than over other flooring types (Anderson et al., 1982; Harris, 2000).

Infection Control

Nosocomial, or hospital-acquired, infections have been identified as a “major public health problem” and a leading cause of illness and death in hospitals (Dillman, 1996, p. 26). Although the role of the hospital environment in the spread of nosocomial infection remains controversial, Hota (2004) points out that existing data has established that hospital surfaces can become contaminated after exposure to colonized patients and that specific isolates of nosocomial pathogens may predominate in the inanimate environment. Martinez, Ruthazer, Hansjosten, Barefoot, & Snydman (2003) found an epidemiological link between patient room assignment and acquisition of vancomycin-resistant enterococci (VRE), establishing contaminated environments as a risk factor for the spread of nosocomial pathogens.

Hospital surfaces can be a reservoir for a variety of microorganisms which, when transmitted directly or indirectly to patients, have the potential to cause nosocomial infections (Dancer, 1999; Hota, 2004; Rutala, 1996; Weber & Rutala, 2003). Recognizing this, hospitals and other healthcare facilities should take a precautionary and preventive approach when making decisions about operations and maintenance as well as materials, furnishings, and equipment, all of which can contribute to transmission of disease and hospital acquired infection (ASHE, 2004; Ayliffe et al., 1999; Dancer, 1999).

As mentioned previously, the "sink" effect can cause higher contamination levels of carpeted surfaces as compared with hard or resilient flooring (Anderson et al., 1982; Ayliffe et al., 1999; Harris, 2000; Luedtke et al., 2000). Further, carpet and carpet dust have been linked with pathogenic fungi (e.g., species of *Aspergillus*), bacteria (e.g., *Staphylococcus aureus, Escherichia coli*), viruses (e.g., noroviruses), and molds (e.g., *Penicillium, Candida*) (Anderson et al., 1982; Engelhart et al., 2002; Hota, 2004; Luedtke et al., 1999). Despite the potential presence of such organisms in carpeting, an epidemiological evaluation of carpeting found no association between carpet contamination and nosocomial infection and no statistical difference between infection rates of patients in carpeted rooms and those in uncarpeted rooms (Anderson et al., 1982).

Acoustic Quality

Hospital noise can interfere with sleep, hinder communication, and cause stress and annoyance for patients, visitors, and staff (Busch-Vishniac, West, Barnhill, Hunter, Orellana, & Chivukula, 2005; Morrison, Haas, Shaffner, Garrett, & Fackler, 2003; Topf, Bookman, & Arand, 1997). Noise levels in healthcare settings have been consistently found to exceed acceptable standards (Busch-Vishniac et al., 2005; Harris, 2000). One study measuring noise sources in a six-bed intensive care unit reported that highest noise levels were attributable to items (mainly metallic) falling onto the floor, loud voices, and equipment and stretchers (Tsiou, Eftymiatos, Theodossopoulou, Notis, & Kiriakou, 1998). Topf et al. (1997) recommends implementing alphanumeric paging systems to replace equipment alarms and ringing telephones, designing equipment with quieter moving parts, and specifying carpet in high-traffic areas as some alterations that could lead to a quieter hospital environment.

Carpet can act as an acoustical aid, reducing transmission of sound to the immediate area as well as to floors below (Radke, 1997; Weinhold, 1988). In a comparison of flooring finish materials, Harris (2000) rates the sound absorption qualities inherent in carpeting as excellent. Weinhold (1988) points out that impact sounds from dropped objects are greatly reduced by carpeted flooring. With regard to general noise levels, pile height and pile weight have an effect on the noise reduction coefficient (NRC), or the amount of sound that carpeting will absorb (Weinhold, 1988). An additional acoustical consideration is maintenance noise, as vacuum-cleaning can create more noise than buffing, sweeping, or mopping (Weinhold, 1988).

Light and Reflected Light

Lighting in healthcare environments must support the functions and activities of medical staff while providing for the sometimes contradictory comfort and lighting needs of patients and their visitors (Horton, 1997; Illuminating Engineering Society of North America, 1995). Both task performance and visual comfort are affected by perceived brightness (IESNA, 1995). The Illuminating Engineering Society of North America (1995) emphasizes the importance of finish materials to luminance ratios, light utilization, and space appearance, all of which influence perceptions of brightness. Another issue is glare, which is excessive brightness in the visual field that causes annoyance, discomfort, and even loss in visual performance and visibility (IESNA, 1995). Because ceilings, walls, and floors can act as secondary light sources, the reflectances of finish materials within a room have a strong influence on luminance levels and can cause glare (IESNA, 1995).

Carpet provides a smooth, matte finish on the flooring surface which significantly reduces glare (Carpman & Grant, 1993; Horton, 1997). In a study of patient room flooring materials, carpet slightly exceeded the recommended reflectance range (Harris, 2000). However, the reflectance level of vinyl composition tile (VCT), a resilient flooring material, was six times greater than that of carpet (Harris, 2000). The same study found that nurses' perceptions of glare were significantly less in carpeted patient rooms (Harris, 2000).

Personal Comfort

Carpeting provides comfort underfoot, psychological comfort, and thermal comfort (Radke, 1997; Weinhold, 1988). The cushioned surface offers some relief from foot and leg fatigue for hospital staff (Radke, 1997; Weinhold, 1988). Weinhold (1988) asserts that "the appearance of carpet suggests quality, warmth, and a home-like atmosphere" and stresses the importance of these factors with regard to employee and patient morale. Harris (2000) reported that visitors spent significantly more time in patient rooms with carpeting than in non-carpeted rooms. It is important to consider the environment's role not only in the physical health, but also in the psychological and social needs of all of its complex user groups (Carpman & Grant, 1993).

Thermal comfort is defined as that condition of mind which expresses satisfaction with the thermal environment (ASHRAE, 1997). Harris (2000) found that although flooring material does not directly affect surface or room temperature, patients perceive the temperature in carpeted rooms to be more comfortable. While patients perceived uncarpeted rooms to be cleaner and have fresher air, they preferred carpeting overall, due in large part to the perception of thermal comfort (Harris, 2000).

Safety Factors

Hospital patients typically represent vulnerable user groups and are often impaired, disabled, or elderly (Carpman & Grant, 1993). Falls are common among the elderly and can be a concern for all users (Guelich, 1999). Willmott (1986) found that elderly patients showed increased gait speed and step length when walking on carpet in comparison with vinyl flooring. Furthermore, Willmott (1986) reported that patients were more confident walking on carpeting and expressed fear of falling on resilient flooring.

Carpet is a slip-resistant flooring material, while resilient and hard surface floorings are not, particularly when polished, waxed, or wet (Harris, 2000; Weinhold 1988). Spilled liquids are absorbed into carpet fibers, reducing the danger of slipping and falling as a consequence of a spill (Radke, 1997).

Ergonomic provisions and risk of injury to employees are also important safety considerations in healthcare settings. Studies have shown that tasks that involve pushing and pulling place healthcare workers at higher risk for neck, shoulder, and lower back pain (Hoozemans, van der Beek, Frings-Dresen, van der Woude, & van Dijk, 2002; Smedley, Inskip, Trevelyan, Buckle, Cooper, & Coggon, 2003). Because carpeting has a higher coefficient of friction than hard flooring surfaces, the force required to push, pull, and turn rolling equipment is greater on carpeted floors (Das, Wimpee, & Das, 2002). Slip-resistance, however, can be a factor in muscle use when pushing and pulling (Lavender, Chen, Li, & Andersson, 1998). Large wheels and properly specified, low-pile, dense carpet without padding can help to mitigate the increased effort required to push and pull wheeled carts and equipment (Carpman & Grant, 1993; Weinhold, 1988).

Material Composition

Carpet is becoming an increasingly popular floor covering choice for healthcare facilities (Radke, 1997). Considerations involved in specifying flooring materials for healthcare facilities include health and safety factors (flame resistance, electrostatic propensity, biogenic factors, and slip resistance), environmental factors (acoustics, comfort, ambience, and wheeled vehicle mobility), and wear-life factors (durability, appearance retention, maintenance, and costs) (Weinhold, 1988).

Generally, loop pile nylon fiber with a synthetic, non-permeable backing and low pile height is recommended for high-traffic hospital settings such as corridors (Carpman & Grant, 1993; Radke, 1997; Weinhold, 1988). The preferred dyeing method for areas subject to occasional spills is solution dyeing, which takes place at the fiber stage and typically offers excellent colorfastness and cleanability as well as some degree of stain-resistance (Radke, 1997; Weinhold, 1988). Antimicrobial agents are considered helpful in preventing the growth and spread of harmful and infectious microorganisms (Carpman & Grant, 1993; Radke, 1997). Carpeting is not recommended for areas that experience frequent and excessive spills, such as operating rooms, intensive care units, delivery rooms, bathrooms, and laboratories (Anderson et al., 1982; Sehulster et al., 2003).

The Role of Cleaning

Hospital cleaning is an important aspect of infection control and can have a significant impact on patient confidence (Ayliffe et al., 1999; Dancer, 1999). Cleaning can be defined as the process of removing microorganisms and the organic matter that supports them through the use of water and detergents as well as mechanical processes (Ayliffe et al., 1999; Hota, 2004).

Zafar, Gaydos, Furlong, Nguyen, & Mennonna (1998, p. 591) state that cleaning is "probably the most important method of eliminating environmental reservoir and thus interrupts the spread from [surfaces] to patients." However, the quality of institutional cleaning is varied and often goes unmeasured (Hota, 2004). Experts at the invitation-only Global Consensus Conference on Infection Control Issues Related to Antimicrobial Resistance (1999) identified "deteriorating housekeeping practices" in healthcare facilities as an assumption that should be made when considering infection control recommendations.

Studies have shown that cleaning can successfully reduce the presence of known pathenogenic microorganisms on common environmental surfaces in hospitals (Dancer, 1999; Zafar et al., 1998). For instance, Zafar et al. (1998) reported a sustained decrease in nosocomial *Clostridium difficile*, with cleaning included as a major part of an aggressive infection control program.

Indoor air quality is also affected by cleaning and quality of maintenance. Franke, Cole, Leese, Foarde, & Berry (1997) reported measurable improvements in indoor air quality attributable to an improved cleaning program. The study found reduced airborne dust mass, total volatile organic compounds, culturable bacteria and cultural fungi after procedures were implemented including use of high-efficiency vacuum-cleaners and entry mats. Franke et al. (1997) points out, however, that evaluation of cleaning programs should include air quality measurements before, during, and after cleaning processes because of pollution and resuspension of dust which can occur during the use of cleaning products.

Chemical disinfectants have not been found to be preferable to cleaning with water or detergents alone (Hota, 2004). Disinfectants eliminate microbes but can shorten the life of some surfaces and can cause irritation (Ayliffe et al., 1999). Because of concern that improper use of disinfectants can create antibiotic resistance, low-level cleaning strategies are recommended and generally considered sufficient (Global Consensus Conference, 1999; Penna, Mazzola, & Martins, 2001; Rutala, 1996; Sehulster, Chinn, & HICPAC, 2003).

Maintenance is consistently mentioned as a crucial factor in the performance, appearance, and safety of carpeting (Radke, 1997; Weinhold, 1988). Radke (1997) suggests that if carpet is properly maintained, its ability to act as a “sink” can allow harmful allergens, dust, and microorganisms to be trapped and removed by vacuuming. Routine vacuuming with a filter bag can could reduce the presence of airborne particles that would be redistributed from hard surface flooring into the air by mopping (Radke, 1997).

Cleaning Methods

In order to resist the growth of pathogenic microorganisms, flooring in patient-care areas should be clean, dry, and well-ventilated (Ayliffe et al., 1999; Sehulster et al., 2003). Hospitals should ensure this by keeping a routine cleaning schedule and developing a maintenance plan based on careful consideration of manufacturer recommendations (Radke, 1997). As a generally accepted practice, manufacturers derive their recommendations from infection control guidelines and industry standards.

Five key elements should be components of a thorough maintenance program: preventive maintenance, vacuuming, spot and spill removal, interim cleaning, and restorative cleaning (Carpet and Rug Institute, 2004; Institute of Inspection Cleaning and Restoration, 2002; Radke, 1997).

Preventive Maintenance

Preventive maintenance is intended to minimize the impact of soiling on carpet. Walk-off mats placed at entrances and major interior traffic areas control the amount of soil that enters carpeted areas (CRI, 2004; IICRC, 2002). Outside mats serve to scrape dirt and debris off shoes before entering the building (CRI, 2004). Inside mats serve the dual purpose of removing small soil particles and absorbing moisture from entrants' shoes (CRI, 2004).

Vacuuming

For carpeting, the "Guidelines for Environmental Infection Control in Health-Care Facilities," set forth by the Centers for Disease Control and Prevention (CDC), recommends regular vacuuming with "well-maintained equipment designed to minimize dust dispersion" (Sehulster et al., 2003, p. 135). The CRI (2004) recommends upright vacuum sweepers with top loading soil bags and separate motors for suction and brushing. Vacuums should be equipped with an enclosed high-efficiency particulate air filter (HEPA) bag and adjustable brushes or beater bars to lift trapped particles to the flooring surface (CRI, 2004; IICRC, 2002; Radke, 1997; Sehulster et al., 2003).

Effective daily vacuuming removes soil in addition to lifting and restoring carpet pile (IICRC, 2002). Actual vacuum-cleaning frequency depends on the amount of foot traffic the area receives, as shown in Table 2.1 (IICRC, 2002). Vacuuming should be performed once or more daily with slow and methodical movements (CRI, 2004).

Table 2.1: Commercial carpet cleaning frequency chart

Traffic Soil Rating	Vacuuming	Spot and Spill Removal	Interim Cleaning	Restorative Cleaning
Light <500 foot traffics per day	1 – 2 times weekly	Daily or when spots are noticed	1-3 times yearly	1-2 times yearly
Medium 500-1000 foot traffics per day	Traffic areas: Daily Overall: 3-4 times weekly	Daily or when spots are noticed	3-6 times yearly	2-4 times yearly
Heavy 1000-2500 foot traffics per day	Traffic areas: Daily Overall: 4-7 times weekly	Daily or when spots are noticed	6-12 times yearly	3-6 times yearly
Very Heavy >2500 foot traffics per day	Traffic areas: 1-2 times daily Overall: 7 times weekly	Daily or when spots are noticed	12-52 times yearly	6-24 times yearly

(IICRC, 2002)

Spot and Spill Removal

Spills, especially involving blood or body fluids, require prompt spot-cleaning (CRI, 2004; Radke, 1997; Sehulster et al., 2003). Radke (1997) cautions against overwetting during treatment of a spill or stain and stresses that spills should be blotted rather than rubbed. Blotting should always be performed from the outside to the center of the spot in order to reduce further contamination or staining (CRI, 2004).

If water alone does not remove a spot, specific solutions can be applied to the carpeting dependent upon the nature of the spill (CRI, 2004). CRI (2004) suggests solutions that can be made by diluting mild detergent, ammonia, or vinegar in water or by using a fast-evaporating dry cleaning fluid such as rubbing alcohol (CRI, 2004). Once the proper solution is selected, it should be applied to a clean, white cloth and blotted (CRI, 2004). Remaining residue from the spill or cleaning solution can be flushed out using clean water. Finally, the carpet should be blotted dry (CRI, 2004; IICRC, 2002).

For carpet tile specifically, the CDC suggests replacement of any contaminated individual tiles (Sehulster et al., 2003). Once a contaminated tile is pried up and removed from the floor, it can be discarded or cleaned in a less obtrusive location for re-use at a later time.

Interim Cleaning

Interim cleaning is performed primarily because it can prolong the duration between restorative cleanings and does not require extended drying time (IICRC, 2002). Usually referred to as dry extraction or soil suspension, the intention is to dislodge and disperse accumulated soil to allow for removal by vacuuming (CRC, 2004; Radke, 1997). Soil suspension uses a combination of chemical action, elevated temperature (heat), agitation, and time (CRC, 2004; IICRC, 2002).

Chemical action, also called pre-conditioning, works by reducing surface tension and dissolving certain soils (CRC, 2004; IICRC, 2002). Time is fundamental to this process because chemicals often need prolonged contact time in order to adequately dislodge and dissolve impacted soils (CRC, 2004; IICRC, 2002). The process can be accelerated by agitation using a common brush or mechanical equipment to enhance and accelerate chemical action on soils (CRC, 2004; IICRC, 2002). Dry foam and absorbent compounds are two commonly used methods for low-moisture interim cleaning (IICRC, 2002). Vacuuming must be performed following these procedures in order to remove dislodged soil particles and residue from chemical solutions (CRC, 2004; IICRC, 2002).

Restorative Cleaning

The CDC recommends periodic deep cleaning with minimal aerosols or residue (Sehulster et al., 2003). Hot water extraction is another soil suspension method designed to remove embedded soils not removed by regular vacuuming or dry extraction methods (CRC, 2004; IICRC, 2002). It is generally considered the best method for deep or restorative carpet cleaning (Radke, 1997).

The process involves applying a detergent pre-spray to the carpet and using a low moisture applicator to agitate the pre-conditioner. In hot water extraction, warm water (not exceeding 120ºF) is injected into the carpet, suspending contaminants in the solution to allow for removal by a vacuum system (IICRC, 2002; Radke, 1997; Sehulster et al., 2003). The elevated temperature of the water or solution employed in the cleaning process can help to reduce surface tension, speeding up the process of soil suspension (CRC, 2004; IICRC, 2002). Wet carpeting should be allowed to dry completely, followed by a thorough vacuuming before use (CRC, 2004; IICRC, 2002). If carpet remains wet for a period of time over 72 hours it should be replaced (Ayliffe et al., 1999; Sehulster et al., 2003).

Summary

The quality of the indoor environment is of growing importance to hospitals and the healthcare and design industries. A more holistic approach to the overall health of all users within a healthcare setting includes careful attention to the physical environment, including interior materials. The selection and maintenance of flooring materials and carpet, in particular, can have a broad impact on the health, safety, comfort, and confidence level of patients, visitors, and employees alike. In order to manufacture and select carpeting that can properly support hospital occupants and activities, it is necessary to consider the factors which impact it.

Similarly, a maintenance plan to properly care for carpeting must respond to actual use and wear, in addition to incorporating preventive measures for infection control and indoor air quality. Proper cleaning removes harmful contaminants and microorganisms and maintains the appearance of carpeting. The necessary frequency and degree of routine, interim, and restorative cleaning measures are dependent upon quantity and patterns of foot traffic and wear factors such as equipment carts.

CHAPTER 3

RESEARCH METHODOLOGY

Research Design

The study design was a cross-sectional case study utilizing observation as a research methodology. This cross-sectional study design was chosen for its effectiveness in exploring a phenomenon or situation at a particular point in time. Kumar (2005) states that cross-sectional studies can be "useful in obtaining an overall picture as it stands at the time of the study." Non-participant observation provides an objective, first-hand look at behavior in a natural setting, whereas a self-report method such as a questionnaire relies on the subjects to be accurate and unbiased (Sommer & Sommer, 2002). In this situation, where the aim was to explore what actually happens in comparison with existing minimum standards, the observation method was a logical choice.

Methodological Background

Observation involves systematically watching and recording how people use their environments (Kumar, 2005; Zeisel, 1990). Unobtrusive observation is ideal for studying commonplace behavior in natural surroundings, generating useful data for design and other professionals concerned with the relationships between people and their physical settings (Sommer & Sommer, 2002; Zeisel, 1990).

Systematic, non-participant observation requires that the researcher not be involved in any observed activities and involves a coding system with prearranged categories (Kumar, 2005; Sommer & Sommer, 2002). Categories are limited to items and behavior that occur naturally in the setting and can be observed and recorded (Sommer & Sommer, 2002). Use of more than one observer or method can improve the reliability of this methodology (Sommer & Sommer, 2002).

Observing and recording behavior provides information about precisely how the physical setting is used by its occupants, but explanations about behavior require further research (Kumar, 2005; Sommer & Sommer, 2002).

Ethics

The research study was approved by the Institutional Review Board of the University of Florida and listed as exempt (Appendix A). This research conforms to the ethical principles and guidelines for the protection of human subjects as set forth in *The Belmont Report*, written by The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (Dept. of Health, Education, and Welfare, 1979). In addition, the researcher completed training in HIPAA for Researchers at the University of Florida.

Research Hypotheses

Hypotheses tested are as follows:

1. Actual carpet cleaning procedures are concurrent with documented hospital protocol.
2. Actual carpet cleaning procedures are concurrent with infection control guidelines and industry standards.
3. Documented hospital protocol is concurrent with infection control guidelines and industry standards.

Setting

The research setting was a hospital in-patient medical/surgical unit in a community medical center. The study took place in a corridor with access to the nursing station, patient rooms, utility closet, staff and public elevators, as well as a nursing “POD” in which healthcare providers document patient charts electronically (Figure 3.1). In addition, the corridor accessed a lounge and restroom area generally reserved for visitor use but temporarily serving as a staff-only break area during renovation of the permanent break room.

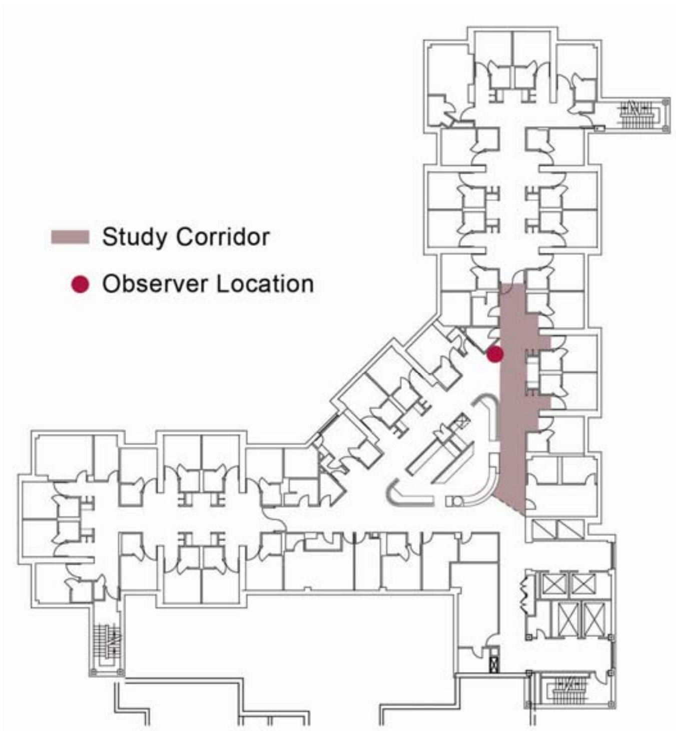


Figure 3.1: Study setting

The carpeting in the setting for this study is comprised of a primary fill and secondary border carpet tile, each tile measuring 19.69 inches square. The construction of both types consists of nylon fiber with a protective, stain-resistant coating and a non-permeable backing, incorporated with an anti-microbial agent. The primary carpet tile is a tufted textured loop, using 71% solution dye and 29% yarn dye. Two notable measurements that effect carpet performance are pile yarn weight and pile density. Pile yarn weight is a measurement of the amount of yarn in a given area of carpet face (Weinhold, 1988). Pile density is the weight of pile yarn in a unit volume of carpet and calculated based on pile yarn weight and pile height (Weinhold, 1988). Higher tuft density generally yields better performance (Weinhold, 1988). The tufted yarn weight for the primary carpet tile is 23 oz. per square yard and pile density is 7,886 oz. per cubic yard. The secondary carpet tile is tufted tip-sheared and the dye method is 100% solution dye. The tufted yarn weight for the secondary carpet tile is 24 oz. per square yard with a pile density of 6,545 oz. per cubic yard.

Observation Procedures

Observation was limited to the documentation of factors impacting carpeting in the corridor. Two observers utilized observation forms to record foot traffic, equipment carts, and housekeeping activities (Appendix B).

The documentation was anonymous, unidentified data with no information about schedules or names of employees, patients, or visitors. Observations were made in two-hour increments between the hours of 7:00am and 11:00pm, during which the vast majority of hospital activity occurs. Four observations of each 2-hour increment were randomized over a six-day period, using Research Randomizer (Social Psychology Network, 2005).

The number and locations of empty patient rooms were documented at each observation period using a diagram of the patient wing. Researchers used a field study observation form to record foot traffic and rolling cart incidences. A separate form was used to detail cleaning procedures and note chemicals and equipment used. The form included a diagram on which the specific locations of each cleaning activity, along with unplanned contamination incidents such as spills or debris, were described and documented. All observation forms utilized can be found in Appendix B.

One foot traffic count was considered to be any movement by a person within the defined corridor until the person reversed direction. A new instance was recorded once the person retraced his or her footstep(s). For each instance, the locations from and to which the user traveled were documented using a system of codes for each access point on the corridor.

Users were identified based on employee badge, or lack thereof, along with uniform, hospital gown, or other forms of dress. Any staff member coming in contact with patients was considered healthcare staff. Environmental services personnel were identifiable by distinct uniform and were considered housekeeping staff. Construction personnel, contractors (e.g., plumbers), and facilities staff not involved in housekeeping were identified as maintenance staff. The classification of visitor was reserved for family, friends, or clergy there solely to visit patients or the facility as non-employees. Volunteers and employees of the hospital who did not fall into the previously mentioned categories, or who were not identifiable as such, were classified as staff.

Equipment carts, transport vehicles, supply carts, treatment carts, and so on were documented in conjunction with the foot traffic count of the person pushing or pulling the cart. Specific codes as well as more detailed notes were recorded on the observation form, and researchers attempted to photograph each type of equipment or cart. Any additional contact with the corridor flooring was noted, such as bags or equipment being dragged across the carpet surface.

Analysis

This study identified factors contributing to the contamination and wear of carpet tile in an acute care patient wing corridor (Figure 3.2). Human impact on carpeting and response to said impact are reported in terms of type and frequency as well as patterns.

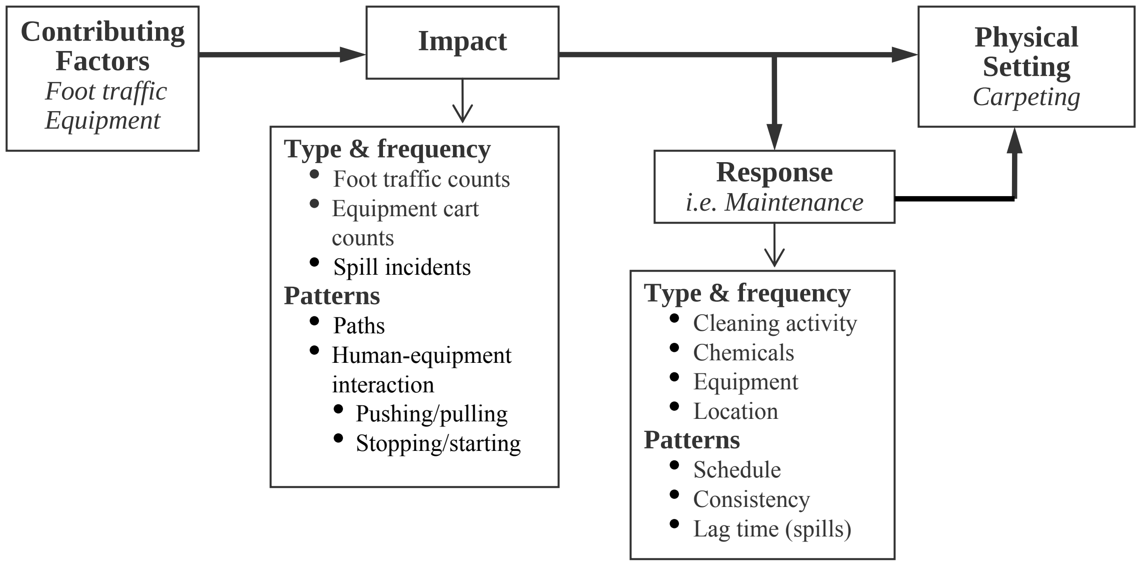


Figure 3.2: Factors contributing to the condition of flooring finish material

Type and frequency of impact were measured by foot traffic and equipment cart counts as well as contamination incidents. Data was examined for differences between days of the week and times of the day to provide further information about traffic frequencies. Patterns of impact were measured by path taken and by human-equipment interaction. Type and frequency of response to impact on carpeting were measured by observations of cleaning activities, chemicals and cleaning equipment used, and location of activity. Response patterns were measured by schedule, consistency, and lag time between contamination incidences and subsequent treatment. Differences were identified between 1) actual carpet cleaning procedures; 2) documented hospital protocol; and 3) infection control guidelines and industry standards.

In order to analyze the effect of day of the week and time of the day on human foot traffic and equipment counts, a two-way Analysis of Variance (ANOVA) was performed using an additive model at level alpha=0.05. The independent variables in both cases were time blocks (time) and days of a week (day). The response variables were (Y)= foot traffic count and (Y)= equipment cart count. Since the response variables were count data, a square root transformation was required in order to ensure a normal distribution for the data. Thus the actual response variables were $\sqrt{}$(foot traffic count) and $\sqrt{}$(equipment). Bonferroni's multiple comparison test was used to identify specific differences between means for each time block. Foot traffic data was re-tested due to an unusually high traffic count during a time block in which an emergency code occurred on the unit. The same tests were performed removing that particular time block from the data set. Pearson correlation was used to test for a relationship between foot traffic and equipment cart counts, again utilizing a square root transformation to ensure normal distribution for count data. Output from statistical analyses can be found in Appendix C. All other statistical data reported is entirely descriptive in order to assist in interpretation.

CHAPTER 4
FINDINGS

The intent of this study was to examine factors specifically impacting carpeting in a defined portion of a hospital corridor. Foot traffic, equipment carts, and carpet cleaning procedures were observed and analyzed. The type, frequency, and patterns of impact on the corridor carpeting are reported here.

Foot Traffic

Type and Frequency

Based on mean traffic counts for each time block, average daily foot traffic between the hours of 7:00am and 11:00pm (16 hours) was approximately 2,900. Table 4.1 shows total traffic counts for each time block observed (n=31). Blank cells indicate an increment of time that was not observed, as determined by a randomization of the 31 time blocks to be studied.

Table 4.1: Total traffic counts observed, by day and time block

	1: 7-9am	**2:** 9-11am	**3:** 11-1pm	**4:** 1-3pm	**5:** 3-5pm	**6:** 5-7pm	**7:** 7-9pm	**8:** 9-11pm
1 Sun					256	218	272	187
2 Mon	559	354		383	399	307	383	
3 Tues	440		518	320	410		298	236
4 Wed	348	409	351	430		370		
5 Thurs	720	353	499		354			318
6 Fri		347	384			325	223	288

Testing for effect of day and time together on traffic counts, there was strong evidence that the means for the 31 time blocks were significantly different (F=4.08, $p<0.05$). Further, day of the week alone did not have a significant effect on number of foot traffic incidents. Time of day, however, did significantly impact traffic counts (F=3.17, $p<0.05$). Bonferroni's multiple comparison test showed a significant difference between the means of the first (7-9am) and eighth (9-11pm) time blocks ($p<0.05$). The data was tested again to see if a patient coding during one of the 7-9am time blocks influenced the results. Testing for effect of time of day on foot traffic counts without data from the aforementioned time block revealed a significant difference between mean foot traffic counts (F=3.87, $p<0.05$). Bonferroni's multiple comparison test did not reveal a significant difference at alpha level 0.05 between any 2 particular time blocks.

Hospital census data tracks the number of patients in beds on the unit, which fluctuates throughout the day. In this case, the number of empty beds was considered a co-variate in testing for possible effect on foot traffic. The number of empty beds on the unit, taken from official hospital census data, had a significant effect on foot traffic in the study corridor (F=8.37, $p<0.05$).

Users fell into one of eight user groups: 1) healthcare staff, 2) housekeeping staff, 3) maintenance staff, 4) food service staff, 5) other staff, 6) visitors, 7) patients, or 8) dogs (present as part of the hospital's Animal-Assisted Therapy program). The categories of specific users are shown in Figure 4.1, expressed as percentages of total foot traffic observed (n=11,249).

- Healthcare staff represented close to 80% of all foot traffic in the defined corridor area (Figure 4.1).
- Visitors were the second highest represented user group, making up 8% of all foot traffic observed.
- Housekeeping staff comprised 6.4% of all foot traffic observed.
- The remaining user groups (maintenance staff, food service staff, other staff, patients, and dogs) each made up less than 3% of all foot traffic observed.

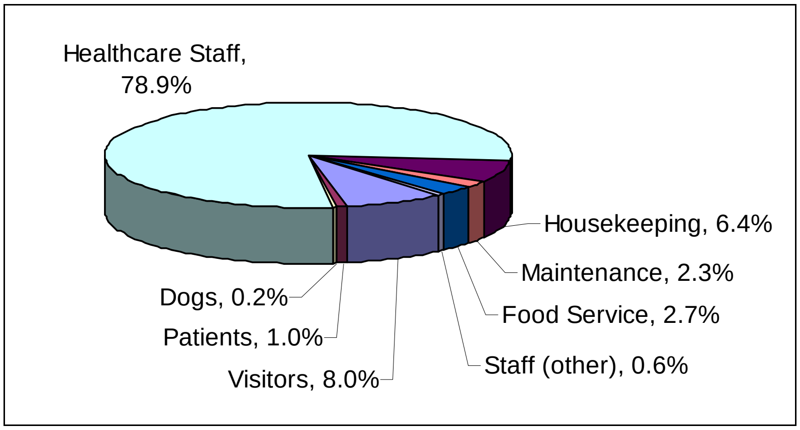
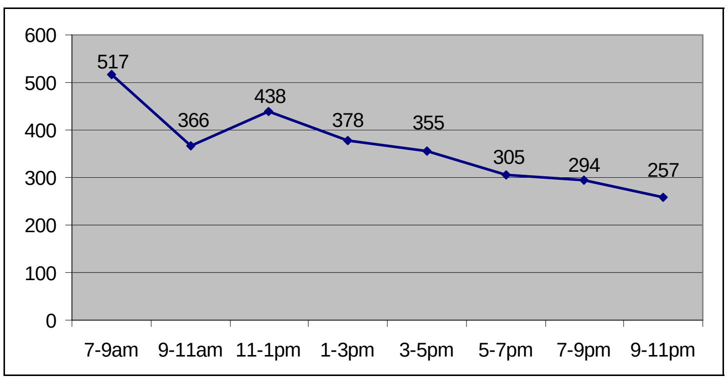


Figure 4.1: Types of users, as percentages of total foot traffic observed

Figure 4.2 shows average foot traffic counts for each time block both with and without data from the time block during which an emergency code occurred. Both timelines show a slightly decreasing trend.



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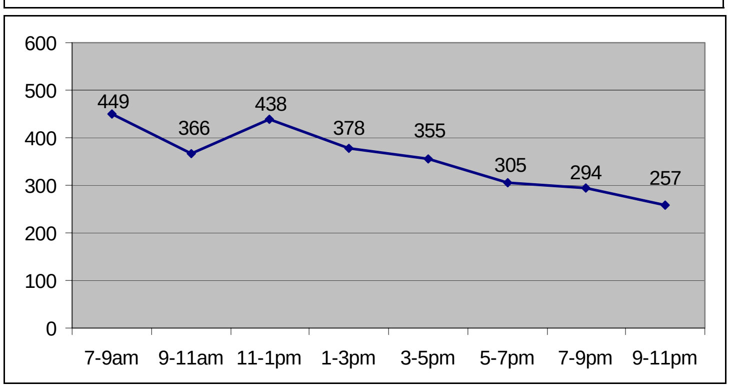


B

Figure 4.2: Average foot traffic timeline, by time block. Part A shows a regression line all time blocks observed; part B shows means taken without data from the time block during which an emergency code occurred

Figure 4.3 shows foot traffic timelines for each user group, based on the mean traffic counts observed for each time block. Healthcare staff averages remained more consistent than those of the other user group categories. Visitor traffic peaked during the 1-3pm and 5-7pm time blocks. Patient and food service traffic both varied considerably throughout the day. Maintenance staff and housekeeping staff traffic both dropped drastically after the 1-3pm and 3-5pm time blocks, respectively.

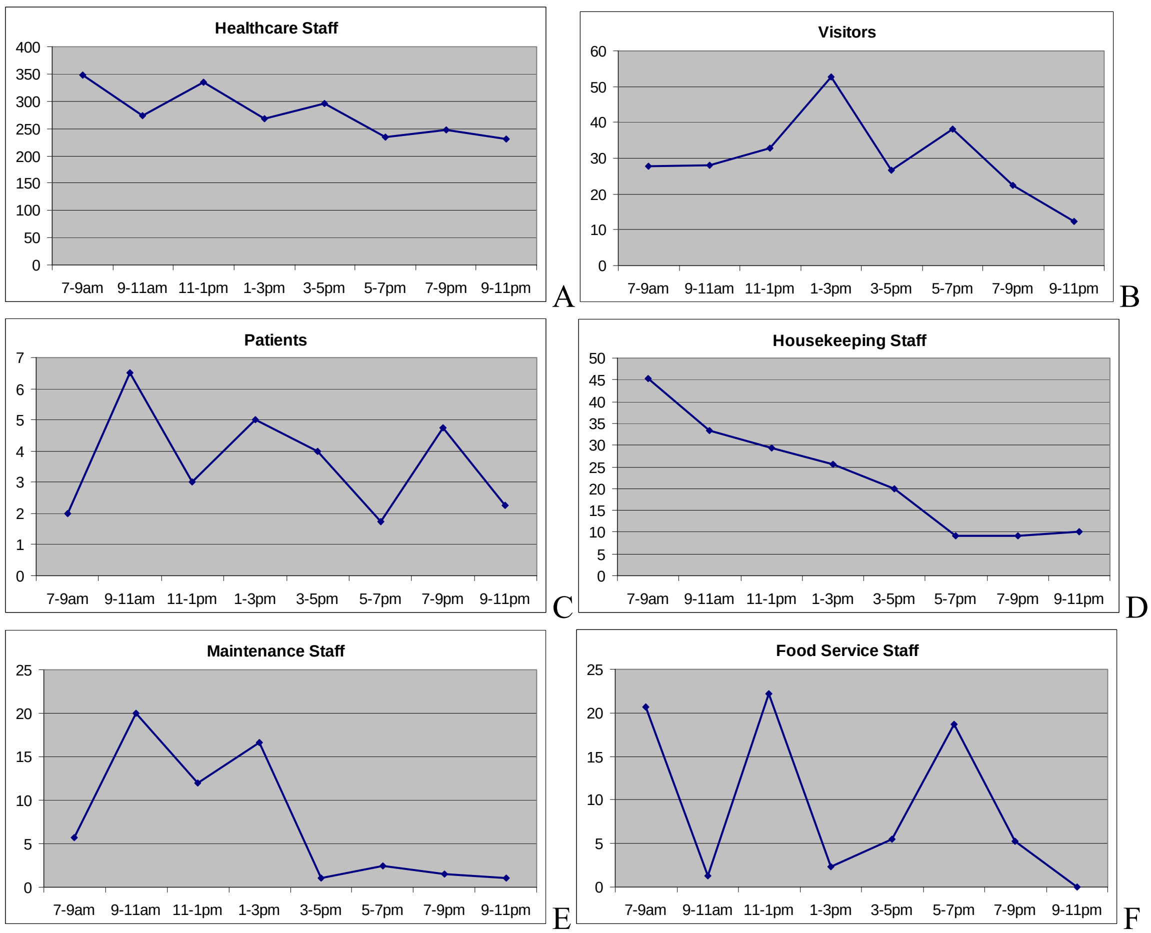


Figure 4.3: Average foot traffic timelines for each user group. A) healthcare staff, B) visitors, C) patients, D) housekeeping staff, E) maintenance staff, and F) food service staff

Patterns

Traffic patterns were observed and recorded in the form of actual paths walked by the various user groups on the study corridor. Fourteen unique locations were identified in the defined corridor area as entry/destination points (Figure 4.4). An additional category was assigned for any location not specifically defined within the corridor, yielding over 100 possible paths.

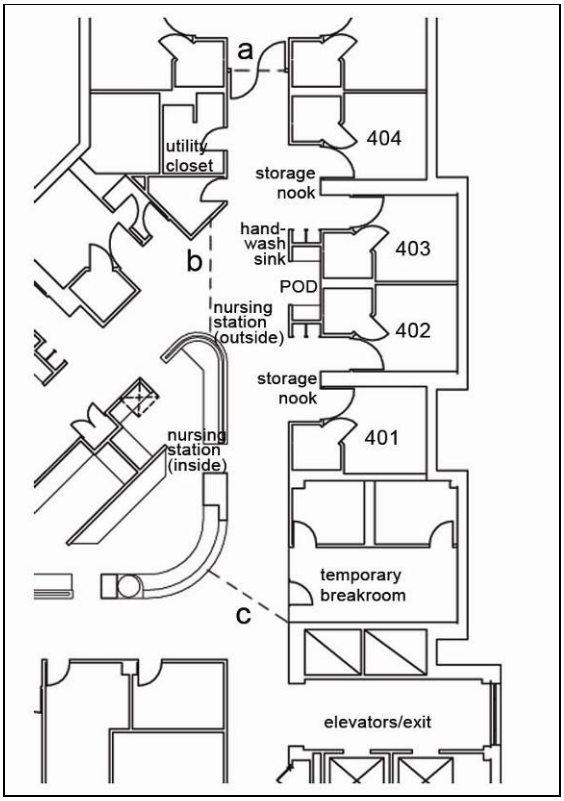


Figure 4.4: Entry/destination locations in the defined corridor area

Of the over 100 possible paths through the corridor area, the 6 most frequently taken are shown in Figure 4.5, expressed as the percentage of total foot traffic observed (n=11,249) who took one of the 6 particular paths.

- Approximately 1 out of every 6 people who traveled through the study corridor walked from point A to point B or from point B to point A. Nearly as many traveled between points A and C.
- The path between point C and the breakroom space was taken by 6.6% of all foot traffic observed.
- The path between point A and the nursing station entrance received 4.4% of all foot traffic observed.
- Paths between the nursing POD and point A and between the nursing POD and point B each received close to 4% of all foot traffic observed.

- The remainder of foot traffic followed various other paths through the corridor, each path receiving less than 3% of all traffic observed.

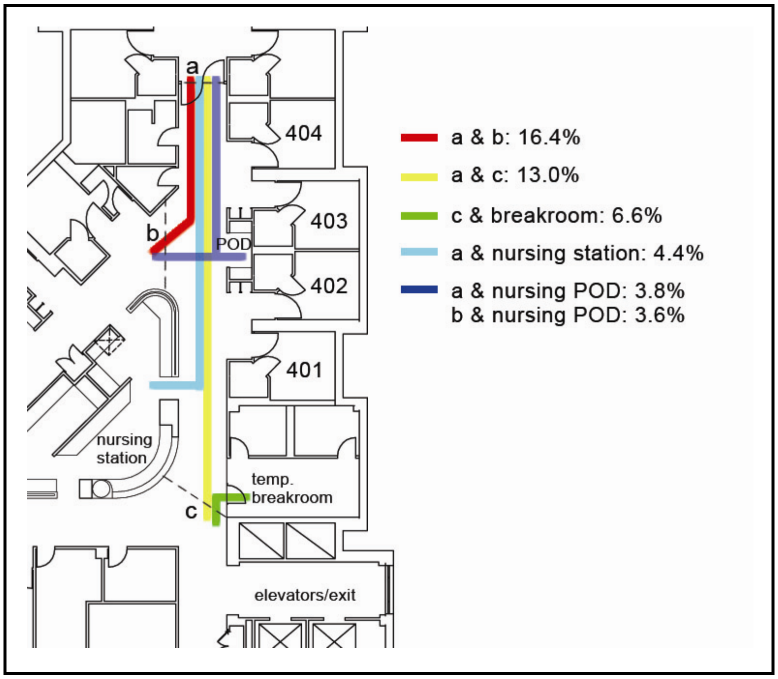


Figure 4.5: Most frequently taken foot traffic paths, as percentages of total foot traffic observed

Thirty-two percent of all traffic observed during the study can be considered through-traffic, passing through the corridor without coming from or going to a room or space located on the corridor in the defined area for the research study. Locations on the corridor accounted for the remainder of foot traffic incidences. While Figure 4.5 showed particular paths taken within the corridor, Figure 4.6 highlights destination/entry points on the study corridor and shows the percentages of total foot traffic observed that traveled to or from these locations.

- Almost half (47%) of all foot traffic instances observed passed through point A.
- Points B and C were each involved in nearly 30% of all foot traffic.
- Approximately 1 out of every 4 people traveling through the study corridor walked from or to the nursing station or the area just outside of it.
- Close to 1 in 5 people traveled from or to the nursing POD.

- 17% of all foot traffic observed visited the 4 patient rooms directly adjacent to the defined study corridor area.

- The room serving as staff breakroom accounted for just over 10% of all foot traffic observed.

- The utility closet and the handwashing sink accounted for 6% and 3% of foot traffic, respectively.

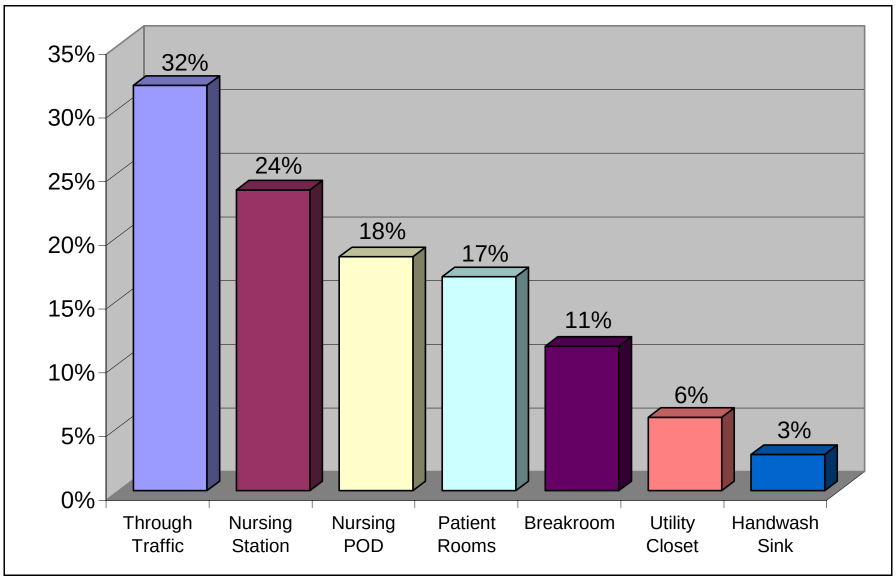


Figure 4.6: Locations on study corridor commonly receiving foot traffic, as percentages of total foot traffic observed

Figure 4.7 details destination/entry locations frequented by specific user group categories.

- Thirty percent of healthcare staff traffic was through-traffic. The remaining two-thirds of healthcare staff mainly frequented the areas in and around the nursing station, the nursing POD, and patient rooms. The room serving as a temporary staff breakroom received 12% of healthcare staff traffic.

- Visitors, of whom nearly 60% were through-traffic, also frequented patient rooms and the nursing station area.

- The utility closet and handwashing sink areas received no traffic from visitors or patients.

- Patients primarily passed through the defined study corridor area as through-traffic.

- Fourteen percent of housekeeping staff traffic was through-traffic. Half of the traffic from housekeeping staff was concentrated around the utility closet area and almost 20% was in and around patient rooms.

- Forty-two percent of maintenance workers were through-traffic. The remaining third of maintenance staff traffic was relatively evenly divided among locations on the corridor, the breakroom receiving slightly more traffic from maintenance staff than other locations.

- One quarter of food service staff traffic was through-traffic, while over half traveled to and from patient rooms.

- Dogs visiting as part of the hospital's Animal-Assisted Therapy program traveled largely to and from patient rooms. Approximately one third of dog traffic was through-traffic. Dogs also visited the nursing station area, but none were observed traveling to or from any other location in the study corridor area.

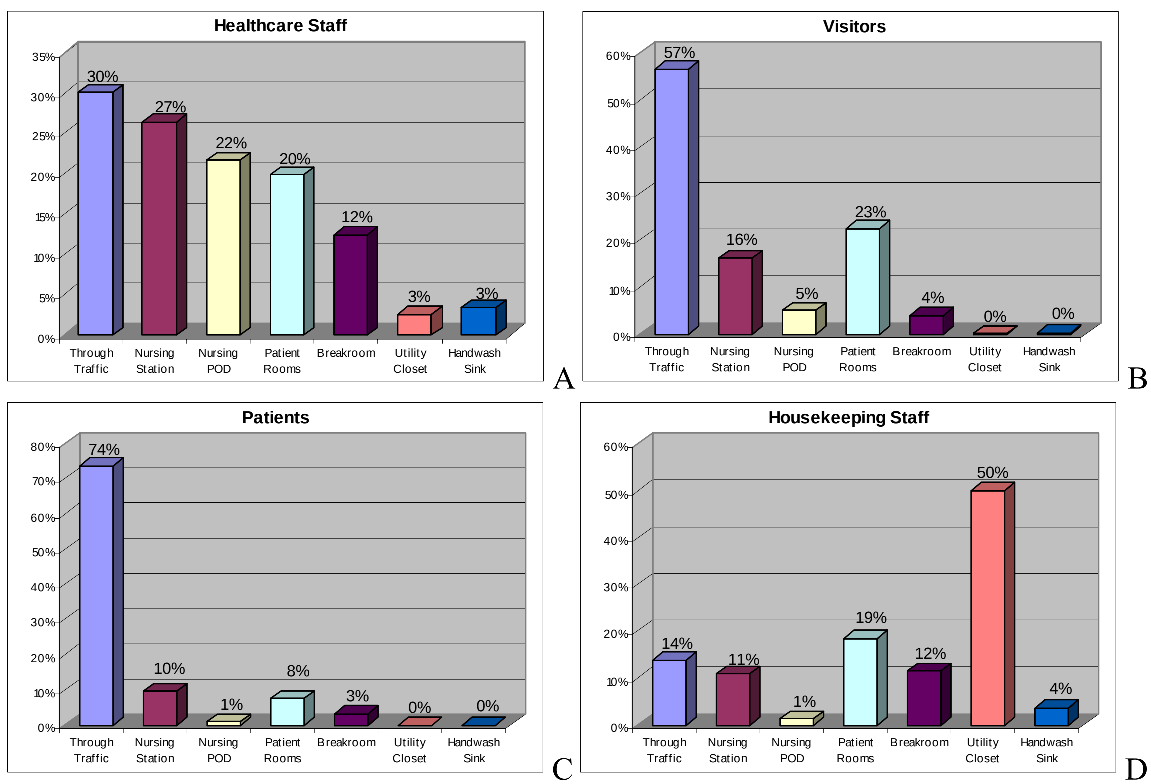


Figure 4.7: By user group category, locations on study corridor commonly receiving foot traffic, as percentages of total foot traffic observed. A) healthcare staff, B) visitors, C) patients, D) housekeeping staff, E) maintenance staff, F) food service staff, G) staff (other), and H) dogs

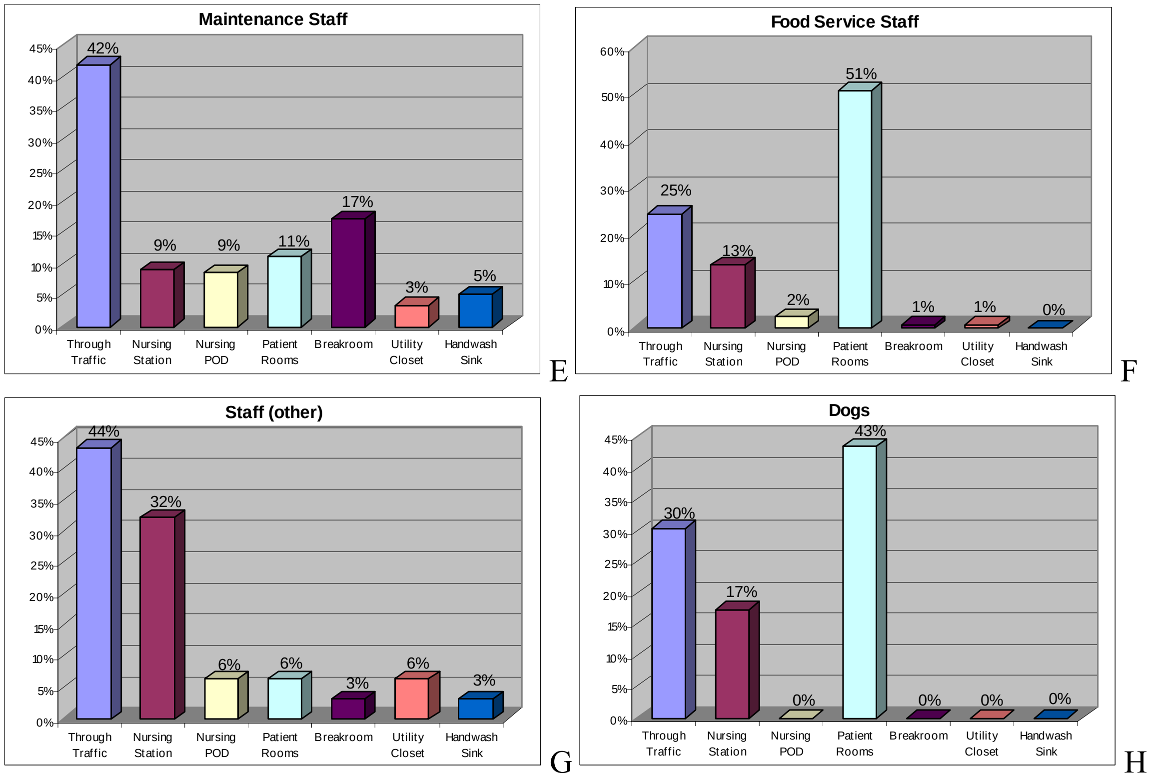


Figure 4.7. Continued.

Equipment Carts

Type and Frequency

Based on mean equipment counts for each time block, the average daily equipment cart/item count between the hours of 7:00am and 11:00pm was approximately 240. Table 4.2 shows total equipment cart counts for each time block observed (n=31). Blank cells indicate an increment of time that was not observed, as determined by a randomization of 31 time blocks to be studied.

Table 4.2: Total equipment cart counts observed, by day and time block

	1: 7-9am	**2:** 9-11am	**3:** 11-1pm	**4:** 1-3pm	**5:** 3-5pm	**6:** 5-7pm	**7:** 7-9pm	**8:** 9-11pm
1 Sun					31	18	23	15
2 Mon	36	21		36	38	32	24	
3 Tues	41		33	22	39		18	14
4 Wed	34	39	37	54		21		
5 Thurs	24	40	45		19			24
6 Fri		18	44			31	23	36

There was no significant difference between mean equipment counts for the 31 time blocks. Further, day of the week alone did not have a significant effect on number of foot traffic incidents. Time of day alone also did not significantly impact traffic counts.

A wide range of types of equipment carts were observed. Figure 4.9 shows types of equipment carts, expressed as percentages of total carts/items observed (n=928). Supply/utility carts, treatment carts, non-wheeled items, and the "other" category all include multiple varieties of carts or items, grouped together for ease of identification and description. Non-wheeled items observed included plastic and linen bags, chairs, and oxygen tanks. The "other" category consisted of equipment that contributed to less than 1% of all foot traffic observed and included patient tray tables, rolling bags/purses, trash cans, rolling walkers, patient beds, scales, and computer carts. The most commonly observed equipment included IV poles, supply/utility carts, housekeeping carts, gurneys (with and without patients), and food service carts. Photographs of commonly observed equipment carts can be found in Appendix D.

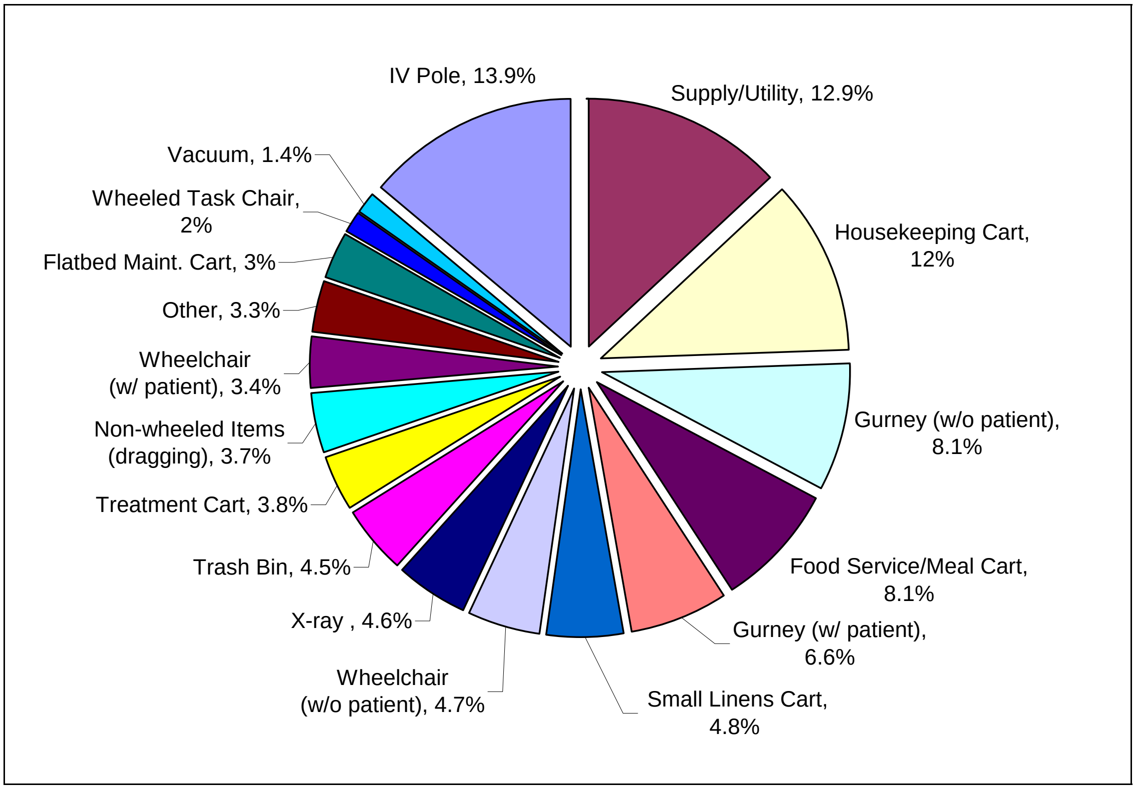
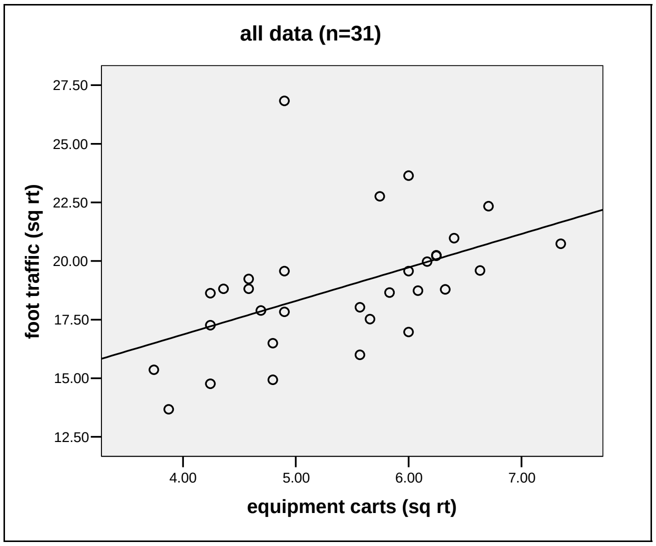


Figure 4.8: Types of equipment carts, as percentages of total carts/items observed

In the case of equipment carts/items, the number of empty beds on the unit did not significantly affect the number of equipment carts traveling through the defined area of the study corridor.

However, testing did show a significant correlation between foot traffic counts and equipment cart counts, both with ($r=0.49$, $p<0.05$) and without ($r=0.65$, $p<0.05$) data from the time block during which the emergency code occurred. Figure 4.9 shows regression lines for the data including all time blocks ($n=31$) and for the data with the time block including the emergency code removed ($n=30$). A stronger correlation exists between between foot traffic and equipment cart counts when the time block during which the emergency code occurred is removed from the data set.



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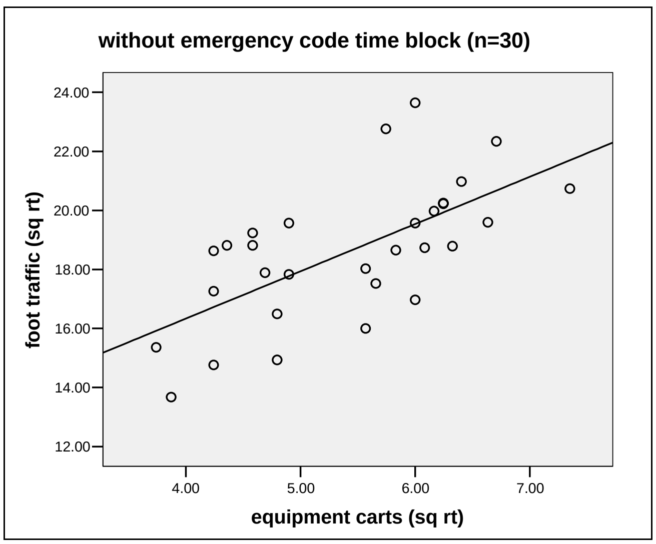

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Figure 4.9: Correlation between foot traffic and equipment cart counts. Part A shows a regression line for all time blocks observed (n=31); part B shows a regression line for all time blocks except the time block during which an emergency code occurred (n=30)

Patterns

Observations of actual paths taken by equipment carts and items on the study corridor were documented.

Of the more than 100 possible paths, the 5 most frequently taken paths through the corridor are shown in Figure 4.10, expressed as percentage of total equipment carts observed (n=928).

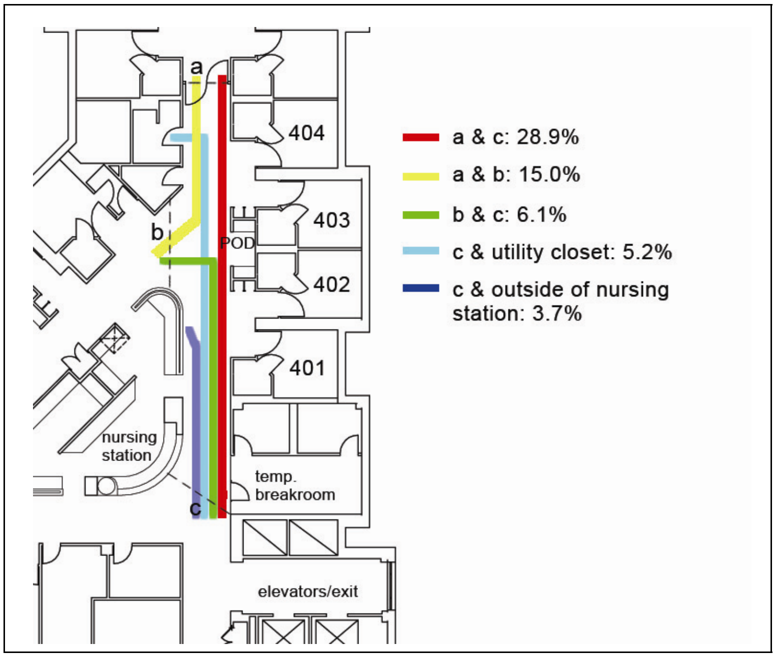


Figure 4.10: Most frequently taken paths by equipment, as percentages of total equipment carts/items observed

- Approximately 1 in 3 equipment carts moving through the study corridor traveled from point A to point C or from point C to point A.
- Fifteen percent of all equipment carts observed traveled between points A and B.
- The path between points B and C was taken by just over 6% of all equipment carts/items observed.
- The path between point C and the utility closet received approximately 5% of all equipment carts/items observed.
- The path between point C and the outside of the nursing station received close to 4% of all equipment carts/items observed.
- The remainder of equipment cart traffic followed various other paths through the corridor, each path receiving less than 3% of all traffic observed.

Fifty percent of all equipment carts/items observed during the study were through-traffic, passing through the corridor without coming from or going to a room or space located on the corridor. Locations on the corridor accounted for the remaining half of equipment observed. Figure 4.11 highlights destination/entry points on the study corridor and shows the percentages of total equipment cart traffic observed traveling to or from these locations.

- Approximately 1 out of every 4 equipment carts moving through the study corridor traveled to or from a patient room.
- 12% of all carts observed traveled from or to the utility closet.
- 10% of all carts observed visited the area in and around the nursing station.
- The nursing POD, breakroom, and handwashing sink each accounted for less than 2% of all equipment carts/items observed.

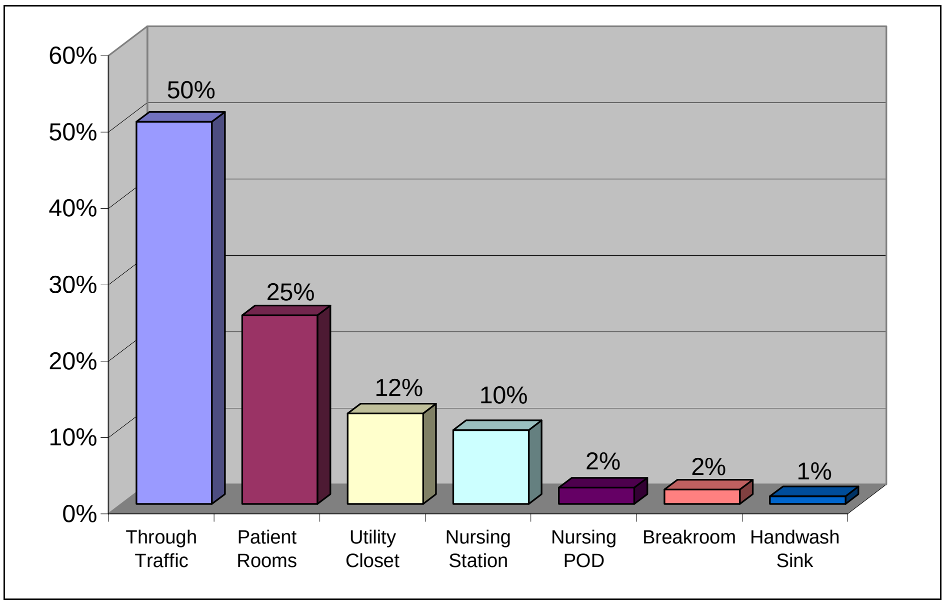


Figure 4.11: Locations on study corridor commonly receiving equipment cart traffic, as percentages of total equipment carts/items observed

Figure 4.12 details the destination/entry points frequented by specific equipment carts/items.

- Three out of every 4 IV poles were through-traffic. Of the remainder, most traveled to or from patient rooms.
- Over half of all supply/utility carts observed were through traffic, one fourth traveling to or from the nursing station area.
- One quarter of all housekeeping cart traffic was through-traffic. The remaining 75% was concentrated mainly around the utility closet and patient room areas, with some activity in and around the nursing station.

- Half of the linen carts observed were through-traffic, and much of the remainder moved to or from patient rooms.

- Only 1 of every 10 food service carts was through-traffic, while half traveled to and from patient rooms.

- Close to two-thirds of all treatment carts observed were through-traffic, with patient rooms receiving most of the remainder of treatment cart activity.

- Gurneys, both with and without patients, showed similar trends with regard to destination/entry points.

- All observed wheelchairs with patients were through-traffic.

- Of wheelchairs without patients, only half were through-traffic. The nursing station, nursing POD, and patient room areas received the remaining traffic.

- Trash bins traveled almost exclusively to and from the utility closet. Just 6% passed through the corridor area as through-traffic.

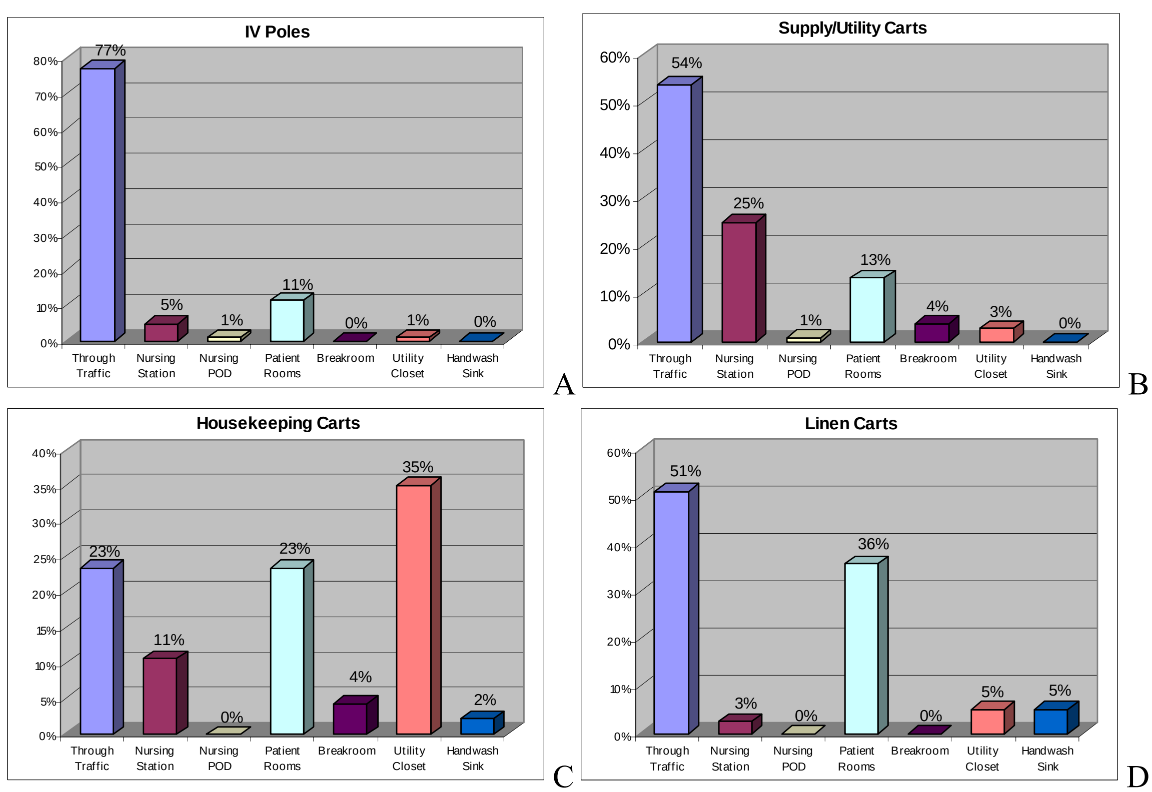


Figure 4.12: By category of equipment, locations on study corridor commonly receiving equipment cart/item traffic, as percentages of total carts/items observed. A) IV poles, B) supply/utility Carts, C) housekeeping carts, D) linen carts, E) food service carts, F) treatment carts, G) gurney (with patient), H) gurney (without patient), I) wheelchair (with patient), J) wheelchair (without patient), and K) trash bins

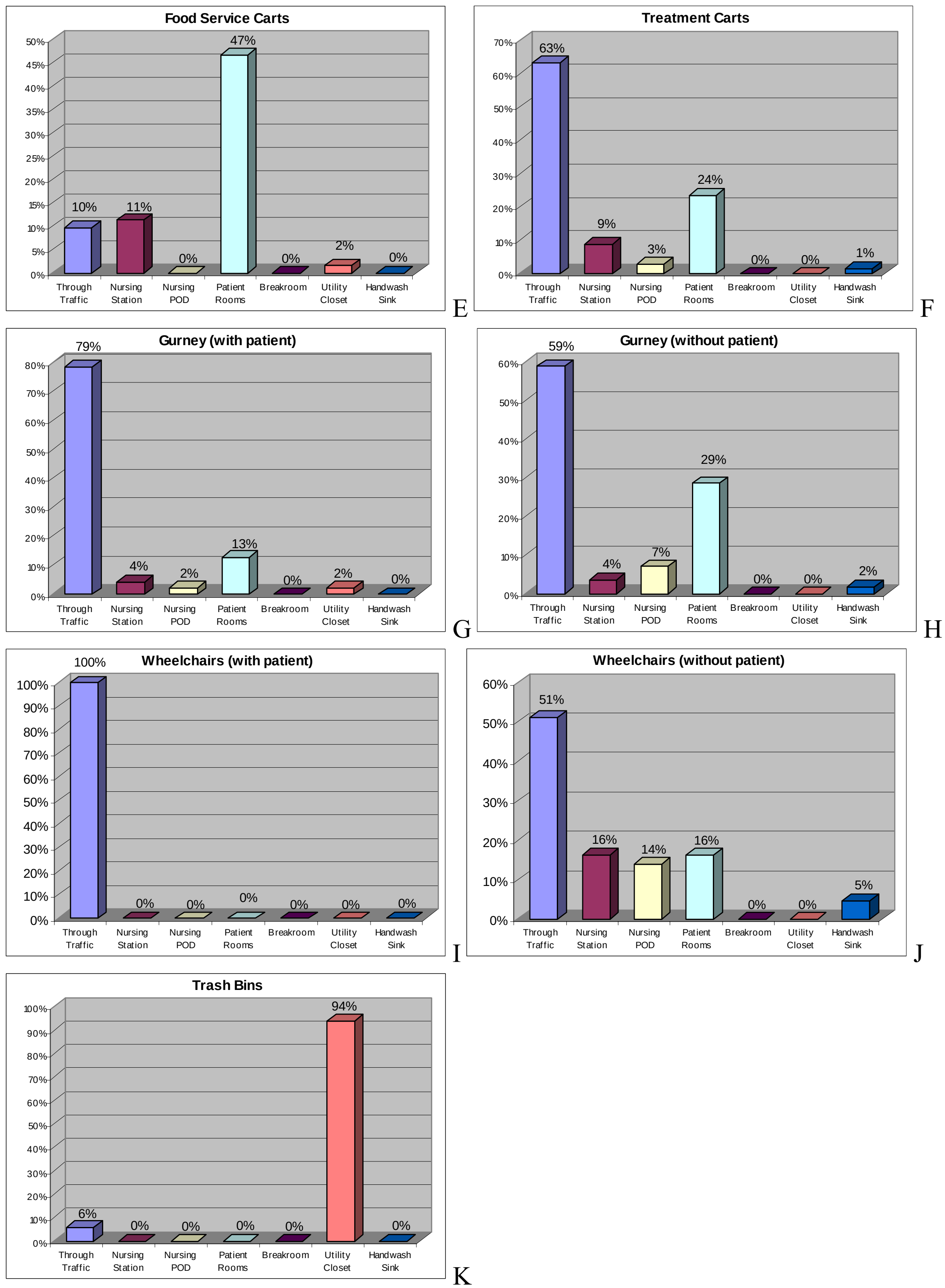


Figure 4.12. Continued.

Figure 4.13 illustrates the human-equipment interaction patterns of pushing, pulling, or a combination of both. The vast majority of equipment carts observed was largely pushed. Trash bins were an exception, with 9 out 10 being pulled, not pushed. Wheelchairs with or without patients and linen carts were pushed exclusively. Users combined pushing and pulling gurneys with patients and housekeeping carts 8% and 5% of the time, respectively.

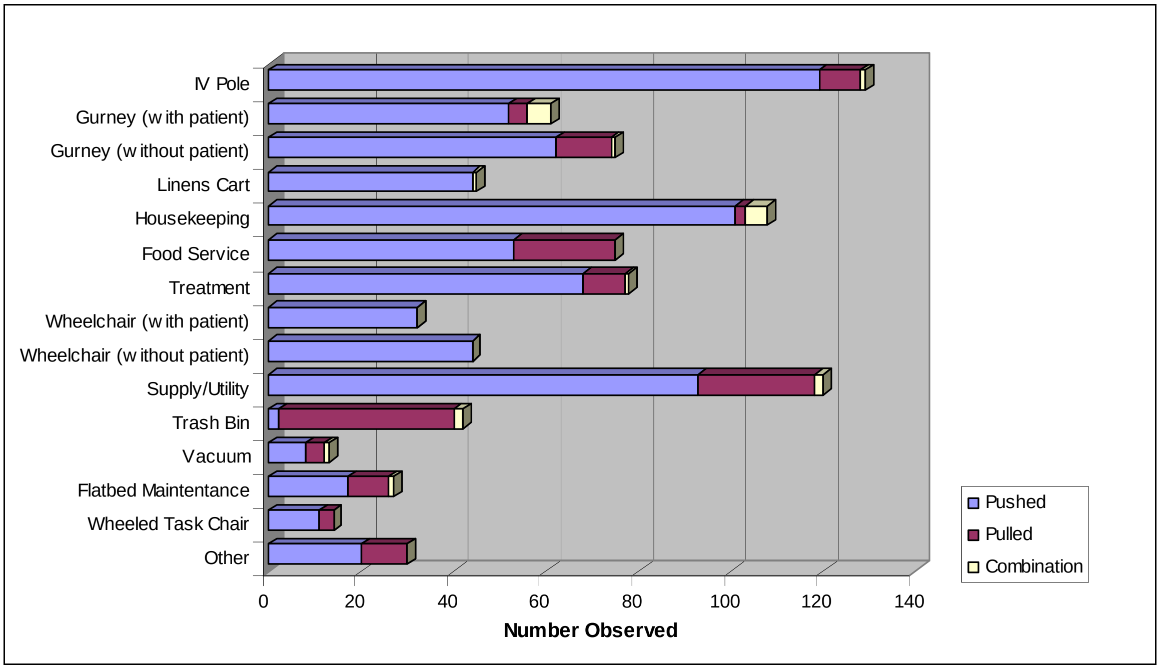


Figure 4.13: Human-equipment interaction patterns observed for each equipment category

Carpet Cleaning Procedures

Type and Frequency

The only carpet cleaning activity observed not directly in response to a contamination incident was vacuuming. Vacuuming of the defined corridor area was observed 3 times during the observation periods (n=31). Table 4.3 shows the occurrences of vacuuming observed. Blank cells indicate an increment of time that was not observed, as determined by a randomization of 31 time blocks to be studied.

Table 4.3: Number of times vacuuming was observed, by day and time block

	1: 7-9am	**2:** 9-11am	**3:** 11-1pm	**4:** 1-3pm	**5:** 3-5pm	**6:** 5-7pm	**7:** 7-9pm	**8:** 9-11pm
1 Sun					0	0	0	0
2 Mon	1	0		0	0	0	0	
3 Tues	0		0	0	0		0	0
4 Wed	0	1	0	0		0		
5 Thurs	0	0	0		1			0
6 Fri		0	0			0	0	0

In each case, the vacuuming performed is considered overall vacuuming, not confined to a particular location within the corridor area. Vacuuming movements were not necessarily performed in a consistent, methodical pattern, with some portions of the carpeting receiving more thorough cleaning than others. However, vacuuming did cover the entire area of the defined corridor.

The vacuum equipment used was an upright vacuum with a top loading soil bag and a separate motor for brushing. Details about the specific vacuum equipment used can be found in Appendix E. No chemicals were used in the cleaning process.

Patterns

Vacuuming did not occur at a consistent time. Vacuuming was observed on three separate days at approximately 8:30am, 9:20am, and 3:00pm, respectively.

Contamination Incidents

Three contamination incidents were observed during the study. Table 4.4 details each incident and response by hospital staff. Material Safety Data Sheets (MSDS) for the specific chemicals used can be found in Appendix F.

Table 4.4: Contamination incidents and responses

Type of Contamination	Time of Incident	Response Time	Chemicals Used	Procedure Followed
Coffee spill	7:10am	Immediate	QuickSpot (<1% hydrogen peroxide)	Blotted spill dry with cloth, sprayed area with QuickSpot, let stand for approx. 15 minutes, blotted. Followed up 2 hours later with vacuum
Swept dust from patient room into corridor	10:00am	Immediate	None	Swept carpet with small brush and dustpan
Dust from construction work	2:00pm	Approx. 18 hours	None	Used masking tape to remove dust from carpet surface (performed by maintenance staff)

Comparison of Cleaning Procedures

Table 4.5 presents findings regarding 1) infection control guidelines and industry standard cleaning methods, 2) documented hospital protocol, and 3) actual carpet cleaning procedures. Documentation regarding hospital protocol can be found in Appendices E-I. Refer to Chapter 2, p. 13-16 for information regarding infection control guidelines and industry standards.

Table 4.5: Comparison of recommended and observed carpet cleaning procedures

	Infection Control Recommendations/ Industry Standards	Hospital Protocol	Actual Carpet Cleaning Procedures
Preventive Maintenance	• Walk-off mats at entrances and major interior traffic areas.	• Walk-off mats at entrances. • Contracted service for entrance mats. • No written documentation available.	• Walk-off mats observed at entrance to hospital. • No walk-off mats observed at elevator entrance to unit or elsewhere on corridor.
Vacuuming	• Traffic areas: 1-2 times daily. • Overall: 7 times weekly. • Upright vacuum sweeper with top loading soil bags and separate motors for suction and brushing.	• Daily in the elevator area, in the hall and behind doors. • Daily final overall vacuum. • Included as part of the daily cleaning schedule (Appendix I). • Upright vacuum sweeper with top loading soil bags and separate motors for suction and brushing.	• Observed on 3 occasions. • Regular schedule not observed.

Table 4.5. Continued.

Spot & Spill Removal	• Daily or when spots are noticed. • Blot or scrape spills off of carpet. • If water alone does not remove spot, solutions can be made by diluting mild detergent, ammonia, or vinegar in water (dependent on spill type). • Dry cleaning solvent can be used (apply standard rubbing alcohol to clean cloth and blot). • Flush out spotting solutions with clean water after spot has been treated.	• Once weekly or bi-weekly checks for spots and spills, dependent on staffing. • Carpet spot-remover listed with chemicals to be kept on housekeeping carts: QuickSpot, containing less than 1% hydrogen peroxide (refer to Hospital Environmental Services Policy Number 11, Appendix G). • Label instructions are to spray carpet until wet, allow to sit 5-10 minutes, scrub or blot soil away, vacuum when dry. • No other written documentation available.	• 3 contamination incidents observed. • Response times ranged from immediate to 18 hours. • Proper application of cleaning solution.
Interim Cleaning	• 12-52 times yearly. • Dry extraction or dry foam method (use low moisture applicator to brush dry extraction compound into carpet fibers).	• As needed between deep cleanings. • Host dry extraction carpet cleaning system. • Label instructions are to apply dry powder to carpeting, brush through fibers with Dry-Clean Machine, vacuum. • No written documentation available.	• None observed.
Restorative Cleaning	• 6-24 times yearly. • Hot water extraction. • Detergent pre-spray agitated with low moisture applicator. • Warm water (not exceeding 120ºF). • Allow to dry thoroughly and vacuum before use.	• Twice Yearly (spring and fall). • Hot water extraction. • Twice yearly in carpeted corridors, generally in spring and fall seasons. • Hospital Environmental Services Policy Number 27 (Appendix H).	• None observed. • Must make arrangements with individual units rather than follow an established written timetable.
Carpet Tile Replacement	• As needed. • Replace severely damaged or stained tiles with shelf stock.	• No written documentation available.	• None observed. • Environmental Services intends to replace damaged or spilled-on tiles immediately, clean back-of-house, and re-use cleaned tiles if possible.

This research tested the following hypotheses:

1. Actual carpet cleaning procedures are concurrent with documented hospital protocol.

2. Actual carpet cleaning procedures are concurrent with infection control guidelines and industry standards.

3. Documented hospital protocol is concurrent with infection control guidelines and industry standards.

Evidence from observation data did not unequivocally support or reject the stated hypotheses. Observation and documentation of vacuuming procedures for the most part support all 3 hypotheses, but information about other types of carpet cleaning procedures does not directly prove or disprove the hypotheses.

CHAPTER 5
DISCUSSION

The well-being of hospital patients, visitors, and staff may be influenced by the quality of the environment within the hospital building, including interior materials. Discussions and recommendations regarding proper selection and maintenance of flooring materials—and carpeting in particular—commonly mention traffic and wear factors. These issues are assumed to exist and to have some degree of impact on carpeting, but little has been studied about the actual type, frequency, and patterns of traffic, wear and the role of maintenance on carpeting.

The purpose of this research was to identify particular wear factors impacting carpeting in an acute care patient corridor. Further, patterns of wear as well as regular and incidental maintenance were explored. This study specifically sought to answer the questions: 1) what specific users and equipment contribute to traffic flow in a patient corridor; and 2) what are the consistency, frequency, and methods of regular cleaning of carpet tile in an acute care patient corridor?

Foot Traffic

Each foot traffic incidence or count does not necessarily mean a different person; once a person changed direction or retraced steps, a new incidence was counted. Therefore, foot traffic numbers should be considered as paths or incidences rather than individuals.

Type and Frequency

Observations showed that the average traffic count was approximately 2,900 during the peak hours of 7:00am to 11:00pm. Thus, daily traffic counts for a 24-hour period number well above this average for peak hours. In other words, over 2,900 paths are walked daily across the defined area studied within this carpeted hospital corridor. This greatly exceeds the minimum number of daily foot traffics for the “very heavy” traffic soil rating in the IICRC’s Commercial Carpet Cleaning Frequency Chart of 2,500 traffic incidences or more (refer to Table 2.1, p. 15). This chart is typically the basis for carpet manufacturer recommendations. It suggests, based on numeric foot traffic counts, specific minimum frequencies for various levels of crucial carpet cleaning practices. The average daily foot traffic count from this study establishes definitively that the traffic soil rating for this corridor is “very heavy.”

Statistical testing showed that day of the week had no significant effect on traffic counts. Mean traffic counts were virtually the same whether observed on a weekend or weekday and whether it was early or late in the week.

Foot traffic counts did significantly differ depending on the time of day, specifically between the first time block (7-9am) and the last time block (9-11pm). This could potentially be explained by a particularly high traffic count during one of the 7-9am time blocks due to a patient coding on the unit. The code brought an influx of healthcare staff through the study corridor in response to the emergency.

However, quantities of foot traffic differed throughout the day regardless of extenuating circumstances. When the time block during which a patient coded was removed from the data set, testing still showed a significant difference between mean traffic counts depending on time of day. The 7-9am time block sees a change in shift for nursing and other healthcare staff as well as the beginning of the workday for housekeeping staff. Meals were served typically during the 7-9am, 11am-1pm, and 5-7pm time blocks, signaling a rise in food service staff traffic. Visitor traffic mainly occurred between the hours of 1pm and 7pm. The 9-11pm interval occurs after the evening shift change for healthcare staff and the typical workday for most other hospital staff members. Additionally, normal meals were not typically served after this time and visitor traffic generally decreased as well, so most foot traffic dropped off noticeably before the beginning of this time block. Thus, many factors contributed to the variation in mean traffic counts between time blocks.

The vast majority of foot traffic through the study corridor was healthcare staff. Four out of five instances of foot traffic occurring on this particular corridor involved healthcare staff. Aside from rare occurrences of foot traffic by dogs and unidentifiable or miscellaneous staff members, patients represented the lowest number of foot traffic instances at just 1% of all traffic. While visitors contributed to 8% of the traffic in this corridor, employees of the hospital still comprised over 90% of all foot traffic observed. Although hospitals exist to provide for patients, this research shows that this particular location within the hospital (a patient unit corridor) primarily serves and supports the activities of the healthcare professionals charged with patient care.

Since most of the traffic through the study corridor was attributable to staff involved with patient care, it follows that fewer patients on the unit may lead to lower foot traffic counts. Thus, hospital census information could act as a predictor of foot traffic levels for the fabrication and selection of flooring materials or the development of a maintenance plan.

Patterns

Twelve patient rooms on the unit lie beyond the portion of the corridor under observation and are only accessible by passing through the corridor at point A. Thus, it is not surprising that nearly half of all foot traffic observed passed through that point. In fact, close to 33% of foot traffic observed was entirely through-traffic, passing through the corridor without coming from or going to a room or space located on the corridor in the defined area for the research study.

It is also unsurprising that approximately 1 out of 5 foot traffic incidences involved patient rooms and 1 out of 4 involved the nursing station area, given the prevalence on the unit of healthcare staff connected with patient care. More notable, however, are proportions of overall traffic as well as specific healthcare staff traffic frequenting the nursing POD. Even though the nursing station is considerably larger and accommodates more staff and a greater variety of activities, the small nursing POD received close to the same proportion of foot traffic. The nursing POD has 21 square feet (SF) and room enough for only one task chair, yet 1 in 5 healthcare staff members traveling through the corridor walked to or from the POD. Observers noted anecdotally that at times a staff member approaching the nursing POD found it full and had to choose another destination. This could mean that charting and work stations that are conveniently accessible from patient rooms are insufficient for the intended use by the healthcare staff.

Given the patient-centered focus of hospitals, it follows that patient rooms would be the destination for a large portion of foot traffic. As stated previously, patient rooms received 20% of all healthcare staff traffic. Predictably, visitors also frequented patient rooms, with 23% traveling to or from 1 of the 4 patient rooms located on the study corridor area. Over 50% of food service staff traffic involved patient rooms due to activity pertaining to the delivery and pick-up of meal trays. Housekeeping staff traffic involved patient rooms 20% of the time. Only 8% of patient traffic is attributable to patient rooms. This is not unexpected, however, considering that just 4 of the 33 patient rooms were located directly on the defined study portion of the corridor.

It should be noted that the space referred to as “breakroom” was temporarily serving as such during most of the research study. It was returned to its typical capacity as visitor lounge on the final day of the observation period. Construction/maintenance activity was therefore involved in returning breakroom furnishings to their permanent location and in the installation of the visitor lounge furniture. This explains the 4% of visitor traffic and the 17% of maintenance staff traffic to and from that location. The fact that 12% of healthcare staff traffic involved this space remains useful in that this traffic will likely shift to the new breakroom but not change much in proportion. It is not atypical for hospital units to undergo construction and/or maintenance projects periodically. Thus, foot traffic by maintenance workers may be more variable than that of other user groups, but occurs during the normal course of business within the hospital environment.

The handwashing sink and utility closet areas received the lowest foot traffic counts. Just over 3% of healthcare staff traffic involved the handwashing sink. Several similar handwashing stations are located elsewhere on the unit, so it is possible that staff members were utilizing other handwashing sinks in addition to this particular location.

Although the utility closet received only 6% of all foot traffic observed, the overwhelming majority of traffic to and from this location was attributable to housekeeping staff. In fact, half of all housekeeping staff traffic was concentrated in and around the utility closet area. In light of this, the location and design of the utility closet area may play an important role in the daily housekeeping procedures.

Equipment Carts

Type and Frequency

Observations showed that the average equipment cart count was approximately 240 during the peak hours between 7:00am and 11:00pm. The average equipment cart count during observed hours indicates that daily traffic counts for a 24-hour period exceeds the average number of counts for peak hours. It is not surprising that a significant correlation exists between equipment cart counts and foot traffic counts, since people transporting equipment carts/items were counted as foot traffic. Since the emergency code brought an influx of foot traffic but did not notably increase equipment cart counts, the correlation is stronger when data from the time block including the emergency code is removed.

The number of equipment carts/items did not differ significantly between days of the week or between time blocks. Further, equipment cart counts were not affected significantly by the number of empty beds on the unit. Generally speaking, equipment carts seem to be present due to operational aspects of the unit and are necessary regardless of patient load. Of the most commonly observed equipment carts, supply/utility, housekeeping, and food service carts were observed to be part of daily operations and therefore present on a regular basis. One-third of all carts/items traveling through the corridor belonged to one of these 3 categories.

Multiple computer carts were available on the unit for healthcare professionals to use as mobile charting stations within patient rooms. It should be noted that these computer carts fell into the "other" category because they contributed to less than 1% of all equipment traffic observed. When coupled with the frequent use of the nursing POD area by healthcare staff, this fact takes on added importance. The observed lack of use of these mobile computers in the corridor study area and the relatively high use by healthcare staff of the small nursing POD may be an indicator of healthcare staff preference for the nursing POD.

Another notable observation was the dragging of non-wheeled items across the carpeted floor, contributing to nearly 4% of all equipment traffic—a relatively small amount, but unexpected altogether. The implications of this largely depend on the item being dragged. A heavy, sharp, or roughly textured item could cause damage to the carpeting and even compromise the installation of the carpet tiles. The tendency to drag items could be an important new consideration in the fabrication of carpet tiles and for hospital facilities decisions and policies.

Patterns

Considering the high proportion (25%) of equipment carts observed traveling to or from one of the 4 patient rooms located on the study corridor, it is not surprising that half of all carts passed through the corridor area to reach the patient rooms beyond. Unlike in the case of foot traffic, equipment carts took the three particular through-traffic paths (points A to B, points A to C, and points B to C) more than any other paths within the corridor. Because of the wide variety of carts/items observed, it is more useful to examine the traffic patterns of individual equipment cart categories.

IV poles, gurneys (with and without patients), and treatment carts traveled almost exclusively as through traffic or in and out of patient rooms. These types of equipment were primarily observed to be associated directly with patients, so paths to and from patient rooms within and beyond the study area of the corridor were not surprising. Small linen carts showed a similar tendency to gravitate toward patient rooms or move through the corridor as through-traffic. Again, these carts were observed to be directly related to patient rooms. Small linen carts were generally positioned in the corridor just outside of the rooms and were taken periodically when full to be emptied in a separate location.

Every wheelchair observed with a patient was through-traffic, while wheelchairs with no patients took more varied paths through the study corridor area. No patient in one of the 4 rooms located on the study corridor left or entered a room in a wheelchair during the observation time blocks. Since 12 patient rooms are located beyond the area of the corridor under observation, it is not surprising that patients traveled through the corridor to or from the rooms beyond. More notable, visits to the nursing station and nursing POD were common for wheelchairs without patients but not observed at all for wheelchairs with patients. Likely, healthcare workers charged with transporting patients from this unit arrive with an empty wheelchair and check with staff on the unit before moving on to individual rooms.

Food service carts were also observed to be of direct service to patients. Just under half of all food service carts observed frequented the areas in and around patient rooms. Food service cart traffic attributed to the nursing station and the utility closet (11% and 2%, respectively) were positioned just outside of those locations. Approximately 30% of all food service cart traffic was not accounted for by any specific location on the corridor, due to movements between various, non-specified locations in the middle of the corridor. Of food service carts observed, only 10% were through-traffic. This, in conjunction with the fact that 30% traveled to or from unspecified points throughout the corridor area, shows a tendency by food service carts, in particular, to take short paths and to start and stop frequently.

Housekeeping carts showed more variability in traffic patterns than most other categories of equipment carts. Only 23% of housekeeping carts were through-traffic, while the same number frequented patient rooms. As expected, a large portion (35%) of housekeeping carts traveled to or from the utility closet area. Similar to food service carts, housekeeping carts were observed servicing virtually all spaces within the unit, rather than passing through without stopping or concentrating in one location.

Rolling carts are directly linked with the people utilizing them, as evidenced by the significant correlation between foot traffic and equipment carts. Carts are either pushed or pulled over the floor surface, causing not only wear on the carpeting, but physical effort and sometimes strain on the person doing the pushing or pulling. For the most part, the equipment observed was pushed through the corridor. Food service, supply/utility, and flatbed maintenance carts were observed being pulled 20-30% of the time, although they were still pushed the majority of the time. Trash bins were the exception, with 91% being pulled through the corridor area. While these findings do not necessarily impact the carpeting directly, they are useful in examining ergonomic factors related to carpeting, especially from a risk management standpoint.

Carpet Cleaning Procedures

As stated previously, the results of this study did not explicitly support or reject the stated hypotheses that: 1) actual carpet cleaning procedures are concurrent with documented hospital protocol, 2) actual carpet cleaning procedures are concurrent with infection control guidelines and industry standards, and 3) documented hospital protocol is concurrent with infection control guidelines and industry standards. The reason for this is that differences varied among the six key components of carpet maintenance programs. While some aspects of carpet cleaning, such as vacuuming, did show concurrence between actual carpet cleaning procedures, documented hospital protocol, and infection control guidelines and industry standards, others did not. Additionally, very little written documentation of hospital protocol was available, so in some cases a comparison cannot be made.

Preventive Maintenance

As part of infection control guidelines and industry standard cleaning protocol, preventive maintenance involves utilization of walk-off mats at entrances and major interior traffic areas. Although there is no written documentation available concerning the hospital's walk-off mat program, hospital Environmental Services stated that there is one in place and that hospital policy includes walk-off floor mats at entrances. While walk-off mats were, in fact, present at the hospital entrance, none were observed at major interior traffic areas, as suggested by guidelines. The unit is accessed by elevator, yet no floor mats were located at this common entrance location.

Vacuuming

On the commercial carpet cleaning frequency chart (refer to Table 2.1, p. 15) developed by the Institute of Inspection Cleaning and Restoration (2002), the hospital in this study falls into the "very heavy" foot traffic category, with over 2,500 foot traffics per day. As a result, industry standards call for vacuuming 1 to 2 times daily. The daily cleaning schedule provided for housekeeping staff by the hospital's Environmental Services department includes vacuuming in specific corridor areas as well as an additional final vacuuming. Evidence from observation data suggests that overall vacuum cleaning occurred once daily, but is not sufficient to assume two daily vacuumings.

Observers noted that, while vacuuming was occurring regularly in the defined area of the study corridor, it was not observed at any time elsewhere in the corridor within view of the observers. The lack of evidence regarding vacuuming within the unit indicates the variability of cleaning practices among housekeeping staff members on the unit. A clearly documented policy regarding vacuuming could help to promote a higher degree of consistency among hospital housekeeping staff members.

Spot and Spill Removal

Standard recommendations require spill and spot removal daily or when spots are noticed. The hospital's Environmental Services department aims for once weekly or bi-weekly spot or spill checks, although there is no written documentation to that effect, and no obvious investigations were observed. Additionally, response times were varied and ranged from immediate to 18 hours. Under hospital protocol, carpet spots are considered special projects, yet spills are not often reported and records of special projects are inconsistent and largely missing. Aside from a list of chemicals to be kept on housekeeping carts (refer to Hospital Environmental Services Policy #11, Appendix G), no documentation could be found regarding either the protocol for treatment of spots or recorded past incidents.

Hospital documentation does include Quick Spot, a carpet spot-remover made by Envirox LLC, on a list of chemicals to be kept on housekeeping carts (Appendix G). Label instructions for this product, which are to spray carpet until wet, allow to sit five to ten minutes, scrub or blot soil away, and vacuum when dry, are in keeping with infection control guidelines.

Two out of the 3 contamination incidents observed received a response by housekeeping staff within approximately 5 minutes. The only liquid spill observed was treated immediately in accordance with guidelines. The third incident, however, was not noticed or treated until some 18 hours later, at which time a maintenance staff member used masking tape to remove dust/debris from the carpet surface. This cleaning method is not in line with infection control guidelines, industry standards, or hospital protocol. The delay in attending to this contamination incident and the improper treatment of it emphasizes the need for policy concerning frequent and consistent spill checks. Though Environmental Service aims for weekly or bi-weekly spill checks, observation data shows that this may not be sufficient.

Interim Cleaning

Interim cleaning should be performed in this corridor 12 to 52 times annually, according to the IICRC commercial carpet cleaning frequency chart (refer to Table 2.1, p. 15). Aside from data on the chemicals used in the procedure, the hospital has no written protocol for interim cleaning or the dry extraction method typically used in this facility. Environmental Services reports that the Host Dry Extraction system is performed "as needed" between deep cleanings. Label instructions are consistent with guidelines, and are to apply dry powder to the carpeting, brush through fibers with a Dry-Clean Machine (made by Host), and follow with vacuuming. No policy exists concerning the frequency with which this process is to be performed, and no documentation of past applications of the procedure was available. This procedure was not observed during the study period.

Restorative Cleaning

Guidelines and hospital protocol both specify hot water extraction as the method of restorative carpet cleaning and both agree on the way in which this process is to be performed. However, while the IICRC's commercial carpet cleaning frequency chart recommends restorative cleaning 6 to 24 times per year, Hospital Environmental Services Policy #27 (Appendix H) specifies deep carpet cleaning just 2 times per year, once in spring and once in fall. This discrepancy is substantial yet difficult to rectify because the same high traffic volume that causes the need for frequent deep cleaning makes closing the corridor for the process extremely inconvenient. This procedure was not observed during the study period.

Carpet Tile Replacement

Infection control guidelines and industry recommendations suggest replacing contaminated or damaged individual carpet tiles as needed. Since the recent installation of carpet tile in place of broadloom carpet, a new hospital protocol has not been established or documented, but is under development. In accordance with guidelines, Hospital Environmental Services intends to replace carpet tiles found to be damaged or stained. Further plans include immediately removing tiles on which spills have occurred in order to carry out proper treatment in a less conspicuous location. One contamination incident observed involved a liquid spill, but the cleaning was performed at the site on which it occurred and the tile was not removed or replaced during the study period. It should be noted, however, that this particular incident involved a food product and no other opportunity occurred to carry out the requisite replacement of a carpet tile.

Summary

Hypothesis 1 was that actual carpet cleaning procedures are concurrent with documented hospital protocol. Findings from this study support this hypothesis with regard to preventive maintenance. Observation data indicates that vacuuming was performed once daily, not twice daily as required by hospital protocol. In this case, the hypothesis is not supported. Due to the limited documentation of hospital protocol available and the lack of observation of particular cleaning methods, there is not enough evidence to support the first hypothesis regarding spot and spill treatment, interim cleaning, restorative cleaning, and carpet tile replacement.

Hypothesis 2 was that actual carpet cleaning procedures are concurrent with infection control guidelines and industry standards. Observations of vacuuming as well as spot and spill treatment support this hypothesis. However, preventive maintenance practices were not concurrent with guidelines because floormats were not present at major interior traffic locations. Findings regarding carpet tile replacement do not support the second hypothesis, although only one incident that called for this action was observed. Since no interim cleaning or restorative cleaning procedures were observed, there is not sufficient evidence of these activities to support this hypothesis.

Hypothesis 3 was that documented hospital protocol is concurrent with infection control guidelines and industry standards. This hypothesis is supported by findings concerning vacuuming, since hospital protocol calls for twice daily vacuuming and guidelines suggest 1-2 times daily. Findings regarding restorative cleaning, however, do not support the third hypothesis. Though they agree on the appropriate method for restorative cleaning, hospital policy requires it twice yearly, compared to the industry standard recommendation of 6-24 times per year. Due to lack of documentation of hospital protocol regarding preventive maintenance, spot and spill treatment, interim cleaning, and carpet tile replacement, hypothesis 3 cannot be accepted or rejected based on evidence collected.

CHAPTER 6
CONCLUSIONS

With growing interest in the indoor environmental quality of healthcare settings, it is important to consider impact factors on interior finish materials such as flooring. Little has been studied about particular factors contributing to the wear and maintenance of flooring—specifically carpeting—in a hospital environment. As a result, those responsible for the manufacturing, selection, and care of such materials are left guessing as to what happens to carpeting in its intended setting.

This study established definitively that the foot traffic in this particular patient unit corridor numbered over the 2,500 required to be considered a “heavy traffic” area by the IICRC. Further, foot traffic was effected by the number of patients being cared for on the unit, and was correlated with equipment cart traffic, which adds to the impact on carpeting. Equipment carts were consistently observed regardless of day of the week, time of the day, or patient load. In light of this, information such as equipment use and hospital census numbers should be examined when selecting appropriate floorcoverings or developing and implementing a maintenance plan.

Healthcare staff contributed to 80% of all foot traffic during the study, evidence that this particular location within the hospital primarily serves and supports the activities of the healthcare professionals charged with patient care. In fact, observations of areas in the study corridor allocated to healthcare staff revealed unexpected patterns. The heavy use of the small nursing POD along with anecdotal observations by researchers of overcrowding in this space point to a preference among the staff for a charting space that is more convenient and accessible than the larger nursing station. These findings, coupled with the observed lack of use of computer carts provided to healthcare staff for the purpose of convenient charting, suggest a need for a reassessment of the types of spaces and tools required by current and future healthcare professionals.

This research brought to light the hospital's lack of a documented carpet maintenance program. Most of the intentions and activities of hospital Environmental Services were generally in line with infection control guidelines and industry standards. However, the lack of documented policy may cause inconsistencies and complications in carrying out proposed maintenance activities. For example, a policy exists requiring deep cleaning twice yearly, yet recent high census numbers have compelled the hospital's Environmental Services to make arrangements with each individual unit in order to schedule this procedure, resulting in possible untimely cleanings. Written documentation of a comprehensive carpet maintenance program, reviewed and approved by hospital administration, could call attention to the frequency and consistency of cleaning procedures necessary to maintain the appearance and sanitary condition of the carpet tile. In this way, hospital administration and Environmental Services could work together to ensure that cleanings are scheduled and performed with regularity despite operational obstacles and that housekeeping staff has a clear understanding of expected carpet cleaning procedures.

Limitations

While systematic observation does not rely on self-reporting by participants, it can still be subject to bias and human error on the part of the observer(s). Obstructed views, unexpected distractions, or excessive activity may have led to inaccuracies in traffic counts and identification of user and equipment types.

Additionally, cross-sectional observation methods do little to explain the findings or determine how the observed behaviors and patterns effect the environment and its users. This research is primarily exploratory in nature.

As this was a case study, findings cannot be generalized to other hospitals or environments. A larger study including more hospitals would have obtained more universal information about this type of location. In addition, this was not a longitudinal examination of hospital activities. While one week is representational of typical activity, it did not allow for the observation of infrequent activities such as spill incidents and interim and restorative cleaning processes. Further information about off-peak hours could also be gathered by 24-hour observations.

Future Directions in Research

Further studies should explore how wear and contamination of carpet tile affect people in the environment, especially with regard to physical health (i.e., infection control and ergonomics). Studies exploring the relationship between carpeting and infection control (including allergies and asthma) in healthcare settings are few in number and rarely examine the role and impact of variable maintenance practices. Future research should also include ergonomic evaluations of the role carpeting and carpet tile play in injuries from pushing and pulling equipment carts.

Further research should also focus on maintenance programs and their practical implementation. The quality and consistency of actual cleaning procedures in healthcare settings and their potential to impact occupants should be examined more closely by researchers in the future. A better understanding of how carpet and carpet tile are maintained in their intended setting could contribute not only to a long wear life and healthy environment, but to appropriate and safe carpet selection at the outset.

APPENDIX A
APPROVAL AND PERMISSION

UNIVERSITY OF
FLORIDA

Institutional Review Board

98A Psychology Bldg.
PO Box 112250
Gainesville, FL 32611-2250
Phone: (352) 392-0433
Fax: (352) 392-9234
E-mail: irb2@ufl.edu
http://irb.ufl.edu

December 8, 2005

TO: Debra D. Harris, PhD
PO Box 115705
Campus

FROM: Ira S. Fischler, PhD, Chair
University of Florida Institutional Review Board 02

SUBJECT: UFIRB Protocol #2005-U-1117
Flooring in acute care facilities: carpet tile seam penetration field study

FUNDING: Interface Flooring Systems, Inc.

Because this protocol does not involve the use of human participants in research, it is exempt from further review by this Board in accordance with 45 CFR 46. Human participants are defined by the Federal Regulations as living individual(s) about whom an investigator conducting research obtains (1) data through intervention or interaction with the individual; or (2) identifiable private information.

Should the nature of your study change or you need to revise this protocol in any manner, please contact this office before implementing the changes.

IF/dl

Equal Opportunity/Affirmative Action Institution

UF Health Science Center

Certificate of Completion

This is to certify that

______Julianna Mitchell______

has successfully completed the

HIPAA for Researchers at the University of Florida

on _____11/17/2005_____

This HIPAA Training Completion has been recorded. Print a copy of this certificate for your records. It will print black and white, not in color.
If you have trouble printing this certificate, please close this window and return to the Privacy Homepage. Click on ***Get Your Certficate*** and print your certificate from there.

Print

If you have any questions, contact Everall Peele, HIPAA training Coordinator in the Privacy Office at 352-273-5096 or **epeele@ufl.edu**
You may now close this browser window.

*If you used **get your certificate** link and the name on the certificate appears to be incorrect, please go back using the browser back button and enter your correct name.*

APPENDIX B
OBSERVATION FORMS

FIELD STUDY OBSERVATION FORM

Corridor, 4th Floor, Bed Tower

Date ______________________________

Time Block ______________________________

Observer ______________________________

No. of Empty Beds ______________________________

Legend

H Healthcare staff
P Patient
V Visitor
S Staff (other)
M Maintenance
F Food Service Staff
HK Housekeeping Staff

NSI Nursing station (inside)
NSO Nursing station (outside)
CH Charting
CL Closet
BR Breakroom
S Sink

WC Wheelchair
G Gurney
BD Blood Drawing
IV IV Pole
MT Medical Treatment
LC Linens Cart
FSC Food Service Cart
HKC Housekeeping Cart

Ref. #	Foot Traffic	From/To		Equipment	Pull / Push		Stop/ Start		Notes	Spill

DAILY CENSUS DIAGRAM

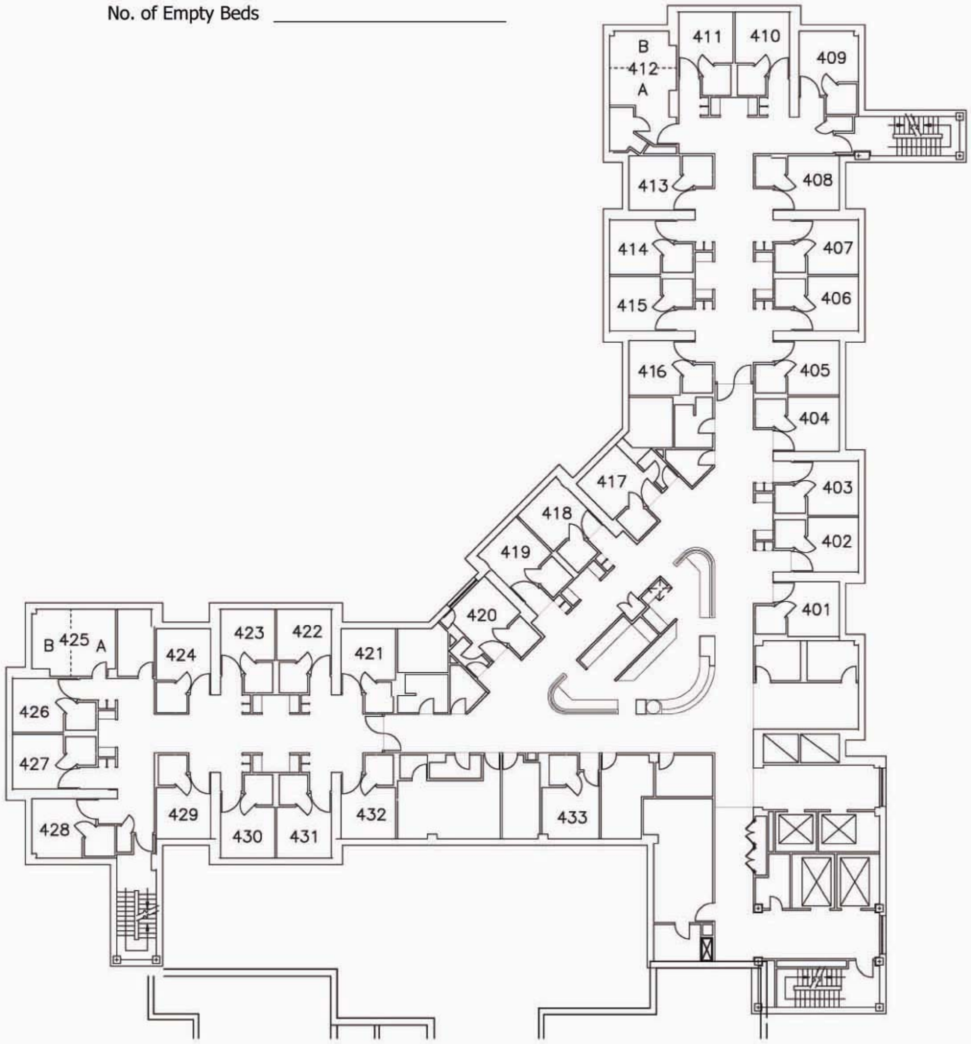
Corridor, 4th Floor, Bed Tower

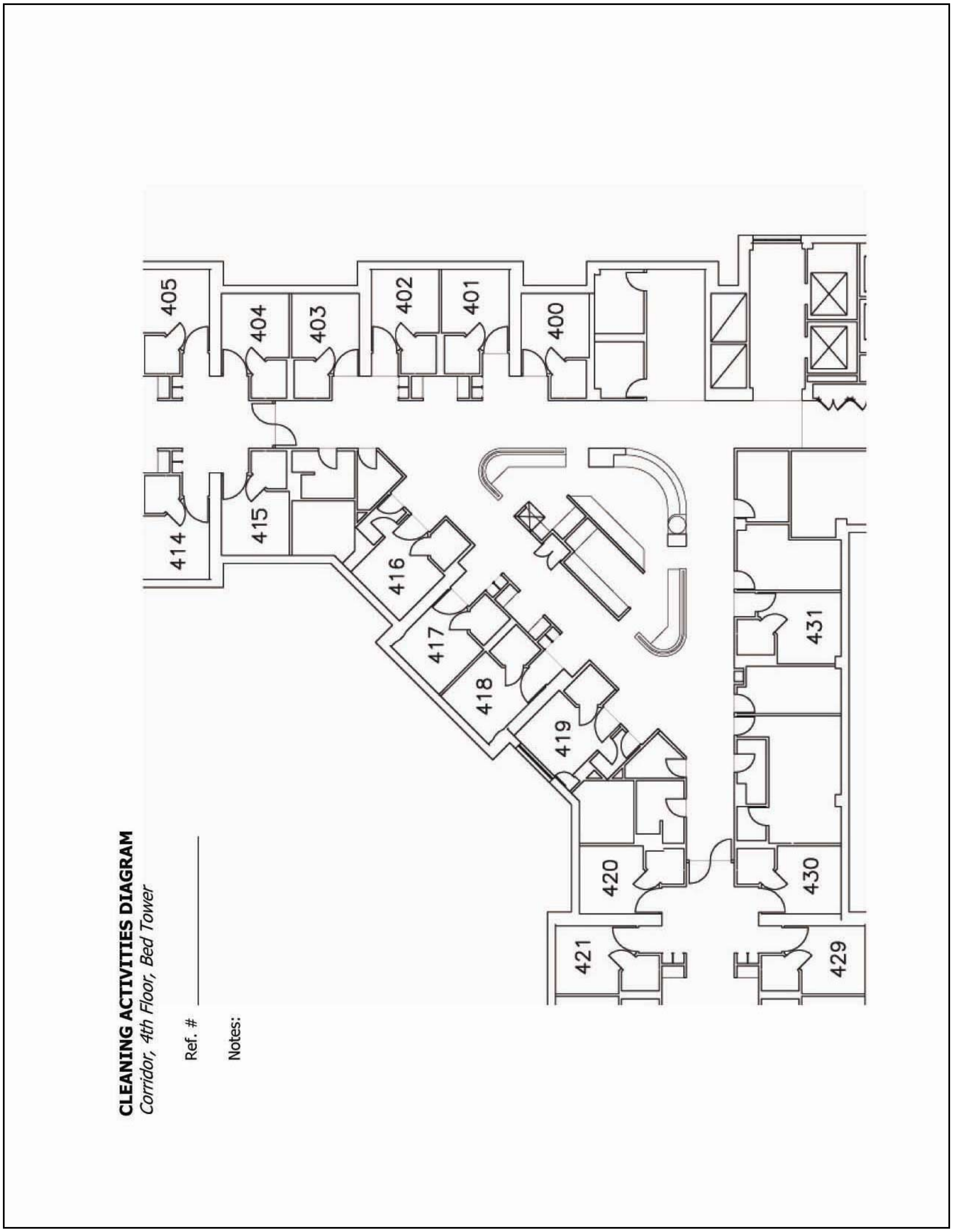
Date ____________________

Time Block ____________________ START or END

Observer ____________________

No. of Empty Beds ____________________





CLEANING ACTIVITIES DIAGRAM
Corridor, 4th Floor, Bed Tower
Ref. #
Notes:
405
404
403
402
401
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414
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416
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420
421
431
430
429

APPENDIX C
STATISTICAL ANALYSES

The following is the statistal analysis testing for effect of time of day and day of the week on foot traffic counts.

The GLM Procedure
Class Level Information

Class	Levels	Values
day	6	1 2 3 4 5 6
time	8	1 2 3 4 5 6 7 8

Number of observations 48

NOTE: Due to missing values, only 31 observations can be used in this analysis.
##

Dependent Variable: sqrtfoot

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	164.0657648	13.6721471	4.08	0.0037
Error	18	60.3453900	3.3525217		
Corrected Total	30	224.4111548			

R-Square	Coeff Var	Root MSE	sqrtfoot Mean
0.731095	9.705333	1.830989	18.86581

Source	DF	Type III SS	Mean Square	F Value	Pr > F
day	5	37.91095997	7.58219199	2.26	0.0922
time	7	74.30927664	10.61561095	3.17	0.0230

Bonferroni's multiple comparison test:

Least Squares Means for effect time
Pr > |t| for H0: LSMean(i)=LSMean(j)
Dependent Variable: sqrtfoot

i/j	1	2	3	4	5	6	7	8
1		0.6906	1.0000	1.0000	0.7830	0.2744	0.1568	0.0186
2	0.6906		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000		1.0000	1.0000	1.0000	1.0000	0.1284
4	1.0000	1.0000	1.0000		1.0000	1.0000	1.0000	1.0000
5	0.7830	1.0000	1.0000	1.0000		1.0000	1.0000	1.0000
6	0.2744	1.0000	1.0000	1.0000	1.0000		1.0000	1.0000
7	0.1568	1.0000	1.0000	1.0000	1.0000	1.0000		1.0000
8	0.0186	1.0000	0.1284	1.0000	1.0000	1.0000	1.0000	

The following is the statistical analysis testing for effect of time of day and day of the week on foot traffic counts after removing data from the time block during which an emergency code occurred.

```
               The GLM Procedure
             Class Level Information

         Class         Levels    Values

        day                6    1 2 3 4 5 6

        time               8    1 2 3 4 5 6 7 8


Number of observations    48

NOTE: Due to missing values, only 31 observations can be used in this
analysis.
#######################################################################


Dependent Variable: sqrtfoot


                                                Sum of
Source                     DF         Squares     Mean Square    F
Value    Pr > F
Model                      12     116.2908109       9.6909009
3.87    0.0057
Error                      17      42.5776858       2.5045698
Corrected Total       29     158.8684967

R-Square     Coeff Var      Root MSE    footcount Mean
0.731994      8.508360      1.582583          18.60033

Source         DF      Type III SS     Mean Square     F Value    P-value

day            5     30.9679642      6.19359285        2.47
0.0739
time           7     48.41685591      6.91669370       2.76
0.0412
```

Bonferroni's mulitiple comparison test:

Least Squares Means for effect time
Pr > |t| for H0: LSMean(i)=LSMean(j)
Dependent Variable: sqrtfoot

i/j	1	2	3	4	5	6	7	8
1		1.0000	1.0000	1.0000	1.0000	1.0000	0.7442	0.1766
2		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3		1.0000	1.0000	1.0000	1.0000	0.7218	0.4010	0.0528
4		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6		1.0000	1.0000	0.7218	1.0000	1.0000	1.0000	1.0000
7		0.7442	1.0000	0.4010	1.0000	1.0000	1.0000	1.0000
8		0.1766	1.0000	0.0528	1.0000	1.0000	1.0000	1.0000

Least Squares Means for effect day
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: sqrtfootcount

i/j	1	2	3	4	5	6
1		0.0718	0.3729	0.6803	0.2558	1.0000
2	0.0718		1.0000	1.0000	1.0000	1.0000
3	0.3729	1.0000		1.0000	1.0000	1.0000
4	0.6803	1.0000	1.0000		1.0000	1.0000
5	0.2558	1.0000	1.0000	1.0000		1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	

The following is the statistal analysis testing for effect of number of empty beds on foot traffic counts.

Dependent Variable: sqrtfoot

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	50.2526737	50.2526737	8.37	0.0072
Error	29	174.1584811	6.0054649		
Corrected Total	30	224.4111548			

R-Square	Coeff Var	Root MSE	sqrtfoot Mean
0.223931	12.98966	2.450605	18.86581

Source	DF	Type III SS	Mean Square	F Value	Pr > F
beds	1	50.25267374	50.25267374	8.37	0.0072

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	21.05678340	0.87601136	24.04	<.0001
beds	-0.60106447	0.20778528	-2.89	0.0072

The following is the statistal analysis testing for effect of time of day and day of the week on equipment cart counts.

```
              The GLM Procedure
            Class Level Information

         Class         Levels    Values

        day                 6    1 2 3 4 5 6

        time                8    1 2 3 4 5 6 7 8

Number of observations    48

NOTE: Due to missing values, only 31 observations can be used in this
analysis.
########################################################################
```

Dependent Variable: sqrtcount

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	12.62580915	1.05215076	1.38	0.2615
Error	18	13.74287472	0.76349304		
Corrected Total	30	26.36868387			

R-Square	Coeff Var	Root MSE	sqrtcount Mean
0.478818	16.18693	0.873781	5.398065

Source	DF	Type III SS	Mean Square	F Value	Pr > F
day	5	2.56589195	0.51317839	0.67	0.6498
time	7	7.83755528	1.11965075	1.47	0.2409

The following is the statistal analysis testing for effect of number of empty beds on equipment cart counts.

Dependent Variable: sqrtequip

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.76560055	1.76560055	2.08	0.1598
Error	29	24.60308333	0.84838218		
Corrected Total	30	26.36868387			

R-Square	Coeff Var	Root MSE	sqrtequip Mean
0.066958	17.06309	0.921077	5.398065

Source	DF	Type III SS	Mean Square	F Value	Pr > F
beds	1	1.76560055	1.76560055	2.08	0.1598

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	5.808745362	0.32925486	17.64	<.0001
beds	-0.112664657	0.07809752	-1.44	0.1598

The following is the statistal analysis testing for correlation between foot traffic and equipment cart counts.

Correlations

		sqrtfootcount	sqrtequip
sqrtfootcount	Pearson Correlation	1	.490(**)
	Sig. (2-tailed)	.	.005
	N	31	31
sqrtequip	Pearson Correlation	.490(**)	1
	Sig. (2-tailed)	.005	.
	N	31	31

** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX D
EQUIPMENT PHOTOGRAPHS

Figures D.1-D.20 are photographs of commonly observed equipment.

Figure D.1: IV Pole

Figure D.2: Typical supply cart

Figure D.3: Supply/utility cart

Figure D.4: Supply cart

Figure D.5: Housekeeping cart

Figure D.6: Typical gurneys

Figure D.7: Gurney

Figure D.8: Food service cart

Figure D.9: Small linens cart

Figure D.10: Wheelchair

Figure D.11: Portable x-ray machine


Figure D.12: Trash bin/large linens cart


Figure D.13: Emergency crash cart

Figure D.14: Treatment cart

Figure D.15: Treatment cart

Figure D.16: Cart used for blood-drawing

Figure D.17: Portable scale

Figure D.18: Mobile computer carts

Figure D.19: Rolling task chair

Figure D.20: Flatbed maintenance cart

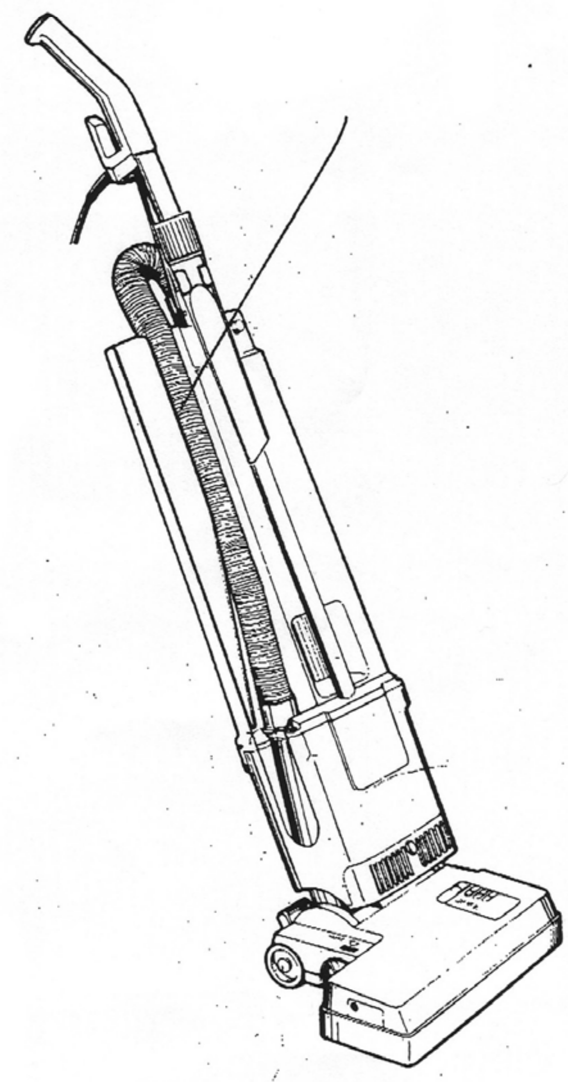
APPENDIX E
CLEANING EQUIPMENT SPECIFICATIONS

VERSAMATIC

electronic control EC

WINDSOR®

VSE 1-3



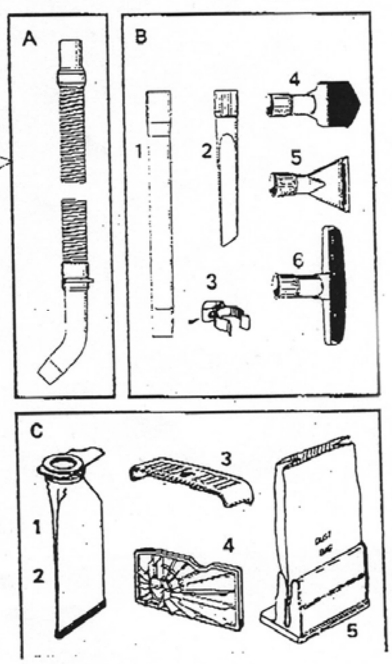
A) Vacuum Extention Hose 1087
Optional

B) VSM-Tool Kit - Optional

1	Straight Tube	1084
2	Crevice Nozzle	1092
3	Clip	1081
4	Dusting Brush	1094
5	Upholstery Nozzle	1090
6	Wall- and Upholstery Brush	1095

C) Bags and Filters

1	Paper Bag (Pkg of 10)	2003
2	Cloth Bag (only use with Micro-Filter)	1079
3	Exhaust Filter	1534
4	Vac Motor Filter	1044
5	Micro-Hospital-Filter	1435



WINDSOR warrants to the original purchaser/user that this product is unconditionally guaranteed free from defects in workmanship and materials under normal use and service for a period of one year. WINDSOR will, at its option, repair or replace without charge, except for transportations costs, parts that fail under normal use and service when operated and maintained in accordance with the Instructions Manual. This warranty does not apply to normal wear or to items whose life is dependent on their use and care.

This warranty is in lieu of all other warranties, expressed or implied, and releases WINDSOR from all other obligations and liabilities. It is applicable only in the U.S.A. and Canada, and is extended only to the original user/purchaser of this product. WINDSOR is not resoonsible for costs for repairs performed by persons other than those specifically authorized by WINDSOR. This warranty does not apply to damage from transportation, alterations by unauthorized persons, misuse or abuse of the equipment, use of noncompatible chemicals, or damage or loses of income due to malfunctioning of the product.

If a difficulty develops with this product, you should contact the dealer from whom it was purchased.

Technical Details

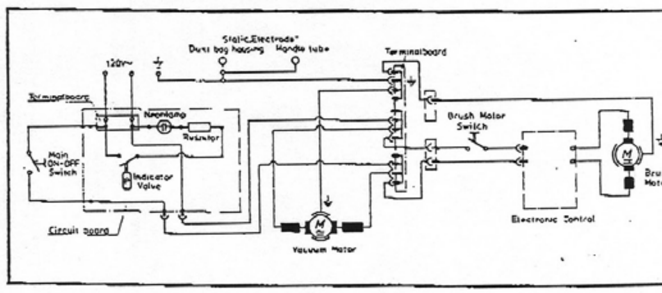
Voltage	120 volt, 60 hz
Vacuum motor	6.4 amp.
Water lift	69 inches
Air flow	91 cfm
Brush motor	1.4 amp.
Dust bag capacity	1.3 gal.
Brush width	12 3/4 inches
Brush strip	replaceable
Brush drive	non slip drive belt with electronic overload protection
Height	48 inches
Width	14 inches
Weight	16 lbs

Approvals:

UL

0622 UL-2/93

Wiring Diagram



WARNING! Electric shock could occur if used outdoors or on wet surfaces!

WINDSOR® INDUSTRIES, INC.
1351 West Standford Ave.
Englewood, Colorado 80110 USA
800-444-7654
303-762-1800
FAX: 303-762-0817

Accidents due to misuse can only be prevented by those using the machine. To guard against injury, basic safety precautions should be observed, including the following:

Read and follow all safety instructions.

WARNING: ELECTRIC SHOCK COULD OCCUR IF USED OUTDOORS OR ON WET SURFACES

This vacuum cleaner is designed to be safe when used to perform cleaning functions. Should damage occur to electrical or mechanical parts, cleaner should be repaired by WINDSOR or competent service station before using in order to avoid further damage to machine or physical injury to user.

A damaged power cord could cause electrical shock and/or fire. To minimize this possibility observe the following precautions:

Do not run cleaner over power cord.

Avoid closing doors on power cord, pulling it around sharp edges, or placing sharp-edged objects upon it.

Wind cord no tighter than is necessary to retain it on the cord hooks.

When disconnecting power cord from electrical outlet, grasp the plug. Pulling it out by the cord itself can damage cord insulation and internal connections to plug.

Your vacuum cleaner creates suction and contains a revolving brush. To avoid bodily injury from suction or moving parts, vacuum cleaner brush should not be placed against, or in close proximity of loose clothing, jewelry, hair or body surfaces while cleaner is connected to electrical outlet. Cleaner should not be used to vacuum clothing while it is being worn.

Always plug your cleaner into a standard wall outlet. Use of extension cord or light socket with inadequate current-carrying capacity could result in electric shock or fire hazard.
Disconnect cleaner from electrical outlet before servicing, such as changing bags or belts. You could receive bodily injury from moving parts of machine should switch accidentally be turned on. Disconnect cleaner from electrical outlet before detaching powerhead.

Do not use your vacuum cleaner in areas where flammable and/or explosive vapor or dust is present to avoid possibility of fire or explosion. Some cleaning fluids can produce such vapors. Areas on which cleaning fluids have been used should be completely dry and thoroughly aired before being vacuumed.

To avoid fire hazard, do not pick up matches, fireplace ashes, or smoking material with cleaner.

Keep your work area well lighted to avoid picking up harmful materials (such as liquids, sharp objects, or burning substances) and avoid tripping accidents.

Use care when operating the cleaner on irregular surfaces such as stairs. A falling cleaner could cause bodily injury and/or mechanical damage. Proper storage of machine in an out-of-the-way area immediately after use will also prevent accidents caused by tripping over cleaner.

Store your vacuum cleaner indoors in a cool, dry area not exposed to the weather to avoid electrical shock and/or cleaner damage.

Exercise strict supervision to prevent injury when using vacuum cleaner near children or when child is allowed to operate vacuum cleaner. Do not allow children to play with vacuum cleaner and never leave cleaner plugged in and unattended.

SAVE THESE INSTRUCTIONS

APPENDIX F
MATERIAL SAFETY DATA SHEETS

EnvirOx LLC
Material Safety Data Sheet

SECTION I- Product Information

PRODUCT NAME: *H_2Orange$_2$ Quick Spot*

Product Classification: Water Soluble Cleaner

Manufacturer: EnvirOx LLC P. O. Box 2327, Danville, IL 61834-2327
1938 E. Fairchild St. Danville, IL. 61832

Telephone: 217-442-8596 Emergency Telephone: 800-255-3924

SECTION II - Ingredients

Hazardous Ingredients: Hydrogen Peroxide <1% - CAS No. 7722-84-1

SECTION III – Fire and Explosion Hazard Data

Flash Point:	None
Flammable Explosive Limits % by Volume	Lower: None
	Upper: None
Fire Extinguishing Media:	CO_2 or Dry Chemical
Special Fire-Fighting Procedures:	None known
Unusual Fire and Explosion Hazard:	None known

SECTION IV – Physical Data

Boiling Point:	212 Deg. F.
Specific Gravity:	.9983
Solubility in Water:	Complete
Melting Point:	Unknown
Ph:	4.01
Appearance:	Cloudy/Clear Liquid
Odor:	Citrus

SECTION V – Product Health Hazard Data

Principal Routes of Absorption:

Inhalation -	Not Applicable
Ingestion -	May cause stomach upset
Skin -	May cause minor skin irritation if left on skin for long periods of time.
Eye -	May cause eye irritation.

Possible Symptoms of Overexposure: Dry skin

Page 1 of 2

Emergency and First Aid Procedures:

Inhalation-	Not Applicable
Ingestion-	Drink several glasses of water and consult a physician.
Skin-	If irritation occurs, rinse thoroughly with water for at least 5 minutes. Apply moisturizing cream. If irritation persists, consult physician.
Eye -	Flush eyes with water for at least 15 minutes holding lids apart to ensure complete irrigation. If irritation persists, consult physician.

SECTION VI – Reactivity Data

Stable:	Yes
Stability Conditions to Avoid:	None known
Incompatibility (Materials to avoid)	None
Hazardous Decomposition Products:	None known
Hazardous Polymerization:	Will not occur

SECTION VII - Spill, Leak or Disposal Procedures

Waste Disposal Method:	Biodegradable product. Dispose of container according to state, federal and local laws. Do not dump into any sewers, on the ground, or into any body of water. All disposal methods must be in compliance with all state, federal and local laws.
Precautions in Handling/Storing:	None
Other Precautions to be taken:	None known.

SECTION VII – Special Protection Information

Ventilation Requirements:	Local exhaust OK
Protective Equipment:	Rubber gloves recommended if skin is sensitive.
Other Protective Precaution:	None

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Date: 01/04

By: M. Rebecca Melikyan

MATERIAL SAFETY DATA SHEET

nufacturer's Name: RACINE INDUSTRIES, INC.
Address: 1405 16th Street, Racine, WI 53403
Phone: 1-414-637-4491

HMIS	RATING
Health	0
Flammability	0
Reactivity	0

CAS: None

Product Information

Brand Name: **HOST® DRY CARPET CLEANER (ODORLESS)**
Product Type: Nonhazardous mixture of processed organic fibers moistened with a water/detergent/solvent emulsion.
Usage: Carpet maintenance and restorative cleaning.

Hazardous Ingredients	CAS No.	%W/W	TLV
1-Methoxy - 2-propanol	107-98-2	1.4%	360 mg/m^3 (TWA)

Physical Data

Boiling Point (°F)	N/A	Flash Point	>210°F (Setaflash cc)
Vapor Pressure (mm Hg)	N/A	Flammable Limits	N/A
Vapor Density (Air=1)	N/A	Extinguishing Media	Will not sustain a flame
% Soluble in Water	68	Special Fire Fighting Procedures	None
% Volatile	68		
Evaporation (Ether=1)	>1 5.0	Unusual Fire/Explosion Hazards	None
Specific Gravity (H_2O=1)	0.60	Appearance/Odor	Straw colored, moist granules

Legal/Labeling Requirements

California Prop. 65: No prohibited ingredients.
New Jersey Right-To-Know: Formula and use exposure identical to consumer goods. No special labeling.
Canadian WHMIS: Not a controlled substance. No special labeling.
DOT (Canada & U.S.): No special labeling.
Canadian Consumer Regs.: Not a regulated product. No special labeling.
EEC Regs.: Not a dangerous preparation. No special labeling.

Health Hazard Data

Primary Route(s) of Entry: Skin; inhalation.
Symptoms of Overexposure or Extreme Sensitivity: No known harmful effects from repeated, long-term exposure. Gloves advised for sensitive skin. Ventilation advised for asthmatics.

S706C
7/10/98

HOST DRY CARPET CLEANER (ODORLESS)
PAGE 2

Emergency and First Aid Procedures

verexposure: Wash hands with water. Fresh air. Flush eyes.
Extreme Sensitivity: Wash hands with water. Fresh air. Flush eyes. Seek advice of physician.

Toxic (NTP): (Yes___) (No X)
Carcinogenic: IARC (Yes___) (No X)
OSHA (Yes___) (No X)

Reactivity Data

Stability: (Stable X) (Unstable___)
Conditions to avoid: None known.
Incompatibility (materials to avoid): None known.
Hazardous decomposition products: Oxides of sulfur.
Hazardous polymerization occurs: (Yes___) (No X)
Conditions to Avoid: None known.

Spill or Leak Procedures

If spilled, sweep up or vacuum.

Waste Disposal: No special. Landfill. Bag or wrap before incinerating.

Special Protection Requirements

spiratory:	(Yes___) (No X)	Can be used safely in closed room,
entilation:	(Yes___) (No X)	but general ventilation encouraged.
Gloves:	(Yes___) (No X)	
Eye Protection:	(Yes___) (No X)	
Other:	(Yes___) (No X)	

Suggested Precautions

Handling: Treat like any cleaning product.
Storing: Treat like any cleaning product.
Use: Provide good general ventilation. For sensitive skin, use plastic gloves. Do not ingest. Avoid direct contact to eyes. Product is safe, but it is a cleaner.

Environmental Data

99% Biodegradable

In Emergency, Contact:

N. K. Harris
1-800-558-9439
Home: 414-639-6836

G. J. Botting
1-800-558-9439
Home: 414-634-8034

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EnvirOx LLC

MATERIAL SAFETY DATA SHEET

SECTION I - PRODUCT INFORMATION

PRODUCT NAME: **H_2Orange$_2$ Carpet Complete Concentrate**

PRODUCT CLASSIFICATION: Water Soluble Cleaner

MANUFACTURER: EnvirOx LLC — P.O. Box 2327, Danville, IL 61834-2327; 1938 E. Fairchild St. Danville, IL. 61832

TELEPHONE: 217-442-8596 — EMERGENCY TELEPHONE: 217-431-1911

SECTION II - INGREDIENTS

HAZARDOUS INGREDIENTS: Hydrogen Peroxide < 6% - CAS No. 7722-84-1

SECTION III - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	None
FLAMMABLE EXPLOSIVE LIMITS % BY VOLUME:	Lower: None Upper: None
FIRE EXTINGUISHING MEDIA:	CO_2 or Dry Chemical
SPECIAL FIRE-FIGHTING PROCEDURES:	None known
UNUSUAL FIRE AND EXPLOSION HAZARD:	None known

SECTION IV - PHYSICAL DATA

BOILING POINT:	212 Degrees F.
SPECIFIC GRAVITY (Water=1):	1.019
SOLUBILITY IN WATER:	Complete
MELTING POINT:	Unknown
PH:	3.6
APPEARANCE:	Clear
ODOR:	Citrus

SECTION V - PRODUCT HEALTH HAZARD DATA

PRINCIPAL ROUTES OF ABSORPTION:

- Inhalation - Not Applicable
- Ingestion - May cause stomach upset
- Skin - May cause skin irritation if left on for long periods of time.
- Eye - May cause eye irritation

POSSIBLE SYMPTOMS OF OVEREXPOSURE: Dry skin or stinging sensation

EMERGENCY AND FIRST AID PROCEDURES:

- Inhalation - Not Applicable
- Ingestion - Drink several glasses of water and consult physician.
- Skin - If irritation occurs, rinse thoroughly with water for at least 5 minutes. Apply moisturizing

cream. If irritation persists, consult physician.

SECTION V - PRODUCT HEALTH HAZARD DATA (continued)

Eye -	Flush eyes with water for at least 15 minutes holding lids apart to ensure complete irrigation. If irritation persists, consult physician.

SECTION VI - REACTIVITY DATA

STABLE:	Yes
STABILITY CONDITIONS TO AVOID:	Keep out of excessive heat
INCOMPATIBILITY (Materials to Avoid):	Strong Reducing Agents
HAZARDOUS DECOMPOSITION PRODUCTS:	None known
HAZARDOUS POLYMERIZATION:	Will not occur

SECTION VII - SPILL, LEAK OR DISPOSAL PROCEDURES

WASTE DISPOSAL METHOD:	Biodegradable Product. Dispose of container according to state, federal and local laws.
PRECAUTIONS IN HANDLING AND STORING:	Store indoors. Store away from strong reducing agents.
OTHER PRECAUTIONS TO BE TAKEN:	None known

SECTION VIII - SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS:	Local Exhaust OK
PROTECTIVE EQUIPMENT:	None
OTHER PROTECTIVE PRECAUTION:	None

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DATE: 01/04 By Rebecca Melikyan

EnvirOx LLC

MATERIAL SAFETY DATA SHEET

SECTION I - PRODUCT INFORMATION

PRODUCT NAME: **H_2Orange$_2$ *Super Concentrate* 112**

PRODUCT CLASSIFICATION:	Water Soluble Cleaner
MANUFACTURER: EnvirOx LLC	P.O. 2327, Danville, IL 61834-2327 1938 E. Fairchild Danville, IL. 61832
TELEPHONE: 217-442-8596	EMERGENCY TELEPHONE: 217-431-1911

SECTION II - INGREDIENTS

HAZARDOUS INGREDIENTS: Hydrogen Peroxide < 8% - CAS No. 7722-84-1

SECTION III - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	212 Degrees F.
FLAMMABLE EXPLOSIVE LIMITS % BY VOLUME:	Lower: None Upper: None
FIRE EXTINGUISHING MEDIA:	CO_2 or Dry Chemical
SPECIAL FIRE-FIGHTING PROCEDURES:	None known
UNUSUAL FIRE AND EXPLOSION HAZARD:	None known

SECTION IV - PHYSICAL DATA

BOILING POINT:	212 Degrees F.
SPECIFIC GRAVITY (Water=1):	1.02
SOLUBILITY IN WATER:	Complete
MELTING POINT:	Unknown
PH:	3.7
APPEARANCE:	Clear
ODOR:	Citrus

SECTION V - PRODUCT HEALTH HAZARD DATA

PRINCIPAL ROUTES OF ABSORPTION:

- Inhalation - Not Applicable
- Ingestion - May cause stomach upset
- Skin - May cause skin irritation if left on for long periods of time.
- Eye - May cause eye irritation

POSSIBLE SYMPTOMS OF OVEREXPOSURE: Dry skin or stinging sensation

EMERGENCY AND FIRST AID PROCEDURES:

- Inhalation - Not Applicable
- Ingestion - Call a doctor or get medical attention. Do not induce vomiting or give anything by mouth to an unconscious person. Drink promptly a large quantity of milk, egg whites, gelatin solution, or if these are not available, drink large quantities of water. Avoid alcohol.
- Skin - If irritation occurs, rinse thoroughly with water for at least 5 minutes. Apply moisturizing cream. If irritation persists, consult physician.

PRODUCT: H_2O*range*$_2$ *Concentrate 112* Page 2

SECTION V - PRODUCT HEALTH HAZARD DATA (continued)

Eye - Flush eyes with water for at least 15 minutes holding lids apart to ensure complete irrigation. If irritation persists, consult physician.

SECTION VI - REACTIVITY DATA

STABLE:	Yes
STABILITY CONDITIONS TO AVOID:	None known
INCOMPATIBILITY (Materials to Avoid:	Strong Reducing Agents
HAZARDOUS DECOMPOSITION PRODUCTS:	None known
HAZARDOUS POLYMERIZATION:	Will not occur

SECTION VII - SPILL, LEAK OR DISPOSAL PROCEDURES

WASTE DISPOSAL METHOD:	Biodegradable Product. Dispose of container according to state, federal and local laws.
PRECAUTIONS IN HANDLING AND STORING:	Store indoors. Store away from strong reducing agents.
OTHER PRECAUTIONS TO BE TAKEN:	None known

SECTION VIII - SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS: Local Exhaust OK

PROTECTIVE EQUIPMENT:
- Eye - Safety Glasses recommended when handling concentrate.
- Skin - Rubber Gloves recommended if skin is sensitive.

OTHER PROTECTIVE PRECAUTION: None

DATE: 01/04 By Rebecca Melikyan

APPENDIX G
HOSPITAL ENVIRONMENTAL SERVICES POLICY #11: CHEMICALS USED ON HOUSEKEEPER'S CART

TITLE	**Chemicals used on Housekeepers Cart**
PURPOSE	
APPLICABILITY	Edward Hospital
POLICY STATEMENT(S)	
DEFINITION(S)	
PROCEDURE	The following list of chemicals are to be supplied on housekeeping carts and used as described.

Quest: Disinfectant to be used on all items
Natures Way : Cleaning product for the following:
Glass
Toilet bowl cleaner
De-limer to be used on pipes and facuets
Carpet Cleaner
Wall cleaner
This product will be used with the dispensing unit to properly dilute to the proper dilution for specific function.

Chemicals for special projects:

Zep:	Used on counter surfaces and tiles
Kitchen cleanser:	Used on ceramic sinks and shower base.
Purell:	Refills for hand sanitizer
Hand soap	Refills for soap dispenser
Murphy Soap	Wood cleaning
Can air	For computers
Gum Remover	Gum and tape removal
Quick spot	Carpet spots

Other items on cart at all times:
Hi-duster
Wet mop bucket / or swifter
Dust pan and brush
Dust mop
Goggles
Trash bags
Toilet brush and container
Mr. Clean sponge
Detail brushes
Scraper
Cleaning rags

Green sponge for detail work

No food or drink at any time

CROSS REFERENCE(S)

Policy No:	11
Previous Policy No.:	
Policy Creation Date:	1994
Revision/Review Date(s):	2000/2002/2205
Approved by:	

APPENDIX H
HOSPITAL ENVIRONMENTAL SERVICES POLICY # 27: CARPET CLEANING PROCEDURES

TITLE	**Carpet Cleaning Procedure**
PURPOSE	To clean carpeted surface thoroughly using high pressure injection of cleaning solution and vacuum retrieval
APPLICABILITY	Edward Cardiovascular Institute, Edward Hospital, Edward Management Corporation.
POLICY STATEMENT(S)	
DEFINITION(S)	
PROCEDURE	Assemble needed equipment: Vacuum cleaner Cleaning solution Extractor Wet floor signs Fans Prepare mixture according to label directions Pour into tank using hot water Vacuum carpeted area before wet extraction Place wet floor signs where carpet meets tile Release solution in a forward motion as you pull back on the machine over the surface that has been sprayed it will automatically extract solution into dirty tank. Over lap the area just completed and continue to move along the carpet work slowly to allow the solution to penetrate and to allow the vacuum to remove amount of soil and solution. Empty tanks Clean equipment and store properly Corridor carpets will be wet extracted two times a year and maintained with spot cleaning and dry chemical cleaning. Offices and other carpeted areas will be cleaned one time a year or as needed as describe above.
CROSS REFERENCE(S)	
Policy No:	**27**
Previous Policy No.:	
Policy Creation Date:	11/1990
Revision/Review Date(s):	7/1996 12/1999 3-2002
Approved by:	

APPENDIX I
TYPICAL PATIENT UNIT CLEANING SCHEDULE

Revised 1/5/2006

2nd NORTH

Sweep your card 7:00
Setup cart: 7:15

All bottles must be labeled properly HSKPG is responsible for cleaning commodes on discharges only.

Replace needle boxes on unit when they are 2/3 full.

The linen hampers are not our use or to maintain. When removing soiled linen from room it must be in a bag before it leaves the room and placed in soiled utility room.

Wear gloves when pulling soiled linen or trash and when using chemicals. Wash hands after removing gloves.

You must use *QUST 256* when disinfecting. You can use other chemical after you have disinfected.

The standard is 17 room and 4 discharge and ancillary areas.

Polish Gold elevators
Vacuum area
Clean window & window sills & spot wall
Lobby and 2 washrooms
Nurse's station soiled utility room
Ice room
Vacc. Hall and behind doors
PODS A, B, C, AND D
Patient rooms:

ROOM	STAT	TERM	ROOM	STAT	TERM
201			210		
202			211		
203			212A&B		
204			213		
205			214		
206			215		
207			216		
208					
209					

Final trashes pick up from POD's, bathrooms and final vacuum
Call supervisor 68600 or 68601 if you have any downtime
No extra supplies under cabinets
Store cart when away from floors
Do not part carts in front of extinguishers
Clean cart 3:15pm
Sweep out 3:30pm

This is a typical schedule for pt areas.

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BIOGRAPHICAL SKETCH

Julianna M. Mitchell was born in New Jersey and grew up with her two sisters in Jupiter, Florida. She graduated from high school in 1998 in Tarpon Springs, Florida, where she met and later married her husband in 2003.

Juli attended the University of Florida as a vocal music major and graduated with honors in 2002, receiving a Bachelor of Music with a minor in business. One year later, she returned to UF to pursue a Master of Interior Design. She studied abroad during the summer of 2004 at the Vicenza Institute of Architecture in Vicenza, Italy.

Following the completion of her degree, Juli plans to relocate to Seattle, Washington where she will apply her skills and energies to creating beautiful, sensitive, and healthy architectural environments.