Exploring design considerations of acute care for the elderly to improve patient outcomes

Holle Michoski
Iowa State University

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Exploring design considerations of acute care for the elderly to improve patient outcomes

by

Holle Michoski

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Major: Interior Design

Program of Study Committee:
Daejin Kim, Major Professor
Jae Hwa Lee
Cameron Campbell

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University
Ames, Iowa
2020

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<td>LOS</td>
<td>Length of Stay</td>
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<td>ADL</td>
<td>Activities of Daily Living</td>
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<td>IADL</td>
<td>Instrumental Activities of Daily Living</td>
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<tr>
<td>IDT</td>
<td>Interdisciplinary Team</td>
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<td>UTI</td>
<td>Urinary Tract Infection</td>
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I would like to thank my committee chair, Daejin Kim, and my committee members, Jae Hwa Lee, and Cameron Campbell, for their guidance and support throughout the course of this research. It truly would not have possible without Daejin’s assistance and direction, I am extremely grateful. In addition, I would also like to thank my family for their unconditional support, understanding, and patience through this process. And finally, my friends, colleagues, department faculty and staff for making my time at Iowa State University a wonderful experience.
ABSTRACT

Acute Care for the Elderly (ACE) is a model designed to address acutely ill elders by minimizing risks associated with hospitalization and maximizing or maintaining physical and cognitive functional levels during their stay. The ACE model incorporates four main principles into their concept, including patient- and family- centered care, a prepared physical environment, a specialized interdisciplinary team, and early discharge planning. The positive impacts of ACE include improved functional status, reduced rate of hospital readmission, decreased fall rates, shorter length of stay, reduced costs, and higher patient/provider satisfaction. The purpose of this research study was to understand the ACE model of care and identify environmental design strategies that support the physical, social, and psychological well-being of patients within the ACE unit and elder-friendly design. An integrative literature review was employed to identify design elements and considerations within the ACE units and hospitals for older adults, specifically within patient rooms. Key environmental facilitators in patient rooms for older adults include privacy, accessibility, familiarity, and social interaction. Designing an ACE unit that ensures the physical, social, and psychological well-being of the older adult requires knowledge of acute illness, age-related functionality, and elements of design needed to successfully carry out the model of care.
CHAPTER 1. INTRODUCTION

In an aging society, the number of individuals aged sixty-five and older are increasing at a rapid pace and account for over 40% of admissions to the acute care facilities (Krall et al., 2012). According to the World Health Organization, between the years 2015 and 2050, the proportion of the world’s population of adults sixty years and older will shift from 12% to 22%. The pace of this growing population is moving much faster than what has been seen in the past and our healthcare facilities need to be prepared to accommodate to this shift (Krall et al., 2012).

It has become apparent during the global pandemic of COVID-19 that elderly adults are exceedingly vulnerable and it is important to limit exposures that could harm their well-being and safety, especially during acute hospitalization. It is particularly true that there are age-related discrepancies between younger (eighteen to sixty-four) and older (sixty-five to eighty-five) adults that demand design considerations. Older adults are more likely to experience loss of sight, hearing, body function, and mobility, along with an increase in developing depression and delirium. Upon hospitalization, these challenges can worsen if the physical environment does not cater to their needs and can present massive barriers in recovery. Improving the quality of care and decreasing functional impairment during hospitalization is critical for the mortality and institutionalization rate of older patients. With an aging population, hospitals are going to face an economic incentive to offer cost-effective care that not only improves functional levels, but can deliver physical, social, and psychological well-being to older adults during their stay (Jayadevappa, Chhatre, Weiner, & Raziano, 2006). Additional criteria is needed to accommodate to the older population in healthcare facilities, other than the standard universal design and ADA guidelines. Acute Care for the Elderly (ACE) is an evidence-based model proven suitable for patient use, as it was designed to improve the outcomes for hospitalized elders, including
decreasing the length and cost of hospital stays, reducing functional decline, decreasing fall rates, and improving patient and staff satisfaction levels (Fox et al., 2013). Although studies have been conducted on the health benefits of the ACE model, there is minimal information on the design considerations to support the growth of ACE units emerging this population shift.

**Purpose of the Study**

There has been growing evidence that ACE units have a significantly positive effect on older patients’ outcomes, but there is a lack of critical attention about the roles the physical environment plays. Thus, the main purpose of this research was to understand the ACE model of care and identify the impact on patient outcomes and environmental design strategies that support the physical, social, and psychological well-being of patients within the ACE unit and elder-friendly hospital units.

Additional objectives of this study are as follows:

1. To understand acute illness and how it affects the aging population.
2. To identify the four principles of the ACE model and how they are implemented.
3. To investigate the impact of the ACE model on patient outcomes.
4. To understand elder-friendly hospital design and why it is effective.
5. To identify specific design elements of the ACE model through case studies.
6. To propose a design guideline for ACE units that ensure the physical, social, and psychological well-being of the elderly patients.

**Significance of the Study**

The significance of the study is to identify design features of the ACE model of care that could improve the patient’s outcome and experience during hospitalization. The results of this
research will be used to create a guideline of design elements that consider the physical, social, and psychological well-being of the patient and to propose a prototype design of the ACE unit. The research findings provide helpful information and advice regarding ACE units, which are of interest to interior designers and architects involved in healthcare design. ACE units have been growing rapidly over the last five years since they were first designed in 1990. More hospitals are starting to establish ACE units due to the strong evidence of improved patient outcomes and lowered costs, for both the hospital and patients. With ACE units on the rise and no current accreditation organization, it is important to provide design considerations and elements that benefit the patient, staff, and family (Clark, 2013).

Research Questions

This research is partially animated by a curiosity about how the physical environment in ACE units should be designed. The following questions will guide the research.

Questions related to ACE in the interior design context:

- What is the impact of the ACE model on patient outcomes?
- What are the specific design elements of ACE unit models?
- What are the specific design elements of elder-friendly hospital unit models?
CHAPTER 2. LITERATURE REVIEW

Acute Illness

Acute illness, while not considered fatal if properly treated, can lead to more serious impairments or diseases that contribute to a functional decline. Onset of acute illnesses typically accelerate at a rapid pace and require short-term care. Examples of acute illness include asthma attacks, broken bones, bronchitis, burns, common cold, flu, heart attacks, pneumonia, respiratory infections, and strep throat. These conditions are often results of an injury, virus, infection, or mistreatment with medication (Team, 2016). While these conditions are not typically fatal to a young and healthy adult, individuals sixty-five and older have a harder time adapting to the hospitalization. The hostile environment may provoke anxiety and safety concerns, depersonalization, malnutrition, restricted mobility, and contribute to the loss of functional independence. Dysfunctional syndrome, otherwise known as hospital-associated disability, is very common in older adults who are constrained into hospitalization. Anxiety, delirium, depression, falls, helplessness, pressure ulcers, and urinary tract infections (UTIs) are the most common hospital-associated disabilities in older patients that are all potentially preventable (Palmer, 2018). Other complications can be caused by changes in daily routine, environmental setting, various tests and procedures, and decreased mobility (Amador, Reed, & Lehman, 2007).

Functional status in the geriatric realm is measured by activities of daily living (ADL). ADL include bathing, dressing, transferring from bed to chair, toileting, continence, and eating. Instrumental activities of daily living (IADL) are explained as maintaining independence in handling finances, managing medications, using public transportation, conducting household chores and errands, cooking, and use of electronics (Palmer, Counsell, & Landefeld, 2003).
As seen in Table 2.1, there are many age-related changes that develop in older adults. These sensory changes can permute the way that older adults perceive and interact with their environment, which is crucial in an acute care setting. Poor nutrition and a decrease in appetite can occur from the changes in the olfactory cells and taste buds. Smell and taste start to diminish as aging occurs, which can affect an individual’s diet. Many changes to vision, including excessive dryness to eyes, yellowing of the cornea, and diminished pupil size can alter the color, light, glare, and detail perceived. Night vision is impacted as well, with some individuals acquiring night blindness, which can create challenges of navigating in dark and low-light environments. Physical changes to the face can include pouches under the eyes, which are caused by weakening of the eyelid elasticity. The color of the eye can change from white to yellow, as the sclera and cornea begin to yellow. Cataracts, macular degeneration, and glaucoma are at higher risks of developing as well. Exposure to light is crucial for regulating important biochemical processes through the skin and eye. Coordinating the biological clock, melatonin production, regulating body temperature, and enhancing attentiveness are all influenced by light contact. Therefore, giving visual access to natural light while incorporating high illuminance levels is important to older adults and their well-being.

Changes within the ear can include thinner skin, longer and thicker hair within the ear canal, and diminished neurons or cells, which can alter the ability to distinguish various pitches and sounds. Thickened and less robust membranes can result in a struggle of hearing high-frequency sounds. Due to the weakness and stiffness of aging muscles and ligaments within the ear, gradual loss of sound and impaired hearing may occur (van Hoof, Kort, Duijnstee, Rutten, & Hensen, 2009).
Other modifications to the human body that occur during aging include a decline in muscle strength, flexibility, and mobility. The action of gripping, turning, pulling, twisting, and pushing can become more difficult as control over the muscles weakens, so accessing any cabinets, doors, or other handle operated objects may present a challenge. Fatigue increases, especially when performing activities or tasks independently. A reliance on another person or the surrounding environment, specifically seating, resting against walls or other objects to prevent further fatigue increases. These changes can make it more difficult to conduct daily activities and perform tasks independently.

Along with physical functional decline, cognitive functional decline is a major issue. Changes in behavior, memory, perception, communication, orientation, comprehension, problem solving, language, and attention span are all common outcomes of declining cognitive function (Resnick, 2001). Age-related changes in cognitive functioning can include a greater risk of dementia and delirium, loss of memory, slower response times, and an increased difficulty in orienting, especially in an unfamiliar environment. Functional decline during hospitalization is supplementary to a greater risk of falls and rehospitalization after discharge and often leads to nursing home placement or mortality (Palmer et al., 2003). “The hospitalization, not the illness, may be the deciding factor in the functional ability of the frail elderly at discharge” (Palmer, Landefeld, Kresevic, & Kowal, 1994, page 545). By encouraging self-care, independent functioning, socialization with other patients and family members, physical activity, sufficient sleep, and nutrition, these threats can hypothetically be eliminated. The ACE model of care was created to prevent and reverse the dysfunctional syndrome while improving patient satisfaction in an efficient manner (Palmer, 2018).
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<th>Skeletal/Muscle Changes</th>
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<tr>
<td>❖ Increased sensitivity to glare</td>
<td>❖ Loss of hearing</td>
<td>❖ Reduced muscle strength</td>
</tr>
<tr>
<td>❖ Reduced depth perception</td>
<td>❖ Lessened ability to localize sound</td>
<td>❖ Decreased flexibility</td>
</tr>
<tr>
<td>❖ Difficulty adjusting to changing light levels</td>
<td>❖ Reduced ability to decipher pitch levels</td>
<td>❖ Reduced dexterity, difficulty pushing, pulling, gripping, lifting, twisting, etc.</td>
</tr>
<tr>
<td>❖ Discoloration and yellowing of the lenses</td>
<td>❖ Difficulty ignoring background or ambient noise</td>
<td>❖ Decreased coordination, difficulty kneeling, standing, and sitting</td>
</tr>
<tr>
<td>❖ Decreased ability to distinguish colors</td>
<td></td>
<td>❖ Slower locomotion speed</td>
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<tr>
<td>❖ Reduced ability of contrast detection</td>
<td></td>
<td>❖ Difficulties with balance</td>
</tr>
<tr>
<td>❖ Decreased vision in low light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>❖ Reduced visual acuity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>❖ Increased risk of macular degeneration, cataracts, and glaucoma</td>
<td></td>
<td></td>
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<tr>
<td>Cognitive Changes</td>
<td>Other Medical Challenges</td>
<td></td>
</tr>
<tr>
<td>❖ Greater risk of dementia</td>
<td>❖ Increased risk of falls</td>
<td></td>
</tr>
<tr>
<td>❖ Reduced ability to focus on details</td>
<td>❖ Susceptibility to delirium and incontinence</td>
<td></td>
</tr>
<tr>
<td>❖ Loss of memory</td>
<td>❖ Reduced thermal response</td>
<td></td>
</tr>
<tr>
<td>❖ Difficulty orienting oneself</td>
<td>❖ Susceptibility to delirium and incontinence</td>
<td></td>
</tr>
<tr>
<td>❖ Slower response time</td>
<td></td>
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Acute Care for the Elderly

In 1990, the University Hospitals of Cleveland designed the ACE model and unit to prevent functional decline in acutely ill elderly patients and to rehabilitate patients with functional decline preceding admission. Patients are admitted directly into the ACE unit, where there is an emphasis on environmental adaptations for the elderly and a specialized geriatric team catered to each individual. To reduce risks and maximize positive outcomes experienced by older adults while hospitalized, specific principles and guidelines are followed.

Principles of ACE

To successfully conduct the model, there are four principles of an ACE unit that are tailored to meet the patient’s needs, including a patient-centered care plan, a safe and prepared physical environment, an interdisciplinary team, and discharge planning to the least restrictive environment (Amador et al., 2007).

Patient-centered Care

Implementing patient- and family-centered care is a crucial process of the ACE model because it provides care that is respectful to the patient’s preferences, values, traditions, needs, and wants. Both the patient and family become essential members of the interdisciplinary team to make all clinical decisions. The staff and family are able to prioritize what services are needed and when. Many protocols are issued as preventative measures to maintain the baseline ADL specific to each patient, and a guideline is created to help patients reclaim independency, cognitive function, enhancing hearing and vision, and nutrition goals (Palmer, 2018). The ACE
unit is able to develop their own policies and procedures, including topics of functional assessment, fall prevention, elder abuse, exploitation, and neglect (Amador et al., 2007).

**Prepared Environment**

Creating a specialized physical environment is important to not only make the unit feel less institutionalized, but to also encourage socialization between other patients and family members, privacy, noise reduction, and improve patient safety and satisfaction (Palmer, 2018). To help promote a safe environment, modifications to lower beds, install exit alarms, raise toilet seats, install grab bars in all bathrooms and hallways, have supplies (walkers, commodes, wheelchairs) in close proximity, and opportunity for constant observation are encouraged (Krall et al., 2012). Disorientation and depersonalization are two major factors that can contribute to functional decline. Placing clocks and calendars on the walls in patient rooms and applying a non-sterile paint color, flooring or artwork with visual interest in the corridors and communal spaces will help facilitate orientation and wayfinding. To avoid and decrease the hazard of depersonalization, including space for personal belongings and a large communal space for family gatherings and socialization were added (Palmer et al., 1994). Communal spaces can include a sitting area with tables and chairs, a space for puzzles or magazines, music therapy, and selected artwork that could inspire nostalgia.

Creating a homelike environment encourages normalcy and facilitates an easier transition into hospitalization. Adding aesthetically pleasing curtains for privacy, lighting on the floor and behind the beds, reclining chairs, and adding sleeper sofas in the patient rooms permits family to spend more time with the patient. Having a spacious room is important to help the patient feel less constricted, but to also make the unit staff friendly and functional. To accommodate the
patient-centered care, meetings can be held within the room itself, and any education lessons can be given to the patient and family members simultaneously in a homelike setting.

Nursing pods or alcoves, which include a desk, chair, computer, telephone, storage, and files, are placed along the corridors in two- to four-room intervals. This guarantees a timely access and response rate to each patient room. File storage is needed for access to patient information, while a storage room or cabinet is needed for housing extra wheelchairs, walkers, commodes, or other equipment that could be utilized during a patient’s stay. Large windows that look into the individual rooms from the central corridor are helpful for the complete interdisciplinary team to manage and monitor patients. Many windows have operable interior blinds that can be closed to the patient and staff’s discretion for privacy matters (Amador et al., 2007).

Hospitals must comply with the room specifications of the Americans with Disabilities Act (ADA), which are congruent with the standards and guidelines created for an ACE unit. Table 2.2 shows the design principles provided by NCBI when building or remodeling an ACE unit (Palmer, 2018). Table 2.2 provides information on the contents per patient bed, spacing/pathways, safe bed exit, IV pole, grab bars, furniture/equipment, bathroom, and hallways.
### Table 2.2 Prepared and Safe Hospital Environment

**Goal:** Standardize safe furniture and equipment placement in the patient room and public thoroughfares to prevent falls and injuries and to optimize patient self-care.

**GENERAL PRINCIPLES FOR PATIENT ROOM:**

- Note: Americans with Disabilities Act (ADA) requires 10% of Acute Care beds comply with ADA standards

- CONTENTS per Patient Bed
  - One patient chair (with armrests)
  - One visitor chair (armrests preferred). If additional visitor chairs, consider using folding chairs in order to remove or fold away when not in use.

- One night stand
- One over-bed table
- Telephone (type that mounts onto side rail preferred)
- Patient waste can
- Two staff waste cans (regular trash and hazardous waste)
- No linen carts (holder on wall with linen bags preferred)
- These items are needed only if patient is using them
  - IV pole
  - Bedside commode with toilet paper holder mounted on side
- Electrical outlets every 12 feet (standard) can be adapted to equipment and usage needs in the patient room
- Furniture and sinks with rounded edges (minimizes injury if patient falls)

- Note: If only one chair can fit into the room, the priority is the patient chair.
- Also, recommendation is that 20% of acute care beds to be equipped with bariatric furniture.

- SPACING/PATHWAYS
  - Clearance space of 3 feet exists around the bed, except at the headwall (ADA). Primarily applies to stationary furniture/equipment. Movable furniture is permitted within this space.
  - Minimum 3 feet between patient beds in semi-private rooms (ADA)
  - Vertically, anything protruding from the wall, within a zone of 80 inches from the floor, must be < to 4 inches, except at the headwall of the bed (ADA)
  - Clear pathway from patient bed to bathroom and entrance/exit to room
SAFE BED EXIT
- Safe bed exit is identified and located on patient’s side of preference, or dominance, especially if a functionally limiting clinical condition exists (such as weakness due to stroke).
  - If no patient preference, the default for safe exit is the side of the bed closest to the bathroom.
- Safe exit side of bed is visually noted in the patient’s room
- Items on safe exit side include:
  - Night stand (within reach)

IV POLE (If being used by patient)
- Beside commode (if being used by patient)
- Items NOT on safe exit side include:
  - Over bed table
  - Chairs (patient and visitor)
  - Patient’s garbage can

GRAB BARS
- Continuous grab bars or handrails available along walls, except where there is affixed, stationary furniture.

Note: This decreases room space by 3 inches on every side there is a grab bar. May want to consider furniture placement as an alternative.

FURNITURE/EQUIPMENT
- Patient chair is designated as such and has armrests
- Rounded corners on furniture or bumper guards on edges
- Assistive equipment and call bell is within patient’s reach
- Lever handles on doors, no doorbells (ADA)
- Divider curtains between beds pull all the way back to the wall
- Electrical cords bundled and kept away from walking paths
### BATHROOM
- No tub
- Walk-in/wheel-in shower (ADA)
- Doorway wide enough for patient and equipment (Standard dimensions: patient room an entry door width of 48 inches, bathroom entry width of 36 inches)
- Continuous grab bars, especially behind and on wall side of toilet (ADA)
- Flip down bars not recommended for toilet area, instead use wall mounted or toilet mounted grab bar that utilizes a mounting bracket
- Sinks with no support between sink and floor must meet mounting standards to tolerate patient weight leaning on sink
- “No slip” surface on floor (0.08 slip co-efficient on potentially wet surfaces)
- Devices available to elevate toilet seat 17-19 inches from floor (ADA)
- Emergency cord accessible from both toilet and shower (ADA)
- Curbless shower threshold (ADA) with two drains (one inside shower and out outside shower area)
- Sensor light in bathroom that automatically turns on when someone enters
- Glow in the dark toilet seats, or seats with a glowing border to help patient locate it (not necessary if lighting turns on automatically on entry). Nightlight that illuminates toilet area is an alternative.

![Bathroom Diagram]

### HALLWAYS
- No equipment permanently stored in hallways
- When in use, equipment placed on one designated side of hall
- Low glare floors with visual breaks (synthetic surfaces)
- Handrails on both sides of the hall that are either a different color than the walls, or have built in lighting to provide contrast against the wall
- Diffuse lighting that projects vertically
- Mirrors for blind corners
- “High risk” patient room with adjustable visibility to front of room for monitoring
**Interdisciplinary Team**

The specialized interdisciplinary team comes from a combination of disciplines, including geriatricians, nurses, nutritionists, social workers, physical therapists, occupational therapists, and pharmacists (Ahmed & Pearce, 2010). Disciplines available to join the existing interdisciplinary team, dependent on patient needs, include speech therapists, ethicists, clergy, and psychologists (Amador et al., 2007). Their purpose is to collaboratively work towards goals established between the patient, staff, and family upon hospitalization. The team meets daily, approximately in half-hour segments, to discuss each patient and their progress, concerns, discharge, schedules, and continue to develop the patient’s care plan for the remainder of their stay (Ahmed & Pearce, 2010). Table 2.3 shows the core members of the interdisciplinary team and their main tasks and roles written by NCBI (Palmer, 2018).

**Discharge Planning**

Discharge planning is administered by the interdisciplinary team the day of admission. Starting the discharge planning process early can allow an estimation of length of stay, encourages communication and ensures like-mindedness across all disciplines of the team members, anticipated outcomes, assist with arranging at-home services, and can help prepare patients on expectations of care during the transition from the hospital to home or other destination (Palmer et al., 1994). Making sure the patient and family members have clear instructions on how to care for themselves after discharge is crucial in reducing the probability of hospital readmission, nursing home placement, or even mortality (Amador et al., 2007).
### Table 2.3 Interdisciplinary Team Members, Tasks, and Roles

<table>
<thead>
<tr>
<th>Member</th>
<th>Tasks/ Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physician and/or bedside nurse</strong></td>
<td>• Admitting diagnosis or problem: key findings</td>
</tr>
<tr>
<td></td>
<td>• Relevant past medical history</td>
</tr>
<tr>
<td></td>
<td>• Treatment plans</td>
</tr>
<tr>
<td></td>
<td>• Anticipated length-of-stay and post-acute site of care</td>
</tr>
<tr>
<td><strong>Bedside nurse (report)</strong></td>
<td>• Assess baseline and current functional status: ADL, mobility, mood/affect,</td>
</tr>
<tr>
<td></td>
<td>cognition, living situation, social support, nutritional status (role shared with physician)</td>
</tr>
<tr>
<td></td>
<td>• Implement preventative/restorative protocols</td>
</tr>
<tr>
<td><strong>Care coordinator/social worker</strong></td>
<td>• Identify resources (caregiving, finances, options)</td>
</tr>
<tr>
<td></td>
<td>• Coordinate discharge (transitions) options</td>
</tr>
<tr>
<td></td>
<td>• Order durable medical equipment</td>
</tr>
<tr>
<td><strong>Clinical pharmacist</strong></td>
<td>• Assess medical appropriateness (potentially inappropriate medications) (shared role with physician)</td>
</tr>
<tr>
<td></td>
<td>• Plan for monitoring of high-risk medications</td>
</tr>
<tr>
<td><strong>Physical therapist</strong></td>
<td>• Mobility assessment (shared role with bedside nurse)</td>
</tr>
<tr>
<td></td>
<td>• Transfer and gait assessment with recommendations</td>
</tr>
<tr>
<td></td>
<td>• Determine need for skilled services (rehabilitation)</td>
</tr>
<tr>
<td><strong>Occupational therapist</strong></td>
<td>• Assess need for ADL devices/aids</td>
</tr>
<tr>
<td></td>
<td>• Evaluate physical functioning</td>
</tr>
<tr>
<td></td>
<td>• Determine need for skilled services (rehabilitation)</td>
</tr>
<tr>
<td><strong>Dietitian</strong></td>
<td>• Assess baseline nutritional status</td>
</tr>
<tr>
<td></td>
<td>• Offer dietary recommendations</td>
</tr>
<tr>
<td></td>
<td>• Work with speech therapy in assessment of oral feeding</td>
</tr>
<tr>
<td><strong>Summary: Interdisciplinary team</strong></td>
<td>• Estimate functional trajectory</td>
</tr>
<tr>
<td></td>
<td>• Estimate length of hospital stay</td>
</tr>
<tr>
<td></td>
<td>• Estimate post-acute requirements</td>
</tr>
<tr>
<td></td>
<td>• Review quality of care and safety</td>
</tr>
<tr>
<td></td>
<td>• Plan for care transitions</td>
</tr>
<tr>
<td><strong>Patient and family (medical power of attorney)</strong></td>
<td>• Review goals of care, personal preferences, advance directives</td>
</tr>
<tr>
<td></td>
<td>• Engage in self-care</td>
</tr>
<tr>
<td></td>
<td>• Share decision-making with ACE team</td>
</tr>
</tbody>
</table>
CHAPTER 3. METHODOLOGY

In this thesis an attempt will be made, based on a qualitative approach, to understand the ACE model of care and the unit design considerations from an interior designer’s viewpoint, as well as an understanding of the interaction between the built environment and older patients’ outcomes within the hospital setting. This thesis is an effort to create a prototype as a guide for designers to facilitate the growth of ACE units and create an effective physical, social, and psychological environment for older adults. As shown in Figure 3.1, there are two steps in order to achieve the purpose of this research identifying environmental design strategies in ACE units. First, the integrative literature review includes impacts of ACE units on patients’ outcomes and design features in elder-friendly hospitals. Literature findings will focus on the layout and zoning of space, privacy, lighting and acoustic considerations, finishes and materials, and nature distraction. Second, the case study will describe design elements and considerations used within ACE units and elder-friendly design. The case is important for studying the elements and principles of the ACE unit in order to further discuss a design guideline and develop a prototype that can facilitate future ACE unit growth and elder-friendly hospitals.

![Figure 3.1 Literature Review Flow Diagram](image.png)
Table 4.1 Evidence Table for Impacts of ACE

<table>
<thead>
<tr>
<th>Source</th>
<th>Target Population</th>
<th>Objectives</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspund et al., 2000</td>
<td>Hospitalized older adults aged ≥ 70 years assigned to acute geriatrics-based ward vs. general medical ward</td>
<td>To determine if specialized, geriatric approach shortened the length of stay and decreased discharges to nursing home facilities</td>
<td>Decreased LOS&lt;br&gt;Decreased NH placement&lt;br&gt;Neutral impact of cost&lt;br&gt;Neutral impact on functional status&lt;br&gt;Neutral impact on readmissions</td>
</tr>
<tr>
<td>Counsell et al., 2000</td>
<td>Hospitalized, community-dwelling adults aged ≥ 70 years</td>
<td>To determine if ACE would improve functional outcome without increasing costs</td>
<td>Neutral impact on cost of care&lt;br&gt;Neutral impact on LOS&lt;br&gt;Decreased NH placement&lt;br&gt;Decreased functional decline&lt;br&gt;Increased patient/provider satisfaction</td>
</tr>
<tr>
<td>Covinsky et al., 1997</td>
<td>Acutely hospitalized medical patients with a mean age of 80 years</td>
<td>To compare the cost of acute medical care between ACE and usual care</td>
<td>Higher initial cost of care&lt;br&gt;Decreased total cost of care&lt;br&gt;Decreased LOS&lt;br&gt;Decreased hospital readmission</td>
</tr>
<tr>
<td>Covinsky et al., 1997</td>
<td>Hospitalized older adults aged ≥ 70 years</td>
<td>To determine if ACE contributed to decreased hospitalization costs and improved functional outcomes versus usual care</td>
<td>Decreased LOS&lt;br&gt;Increased initial costs&lt;br&gt;Decreased total costs&lt;br&gt;Decreased functional decline</td>
</tr>
<tr>
<td>Jayadevappa et al., 2006</td>
<td>Hospitalized older adults with a mean age of 79.6 with an admitting diagnosis of UTI or CHF</td>
<td>To determine if ACE decreased cost of care and improved hospital outcomes when compared to usual care</td>
<td>Decreased hospital costs&lt;br&gt;Decreased LOS&lt;br&gt;Decreased acute care readmissions&lt;br&gt;Decreased NH placement</td>
</tr>
<tr>
<td>Landefeld et al., 1995</td>
<td>Hospitalized older adults aged ≥ 70 years and at teaching hospital randomized to a specialized geriatric unit versus usual care</td>
<td>To determine whether ACE contributed to improvement of functional mobility and performance of ADL when compared to usual care</td>
<td>Decreased cost of care&lt;br&gt;Decreased LOS&lt;br&gt;Decreased NH placement at discharge&lt;br&gt;Decreased functional decline</td>
</tr>
<tr>
<td>Study</td>
<td>Population Description</td>
<td>Study Objectives</td>
<td>Findings</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Krall et al., 2012</td>
<td>Hospitalized older adults aged ≥ 65 years with a history of mild impairment or dementia</td>
<td>To examine falls, pressure ulcers, functional levels, and LOS between ACE and usual care</td>
<td>Decreased functional decline, Decreased fall rates, Decreased LOS</td>
</tr>
<tr>
<td>Flood et al., 2013</td>
<td>Hospitalized older adults aged ≥ 70 years spending majority of hospital stay in ACE or usual care</td>
<td>To examine variable direct costs between ACE and usual care</td>
<td>Decreased hospital costs, Decreased hospital readmission</td>
</tr>
<tr>
<td>Wald et al., 2011</td>
<td>Hospitalized patients aged ≥ 70 years</td>
<td>To evaluate hospital charges, LOS, readmission rates, discharge location, and falls between ACE and usual care</td>
<td>Decreased fall rates, Neutral impact on cost of care, Neutral impact on LOS, Neutral impact on readmissions</td>
</tr>
<tr>
<td>Barnes et al., 2012</td>
<td>Hospitalized patients aged ≥ 70 years</td>
<td>To compare LOS and hospital costs between ACE and usual care</td>
<td>Decreased LOS, Decreased hospital costs</td>
</tr>
</tbody>
</table>
CHAPTER 4. INTEGRATIVE LITERATURE REVIEW

Impacts of ACE

An intensive literature review was conducted in order to understand the roles of ACE units on patient outcomes. As seen in Table 4.1, several studies have been conducted to compare these deliverables between ACE and usual care. Positive impacts of the ACE model include an improved functional status; lower risk of hospital readmission and nursing home placement; higher levels of patient, family, and staff satisfaction; decreased fall rates, and shortened length of hospital stay (Palmer et al., 2003).

Reduced Functional Decline

Functional decline is one of the biggest downfalls and challenges of hospitalization in older adults. Along with normal changes that go along with aging and previous health problems, hospitalization can lead to serious irreversible decline in functional status and lack of independency (Mehta, Yaffe, & Covinsky, 2002). Poor hospital design has adverse effects on patients, including increased anxiety, sleeplessness, and delirium. Designing a functional space that supports patients during stress and their newfound illness can aid and encourage fast recovery (Douglas & Douglas, 2005).

Delirium and depression are common among hospitalized patients, especially in older adults. Depressive symptoms have been linked to declining functional status and may also lead to cognitive impairment, or vice versa (Mehta et al., 2002). The ACE unit was designed to reduce the risk of functional decline and delirium (Ahmed & Pearce, 2010). Maintaining independence during hospitalization is important, not only for functional status, but for the patient’s morale. Allowing the patient to have control over their environment (e.g. lighting,
temperature, drawing the blinds) and designing to cater to visitors within the unit is essential. Permitting accessibility to the outdoors and having windows within the units have been found to uplift moods and to encourage social interaction and normalcy (Douglas & Douglas, 2005).

In noninstitutionalized adults seventy years and older, 20% need help performing at least one daily activity (Mehta et al., 2002). Upon arriving, the patient is assessed on their ability to achieve daily living activities independently, including bathing, dressing, toileting, transferring, continence, and feeding. The Katz Index of Independence in Activities of Daily Living (KATZ ADL) has been found to be successful in measuring the independent performance of these daily activities and has been used for over thirty-five years within hospital and home environments to assess older adults and their functional status. The patients are scored on a level from six to zero, both before and after discharge. Six indicates full function, four or below indicates impairment, and two or below indicates severe functional decline (Krall et al., 2012).

**Reduced Hospital Readmission**

Hospital readmissions can lead to functional and physical decline, loss of independence, higher costs, and initiate long-term institutionalization. Patients who are discharged from the ACE unit have been more functionally, socially, and physically inclined than those discharged from usual care (Ahmed & Pearce, 2010). According to a study from Jayadevappa et al., there was an 11% decrease in hospital readmissions and 8% decrease in nursing home placement compared to usual care. It is typical for an elderly patient to never return home once discharged into a nursing home, which is why it is critical to maintain or improve functional levels during hospitalization. The hospital readmission or nursing home placement rate can act as an illustration for the quality of care received within the ACE unit, which can be crucial for the reputation of the hospital (Jayadevappa et al., 2006). Landefeld et al. (1995), has also reported a
significant decrease in long-term care discharges from patients who received ACE care compared to usual care. Because the ACE unit maintains or improves functional levels, it is less likely to cause caregiver burden, which is correlated to lower nursing home placement rates (Ahmed & Pearce, 2010). Caregiver burden is brought on by informal care of someone, typically a family member or friend, outside of hospitalization. Being a caregiver of an older adult that suffers from frailty, low functional status, and dependency can lead to depression, anxiety, and other negative effects (Ringer, Hazan, Agarwal, Mutsaers, & Papaioannou, 2017).

**Increased Patient/Provider Satisfaction**

The ACE model introduces a patient-centric approach to geriatric care, which has been found to improve the process of care and overall satisfaction between the caregiver and patient compared to usual or previous care, without increasing the length of stay or hospitalization costs (Jayadevappa et al., 2006). According to a study conducted by Ahmed et al., nurses in the interdisciplinary team were very satisfied that the elderly patients were receiving needed care tailored to their illness and age, compared to being treated in a usual unit. All satisfaction scores for the interdisciplinary team, patients, and family members were superior to those who were treated in usual care (Ahmed & Pearce, 2010). The physician and nurse ratings, residency education, staff attitudes, and administrative support were all found more satisfactory in the ACE unit (Jayadevappa et al., 2006).

**Decreased Fall Rates**

Frailty is exceptionally common in older adults, especially within acute care facilities. Frailty can lead to a higher risk of hospital-associated disabilities, extended length of stay, hospital readmission, nursing home placement, and mortality (Mudge & Hubbard, 2019). The
ACE unit has addressed ways to keep the fall rate at a minimum, or zero, by implementing strength programs, having patients within view of a caregiver at all times, and continuously assessing functional levels. The interdisciplinary team makes rounds hourly to visit patients and assess their comfort level, assist them with repositioning and toileting, and any other ADL that may cause a fall hazard. Strength and walking programs are encouraged by the staff, which take place several times a day to maintain physical ability. In a study conducted by Krall et al., there was a reported zero falls compared to six that took place in usual care outside of the ACE unit (Krall et al., 2012).

**Shortened Length of Stay and Lower Costs**

Shortened length of stay and lower costs are congruent with each other and are influenced by other factors. For example, decreased readmission rates along with decreased length of stay will reduce costs. On average, the ACE unit reported a one-day reduction of length of stay compared to usual care. The ACE unit typically has higher initial costs, but because of the shorter length of stay, it is significantly less compared to the cost of usual care (Ahmed & Pearce, 2010). Jayadevappa et al., reported a 21% reduction in costs compared to usual care, including lower room, physical therapy and medical supply costs (Jayadevappa et al., 2006). Flood et al., used the Transaction Systems Incorporated (TSI) database to acquire financial evidence from the patients during their hospitalization. The evidence included total cost of patient stay from fixed direct, variable direct, and indirect costs. Fixed direct costs are defined as costs that cannot be associated to a specific patient, including the salaries of the interdisciplinary team. Variable direct costs are costs associated directly with the patient, including tests or medications. Indirect costs are defined as costs that cannot be associated to a specific patient or department, including the utility bill of the general wing. Due to the discrepancy of the fixed
direct and indirect costs, the study measured the total variable direct costs of each patient within the ACE unit. The calculation of daily variable direct costs was concluded by dividing the total variable direct costs by the length of stay. The findings determined that the ACE unit was significantly less expensive than usual care, resulting in a one-hundred dollar or more difference per day (Flood et al., 2013).

**Elder-Friendly Hospital Design**

Designing a physical environment for the elderly should focus on accessibility, independence, safety, minimizing vulnerabilities, and supporting functional well-being. Many hospitals have been designed to augment care for the younger demographic and respond to illnesses without acknowledging the age-related changes older adults are experiencing. Small challenges that would be negligible to a younger patient can be detrimental and prompt substantial declines in functioning of older adults by increasing the length of stay, compromising independence, and other adverse effects (Wong, Ryan, & Liu, 2014). Lawton and Nahemow stated, “A person’s functioning is the result of biological, psychological, and social resources as well as the environment and the fit between individuals and their environments.” (Nordin et al., 2017, page 728). With age comes an unavoidable decline of vision, audition, body function, and mobility. As designers, it is important to recognize these challenges to provide a physical environment that is tailored to the loss of these age-related changes (Boot, Nichols, Rogers, & Fisk, 2012). During hospitalization, the patient spends a majority of time within the walls of their room. Incorporating design features that facilitate healing and warrant the safety of older adults in the patient rooms significantly affects the patient’s well-being and recovery process (Lorenz & Dreher, 2011).
Lighting and Acoustic Considerations

Age-related changes of visual impairment include acuity, contrast detection, glare, discoloration, reduced depth perception, and failure to adjust to light or dark areas. Of the legally blind, 46% are over the age of sixty-five (Webb & Weber, 2003). As an individual ages, the cornea tends to scatter light as it enters the eye, allowing less light to reach the retina. Because of this, older adults have lower contrast detection and are more susceptible to glare (Boot et al., 2012). Using non-reflective surfaces and providing a form of window covering (tinting, film, shades, or solar shading) can help prevent glare within the patient room (McCunn & Gifford, 2013). Yellowing of the lens is another age-related challenge, causing colors to be more difficult to distinguish in lower light levels and lower color saturations, especially blues and greens (Boot et al., 2012). Blues can start to look like greens, while purples or violets can become gray (Webb & Weber, 2003). Using warmer tones, like red, orange, and yellow, is encouraged in a setting for older adults to ease confusion and make it easier on the eyes (Friesen, 2015). It is recommended when using color in a space, to use a single shade at a high saturation level and to avoid close colors on the color spectrum so color and contrast distinction is simple (Boot et al., 2012). Using contrasting colors on the walls and floors can help define boundaries and orientation. Avoiding bold patterns on the walls, flooring, and other materials or surfaces can help ease visual stimulation and confusion in older adults (Friesen, 2015). Various depths of information should be minimized as much as possible because it is challenging for older adults to perceive and focus on objects of different depths, especially at a distance. Macular degeneration, cataracts, and glaucoma are common in older adults and have been associated with loss of detail and sensitivity to luminance, contrast, color, and motion.

Older adults benefit from increased illumination and even lighting levels in all environments (Boot et al., 2012). Exposure to both artificial and natural light can decrease
depression, anxiety, agitation, and can help regulate sleep and the patient’s circadian rhythm. Having access to natural light has been found to facilitate the healing and recovery process, benefiting patients far more than artificial light. Reducing or blocking off natural light from patients can worsen depression, stress, sleep schedules, and cognitive functioning. Having access to a nature view through a window can offer positive distraction and stress relief during the patient’s stay. Orienting east-facing windows in patient rooms can provide space with natural daylight, making sure to place the bed in a position where the patient can take advantage of the sunlight (Ulrich, 2004). Installing windows that line the top of the wall can achieve access to natural daylight while also contributing to even lighting levels, thermal control, and allowing light to penetrate through large buildings into corridors or hallways (McCunn & Gifford, 2013). Creating ambient light compared to direct light, along with having more than one light source, will lessen glare and reduce harsh shadows (Boot et al., 2012). Combining the use of ceiling-mounted light fixtures with indirect lighting (i.e., standing or table lamps) can increase lighting levels and distribute light throughout the space (Friesen, 2015). Incorporating wall-mounted lighting above patient beds with two sources of light (one accessible to patient by pull-chain, another accessible to staff by main switch) can allow both patients and staff to maintain control of lighting without compromising functionality (McCunn & Gifford, 2013). Directly outside of the bathroom door and inside the bathroom, installing night lights, automatic lighting, and illuminated light switches is recommended to ensure patient safety and orientation. Patient-controlled lighting within the hospital room is strongly encouraged to give a sense of familiarity, control, and to allow the patient to personalize the space to their own liking and comfortability. Adding task lighting can encourage normalcy to continue hobbies of their everyday life during hospitalization and maintain cognitive function (Friesen, 2015).
Auditory issues arise from loss of hearing and lessened ability to localize sound. Higher frequency sounds are more difficult for older adults to hear and should be avoided, with men having a harder time deciphering than women. Providing volume control to allow individuals to adjust levels of frequency themselves is encouraged, especially if there is a white noise machine. Auditory stimulation should be not presented directly in front or behind an individual to orient attention, but rather for durations of time long enough for the individual to localize where the sound is coming from. Inserting visual cues in areas where there could be high noise levels is important for optimal perception (Boot et al., 2012). Noisy environments can increase stress, heart rate, and blood pressure (Rainey, 2019). Both patient and staff productivity suffer from a noisy environment. Engagement between patient and staff becomes less personal, cognition is delayed, concentration is compromised, and stress is induced (Chaudhury, Mahmood, & Valente, 2009). Using sound-absorbing materials is encouraged on floors, walls, ceilings, or partitions to combat noise (Boot et al., 2012). It has been found that when traditional lightweight ceiling tiles have been exchanged with sound-absorbing ceiling tiles, patients tend to sleep better, have decreased levels of stress, and feel as though they received better care (McCunn & Gifford, 2013). Installing solid doors to reduce noise transfer from hallways and other gathering areas outside of the patient room can help reduce excess environmental noise, being aware to not compromise the safety of the patient (Friesen, 2015). A Quiet Treatment Room has been used in various hospitals to accommodate one patient at a time when noise levels overstimulate the individual to provide a calm, relaxed, private, and quiet environment (McCunn & Gifford, 2013).

**Body Functionality/Mobility**

Body functionality presents a challenge to the older population when it comes to design. The act of pushing, pulling, gripping, lifting, twisting, and pressing can become more difficult as
the body ages and muscle strength declines (Boot et al., 2012). As muscle strength declines and posture changes, individuals become smaller over time. The ability to avoid environments or situations that cause vulnerabilities is lessened (Webb & Weber, 2003). Including accessible handles, faucets, levers, and grab bars is crucial when designing for the elderly. Extra texture can be provided to help reduce over-gripping and counteract perceptual loss (Boot et al., 2012). Installing lever-styled handles that can be operated with one hand and avoid twisting are recommended on all doors. Side-hinged windows are easier to open and operate compared to windows with the “lift-up” functionality (Friesen, 2015).

Along with the loss of hand and arm function, mobility presents a challenge to older adults as well. It becomes more difficult for older adults to kneel, transition from a sitting or standing position, and stand upright (Demirkan, 2015). Balance becomes more difficult as aging occurs, which increases the amount of time both feet need to be on the ground, slowing down the walking and locomotive speed. It is important to cater to this speed when placing revolving or automatic doors. Installing handrails or furniture along walls and long corridors for support is encouraged to aid balance (Boot et al., 2012). Selecting a contrasting finish on handrails is helpful to differentiate the safety feature from the wall, allowing older adults to visualize the handrail from a distance (Friesen, 2015). Placing visual cues on walls or surfaces can assist older adults during locomotion to aid balance and give them something to focus on. When there is a change of slope, indicating arrows, ramps, or handrails is necessary to warn the individual of the change in level (Boot et al., 2012).

Privacy

Single-occupancy patient rooms have been recommended by the American Institute of Architects (AIA) as the industry standard in all new construction of acute care facilities. Private
rooms foster many advantages compared to multi-patient rooms, including a decrease of infections, an increase in staff efficiency, providing additional space for friends and family to visit, greater privacy, and a decrease in noise level. Although the single-occupancy rooms produce a 14% higher initial cost during construction, they typically pay themselves off in two to three years (Lorenz & Dreher, 2011; Rainey, 2019). Patients are shown to heal and recover at a quicker pace, allowing more patients to go through the hospital. The employee turnover rate and medical error rate have declined. Single-occupancy rooms tend to attract more patients, as long as the individual has the resources to choose where they are placed (Rainey, 2019). Social support during a hospitalization can drastically affect the recovery process. Accommodations for family and friends to stay in the room with the patient can encourage normalcy, a homelike atmosphere, and provide a positive, secure setting. Providing a personal environment has been shown to help patients focus on themselves, improve sleep, lessen the chance of depression or stress, and ease the healing process (Persson, Anderberg, & Kristensson Ekwall, 2015). In contrast, patients without visitors in a single-occupancy room can feel isolated, lonely or even unsafe, so providing both private and semi-private rooms can guarantee that the needs of all patients are met by giving them the option to choose how they receive care (Lorenz & Dreher, 2011).

A private bathroom attached to each patient room ensures privacy, infection control, and is highly preferred over a shared bathroom. Providing a safe space for older adults within the bathroom is crucial, as the majority of falls and injuries occur within the room. Outside of the ADA guidelines and other space programming recommendations, additional design elements to take into consideration are the toilet seat, counter, shower, and faucets. Toilets that provide back support are needed to assist the individual with balance and facilitate the act of sitting down and
standing up. A flush mechanism that is easy to use (i.e., lever) is encouraged, as you can operate it with one hand and it does not require an excessive amount of strength. Toilet paper should be visible and within reach of the toilet, avoiding placing holders on or behind the fixture. Providing a chair for patients with a wheelchair, walker, or other device can assist staff with transferring and provide a sense of security for the patient. Clear space under counters is needed for wheelchair access, with a counter height no higher than 34 inches to accommodate. Faucet specification should be operable with a single arm and mounted where they can be reached from a wheelchair (wall-mounted not encouraged). Standing showers should be fitted to accommodate a wheelchair and offer a sitting surface. Fixtures should be accessible from the height of a wheelchair and be operable with one hand. Grab bars should be placed along the walls and adjacent to every fixture, allowing the patient to have assistance during any task. Any accessories or towel dispensers should be mounted no higher than 48 inches from the floor, while bath hooks should be mounted no higher than 56 inches from the floor (Friesen, 2015).

Layout/Zoning

In single-occupancy patient rooms, there are typically four categories of zoning including the patient zone, patient bathroom, staff zone, and family zone. According to a study by Hughes et al. (2008), nurses were found to follow three main paths: different points within the staff zone, trips between staff zone and patient zone, and different points within the patient zone. The efficiency of the staff was reliant on the spatial configuration of the unit. Since a majority of time is spent within the patient and staff zone, incorporating a decentralized nursing station or storage area that allows space for supplies, linens, or other equipment can improve quality of performance, reduce fatigue of staff, and encourage increased monitoring of patient. Standardization of room layout, location of supplies, furniture, and equipment, and consistency
of materials and finishes within the patient rooms is essential to staff efficiency, productivity, patient safety, and satisfaction from both staff and patient (Reiling, J; Hughes, 2008).

**Ergonomics**

One of the main goals in elder-friendly hospital design is creating a space that resembles a homelike atmosphere rather than an institutionalized feel. Incorporating space for personal belongings, attaching whiteboards for notes written by friends and family, and placing enjoyable artwork throughout the room has been shown to evoke positive attitudes and higher satisfaction rates from both the patient and staff (Persson et al., 2015). Specifying furniture and equipment that is not only aesthetically pleasing, but safe and functional for patients is crucial for their physical and psychological well-being. When selecting chairs or sofas, sturdy, four-legged objects should be considered. Seat cushions or padding should be angled slightly forward to provide support when transitioning into the standing position. Avoiding any furniture that has a back-tilt option or movable casters will help ensure the safety of the patient. Sharp edges are frowned upon to avoid injury. Slight variations of furniture can be considered in a single patient room to provide options for the older adult, allowing them to select whichever is most comfortable. If arm chairs are provided, the armrest should cover the entire base of the chair to deliver support when sitting down or standing up. When selecting upholstery, it is encouraged to consider matte, non-slip fabrics in a solid color that contrasts from the surrounding environment, while avoiding bold patterns. Sturdy tables with rounded corners that accommodate wheelchair access are recommended and an adjustable height feature is encouraged. Every room should be equipped with a hospital bed, overbed table, visitor chairs, and at least one chair with an armrest. When space planning for a patient room, it is important to consider barrier-free access when placing furniture. Fall prevention is crucial for the safety of the patient and staff (Friesen, 2015).
The following codes from FGI Guidelines for Design and Construction of Hospitals, 2018 are referenced for the specification of furnishings:

### 2.1-7.2.4 Furnishings

#### A2.1-7.2.4 Furnishings

a. *Characteristics and criteria for selecting furnishing materials and products.* The effect of furnishing material colors, textures, and patterns on patient staff, and visitor safety and on maintenance and life cycle performance should be considered in the overall planning and design of the facility.

b. *Work areas.* Where a work space, work area, work counter, or work surface is provided, it should have a minimum of 4 square feet of contiguous clear surface for each person programmed to work in the space at the same time.

#### 2.1-7.2.4.1 Built-in furnishings

In patient treatment areas with risks of exposure and contamination from bodily fluids and/or other fluids, built-in furnishings shall be upholstered with impervious materials where required by an infection control risk assessment (ICRA).

a. *General furnishing characteristics*

- Built-in furnishings should have eased or rounded edges and corners of no less than 3/8-inch radius to avoid patient injuries.
- Built-in furnishings should have non-abrasive surfaces to minimize patient injuries, such as abrasions and skin shear.

b. *Seating.* Evidence identifying single environmental variables and their importance in patient falls is still emerging. A number of studies have suggested an associated between falls and the design of chairs, whether built-in or freestanding.

- Built-in seating used by patients should be appropriate or adaptable to the height, weight, and physical limitations of the patient population.
- Seated patients should be able to place their feet flat on the floor with level thighs to facilitate successful sit-to-stand movements.
- Space beneath a seat front should allow a user to pull back his or her heels far enough under the seat to assist with rising.
- The seat front edge should not compromise blood flow to the legs.
- Built-in furnishings used by patients and visitors should have armrests of a length and height appropriate to facilitate standing from a seated position for the patient population.
- The angle of the seat and seat back should not hinder rising nor cause shoulder-forward or hip-forward slumping or sliding out of the seat.
- Chair legs should not extend laterally or forward beyond the chair seat to avoid creating a trip hazard.

### Finishes/Materials

Finishes and materials that are specified for healthcare facilities need to consider cleanability, durability, service area functions, infection control, and patient populations (Friesen, 2015). All materials have a light reflectance value (LRV) which has a scale from
1 – 100 with 1 absorbing the most light (black) and 100 reflecting the most light (white). The amount of light that is reflected off surfaces can play a key role in the patient’s perception and exposure to injury (Drew, 2020). Appropriate flooring for patient rooms and healthcare facilities considers a non-glare, non-slip finish to prevent falls and other injuries. Shiny, glossy, or reflective surfaces can result in the appearance of water or a slippery surface. When usable, carpeting is preferred compared to a hard surface because of its minimal glare and noise-reducing qualities. To make sure it doesn’t interfere with wheelchairs, walkers, or other mobility, a low-pile carpet (less than ½ inch thick) with a firm underpad or no underpad is recommended. Similar to upholstery, avoiding bold or high contrast patterns and using solid colors can prevent confusion and visual difficulties with older adults. Other options for flooring that are non-glare, non-slip, and minimize noise reverberation include solid vinyl tile, cork, and rubberized tiles (Friesen, 2015). Solid vinyl tiles provide for an easy keep up as they can be easily cleaned, heat welded, and have a no-wax finish. Any damaged tiles can be easily replaced or swapped out without having to undergo a major renovation. Rubber flooring is another low-maintenance, affordable option that allows specification on stain and chemical resistance to maximize durability.

Wall finishes can include paint, paneling, wallcovering, or solid surface (Haynes, 2019). When selecting paint for the interior walls, matte finish is encouraged to keep the glare index under twenty (Friesen, 2015). Epoxy paint is easy to clean and cost effective. It is able to endure disinfectants, hot water, or other detergents without damaging the surface. It is not impact resistant, as you would need to install an abuse-resistant drywall underneath to enhance the durability. Wall paneling can be specified as it complies with the nonporous, easy-to-clean, and impact-resistant qualities. Stainless steel wall paneling is nonporous, impact and chemical
resistant, but is one of the most expensive options. Hygienic wall panels are water and impact resistant, can be heat welded to create a seamless surface, and can be welded to the base of the floor to reduce sharp edges (Haynes, 2019).

DuPont Corian solid surface has been frequently used in healthcare facilities because of its nonporous and sterile attributes. When properly maintained, Corian does not promote the growth of mold, mildew, or bacteria, which is essential to a sterile environment. The material is able to be thermoformed and sealed together to generate a seamless surface (Lorenz & Dreher, 2011). The following codes from FGI Guidelines for Design and Construction of Hospitals, 2018 are referenced for the specification of materials and finishes:

2.1-7.2.3 Surfaces

A2.1-7.2.3 Characteristics and criteria for selecting surface and furnishing materials and products. The effect of surface materials, colors, textures, and patterns on patient, staff, and visitor safety and on maintenance and life cycle performance should be considered in the overall planning and design of the facility.

a. Materials and products selected for use in patient care settings and operate 24 hours a day, seven days a week should meet local, state, and federal regulations and industry standards for heavy-duty commercial use.

b. The following characteristics and criteria should be used in selecting and specifying surface and furnishing materials and products for hospital design and construction projects.
   - Inflammable.
   - Durable.
   - Resistant and impact-resistant.
   - Reduces user fatigue and musculoskeletal injury
   - Uses compatible substrate and materials in surface and furnishing assemblies
   - Safe and efficient for use in occupied patient care settings.
   - Supports the facility’s clinical needs and is appropriate for the emotional and cultural well-being of patients, staff, and visitors.
   - Has acoustic properties that support clinical function and patient safety and well-being.
   - Made of non-toxic, non-allergenic materials.
   - Can control and minimize reflectivity and glare.

c. Patient safety risk assessment issues addressed by surfaces and furnishing performance characteristics and criteria:
   - Reduction of surface contamination linked to health care-associated infections (HAIs).
     - Surfaces should be easy to clean, with no surface crevices, rough textures, joints, or seams.
     - Surfaces should be non-absorptive, nonporous, and smooth.
   - Reduction of patient falls and associated injuries.
   - Reduction in medication errors.
   - Reduction of stress and fatigue and improvement in communication and social support for patients and family members.
• The sound-mitigating properties of surfaces and furnishings should be used to reduce noise.
• Surface materials should provide options for color, pattern, and texture that are clinically and emotionally appropriate and culturally supportive to patient, staff, and visitor well-being.
• Built-in seating should meet industry resting standards for safe use by all users, including persons of size.
• Built-in furnishing layouts should support acoustic and visual privacy for staff, patients, and visitors.

- Improvement in staff safety, effectiveness, efficiency, and communication.

2.1-7.2.3.1 Flooring and wall bases
A2.1-7.2.3.1 Characteristics and criteria for selecting flooring materials and products
a. The fall prevention portion of the safety risk assessment should be consulted when choosing flooring materials.
   - Balancing the softness (non-rigid properties) and firmness of a flooring material is a key consideration for supporting maintenance of gait, postural stability, and balance; reducing fatigue and falls; and facilitating movement of wheelchairs and other wheeled traffic.
   b. The evidence associated with identification of single environmental variables and their importance in preventing, attenuating, or exacerbating patient falls is still emerging. A number of studies in which multiple variables were studied have suggested an association between falls and the following materials and characteristics:
      - Flooring. Some flooring types (e.g., carpet, resilient flooring such as rubber, VCT, sheet vinyl) can be a trip hazard.
      - Floor pattern. Some studies suggest that flooring with a medium-sized pattern (1-6 inches wide) were associated with more falls than floors with no pattern, a small pattern (less than 1 inch wide), or a large pattern (wider than 6 inches).
      - Floor contrast. High-contrast patterns on floor surfaces may be associated with more patient falls.
      - Floor reflectivity. Finished floors with a high gloss value cause glare that may compromise patient vision, disrupting balance. The selection of non-wax flooring eliminates finish glare. Where a finish coat is required, smooth flooring surfaces should be sealed with a matte finish to reduce surface glare.
      - Wall and floor color contrast. Color contrast between walls and floors and minimized transitions between different types of flooring may reduce fall risk.
      - Floor acoustic properties. Floors should be selected with consideration to acoustic properties to help preserve sleep and to protect privacy and accuracy of communication in support of HIPAA compliance and medical error reduction.
   c. Floor resistance. Floor surfaces should allow easy movement of all wheeled equipment to be used in the facility.
      (1) Flooring surfaces shall be cleanable and wear-resistant for the location.
      (3) Smooth transitions shall be provided between different flooring materials.

A2.1-7.2.3.1 (3) Flush thresholds should be used to reduce tripping hazards.

2.1-7.2.3.2 Walls and wall protection
A2.1-7.2.3.2 Sharp, protruding corners should be avoided.
(2) Wall finishes
   (a) Wall finishes shall be washable.
   (b) Wall finishes near plumbing fixtures shall be:
      (i) Smooth
(ii) Scrubbable
(iii) Water-resistant

2.1-7.2.4.2 Window treatments in patient rooms and other patient care areas

A2.1-7.2.4.2 Window shades should be a neutral color to maintain true rendition of patient skin.
(1) Blinds, sheers, or other patient-controlled window treatments shall be provided to allow for patient privacy and to control light levels and glare.
(2) Window treatments shall not compromise patient safety and shall be easy for patients, visitors, and staff to operate.
(3) Window treatments shall be selected for ease of cleaning, disinfection, or sanitization.
(4) Use of fabric drapes and curtains for window treatments shall be permitted if the fabric is washable.

Nature Distraction

Views of nature and exposure to sunlight have significant effects on stress, pain management, and cognitive function (MacAllister, Bellanti, & Sakallaris, 2016). Exposure to nature and sunlight improves cognition and lessens stress on the patients by dismissing the “directed attention” essential to complete many daily mental tasks and provides a positive distraction (Rainey, 2019). Studies have shown that brief encounters with real or artificial nature can provoke recovery from stress in as little as three minutes. Negative emotions and attitudes of fear, pain, anger, or uneasiness can fade in exchange for positive emotions, benefiting the heart rate and blood pressure rates as well (Ulrich et al., 2004). It has also been shown that viewing nature can strengthen the immune system. In contrast, prolonged exposure to fluorescent lighting and little to no access to natural light or sun exposure can diminish positive attitudes and lead to depression, which in turn weakens the immune system. If a patient cannot be in proximity to natural sunlight or plants, placing photographs or videos of landscapes, animals, flowers, and other nature scenes are beneficial to their psychological well-being (Rainey, 2019). The following codes from FGI Guidelines for Design and Construction of Hospitals, 2018 are referenced for the consideration of nature distraction:

2.1-7.2.2.5 Windows in patient rooms
(1) Each patient room shall be provided with natural light by means of a window to the outside.
A2.1-7.2.2.5 (1) A window in each patient room, the view from it, and the diurnal cycle of natural light afforded by it are important for the psychological well-being of all patients.

(2) Where operable windows are provided in patient rooms or suites, their operation shall be limited – with either stop limit/restricter hardware or an open guard/screen – to prevent passage of a 4-inch diameter sphere through the opening.

(3) Window size in patient rooms
   (b) In new construction, windowsill height in a patient room shall be a maximum of 36 inches above the finished floor.

Wayfinding

To prevent further confusion, lessen stress upon hospitalization, and promote independent functioning, it is important to supply sufficient wayfinding throughout the hospital and the patient rooms. Many hospitals have undertaken the idea of choosing a single color per floor to facilitate wayfinding. The materials, finishes, and texture throughout the floor accompany the color chosen to allow recognition as to what services are provided. Maps that provide a “you are here” location, along with applying large, visible numbers outside of elevators, can help with immediate indication and clarification as to where the individual is.

Providing clear and concise signage is essential to circulation and orientation within the hospital. Using simple, self-explanatory, and universal graphics on signage wherever possible is encouraged to prevent confusion or miscommunication between the patient and the environment. High-contrast color combinations are easy for older adults to see, preferably light symbols on a dark, matte background. Due to the changes of the aging eye, avoiding color combinations of yellow on black, yellow on green, green on blue, or red on green will ease perception for older adults. Fonts on signage should be consistent using Helvetica style, letters and numbers reaching 5/8 inches in height on small signs and 1-1/2 inches on larger signs, with raised letters 1/20 inches high, and using a combination of uppercase and lowercase symbols (Friesen, 2015).
CHAPTER 5.  CASE STUDY

The purpose of the case study is to identify design elements and considerations used within the ACE units, elder-friendly, and patient-centered hospital rooms from literature reviews. As shown in Table 5.1, the case studies include an 80-bed community hospital, 22-bed rehabilitation unit, 274-bed acute care unit, 58-bed inpatient unit, and a 10-bed inpatient unit. These five patient room designs from literature findings have been analyzed and focused on layout and zoning, privacy, lighting and acoustic considerations, finishes and materials, and nature distraction.

Table 5.1 List of Case Studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Units</th>
<th>Built Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Joseph’s Hospital</td>
<td>West Bend, Wisconsin</td>
<td>80-bed community hospital</td>
</tr>
<tr>
<td>The Villages Regional Hospital</td>
<td>Villages, Florida</td>
<td>22-bed rehabilitation unit</td>
</tr>
<tr>
<td>California Pacific Medical Center – Van Ness Campus Hospital</td>
<td>San Francisco, California</td>
<td>274-bed acute care unit</td>
</tr>
<tr>
<td>Erlanger East Hospital</td>
<td>Chattanooga, Tennessee</td>
<td>58-bed inpatient unit</td>
</tr>
<tr>
<td>CapRock Health</td>
<td>Las Vegas, Nevada</td>
<td>10-bed inpatient unit</td>
</tr>
</tbody>
</table>

Design Analysis

St. Joseph’s Hospital

St. Joseph’s Hospital located in Wisconsin was built in 2002 to emphasize patient safety. When creating their eighty-bed unit for the community hospital, the team of architects, designers, and healthcare workers focused on ten specific safety design principles that they incorporated into patient areas and rooms, shown in Table 5.2.
Table 5.2 St. Joseph’s Hospital Safety Design Principles

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Automatic when possible</td>
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<tr>
<td>2.</td>
<td>Design to prevent adverse events (e.g. patient falls, operative/postoperative complications and infections, and deaths associated with restraint use)</td>
</tr>
<tr>
<td>3.</td>
<td>Design for scalability, adaptability, and flexibility</td>
</tr>
<tr>
<td>4.</td>
<td>Place accessibility of information in close proximity to the patient</td>
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<tr>
<td>5.</td>
<td>Improve visibility of patients to staff</td>
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<tr>
<td>6.</td>
<td>Involve patients in their care</td>
</tr>
<tr>
<td>7.</td>
<td>Minimize fatigue of staff</td>
</tr>
<tr>
<td>8.</td>
<td>Minimize patient transfers/handoffs</td>
</tr>
<tr>
<td>9.</td>
<td>Reduce noise</td>
</tr>
<tr>
<td>10.</td>
<td>Standardize</td>
</tr>
</tbody>
</table>

**Layout/Zoning**

The single-bed patient rooms have two entrances; one located in the hall and the other located in the alcove to the right of the patient room. The alcove contains a desk, computer, chair, and storage for staff, as seen in Figure 5.1. The alcove attached to each individual room allows for a patient/staff ratio of 1:1, with one staff member assisting one patient. The patient room includes a family zone, patient zone, staff zone, and bathroom (Figure 5.2). The family zone, which is located in the right corner, includes a large window, couch, pull-out bed, chair, and desk. The patient area is located on the left side of the room. The bed is oriented where the patient will be on the nurse’s right when performing any tasks. There is extra room surrounding the patient bed to allow flexibility for some procedures to be performed within the room. The bathroom is located at the head of the patient’s bed for close proximity and has access to a handrail for safety. A hand-washing station is located immediately at both entrances to encourage cleanliness and lessen the risk of a hospital-acquired infection.
Figure 5.1 St. Joseph’s Hospital Floor Plan of Single Patient Rooms

Figure 5.2 St. Joseph’s Hospital Patient Room Zoning
Figure 5.3 St. Joseph’s Hospital Single Patient Room

**Privacy**

Each alcove door entering the patient room has a glass window and operable blinds for patient visibility without invading the patient’s privacy. This window also allows the staff to check in on patients during the night without physically entering the room, unless special assistance is needed. Positioning the alcove to the right of the patient room allows the entry from the hallway to be completely private, eliminating other visitors or staff to see inside through means of windows or transparent doors.
**Lighting and Acoustic Considerations**

The large window in the family zone maximizes the amount of daylight brought into the patient room, equipped with internal blinds to eliminate excess dust and a radiant heat panel to eliminate condensation. There are fifteen lights placed in each patient room, including the bathroom and alcove. Canned lights are located over the patient bed for facilitation of assessments, procedures, or other performance tasks. After daylight hours, the light sources are specified to deliver light as similar to natural light that can be achieved cost effectively. Fixed nightlights are installed in patient rooms and automatic bathroom lighting to facilitate ambulation and reduce fall risk.

As seen in Figure 5.1, the linear plan and repetition of each patient room, alcove, and bathroom are used to facilitate orientation and standardization throughout the hospital. The bed is located in the exact position in each patient room. Orienting patient beds in a manner where they don’t share the same headwall can drastically minimize noise. The goal is to reduce noise levels to provide a calm, private environment for both the patient and staff. Rubber flooring, carpet, and specialized ceiling tiles are specified to minimize and absorb noise. The windows within the patient rooms have been triple glazed to reduce outdoor noises.

**Finishes/Materials**

Rubber flooring was specified in the patient rooms for purposes of cleanliness, non-slip functionality, and durability. Carpet was specified within the alcoves and hallways to assist staff and potentially minimize fatigue by providing a supportive flooring for the duration of hours spent standing and walking within the hospital. Figure 5.3 shows sterile-color walls, failing to provide a homelike atmosphere for the patient through a soothing color palette. The built-in desks where the television rests are rounded for patient safety and are oriented where both
patient and family have visual access. The wood selected for the casework does contrast from the wall, making it easy to orient where the doors and built-ins are located throughout the room. The sofa and chair provided in the family zone have an upholstery that involves a bold pattern with multiple colors. This could cause visual confusion in older adults, as it could affect depth perception issues, along with difficulty defining boundaries, as the armrests are covered in the same pattern. The chairs are equipped with armrests, issuing support to older adults in the process of standing or sitting.

**Nature Distraction**

The large window positioned behind the sofa in the family zone provides not only daylight, but access to nature as well. The access to natural light was provided to help patients with the healing process and facilitate staff with their long hours and heavy workload. There is no artwork specified for either the staff alcove or the patient room, neglecting to provide any landscape or nature scenes to provide a positive distraction (Reiling, J; Hughes, 2008).

**The Villages Regional Hospital**

The Villages, Florida, has an exclusive demographic of being home to more than 110,000 residents over the age of fifty-five. The Villages Regional Hospital is one of the few hospitals in the nation that was built specifically for older patients. Their main goal was providing the industry with a lesson on creating an environment that best suits the older population. The Villages Regional Hospital patient room (Figure 5.4) focuses on many design elements, including lighting, furniture selection, and flooring.
The layout of the patient room in The Villages Regional Hospital includes a patient zone, patient bathroom, family zone, and staff zone. The patient zone is equipped with a patient bed oriented facing the television and calendar, along with a ceiling lift that has the capability to transfer the patient throughout the patient room. A staff computer is attached to the headwall adjacent to the patient bed. The family zone is positioned along the window wall, providing a pull-out bed, chair, and side table to encourage visitors.

Privacy

While acoustical features are made to combat noise and enhance speech privacy, visual privacy is achieved by providing a patient room equipped with features that allow for a centralized nursing station located on each floor. Computer and equipment storage are located within patient rooms to allow staff to perform necessary tasks with the patient and carry out
additional paperwork and data entry at the centralized nursing station, leaving the patient more time with family and friends.

**Lighting and Acoustic Considerations**

The light sources were chosen to reduce glare and uneven lighting levels. An emphasis on daylight was integrated into the patient room to reduce stress and aid in healing. Visitor rooms were added at the end of corridors with extra windows to accommodate both patients and visitors. Where natural light was not available, table lamps, wall sconces, and cove lighting have been applied in warm hues to brighten spaces. Acoustic ceiling tiles were used, as you can see in Figure 5.4, to absorb sound and reduce excess noise. Furniture selection involved specifying chairs that were comfy yet sturdy and had arms to accommodate the deep cushions for assistance when standing up or sitting down. In social spaces, seating was arranged in small clusters instead of in rows to support those with hearing loss.

**Finishes/Materials**

Material specification considered minimal flooring transitions to avoid fall hazards, avoidance of dark pattern flooring that could be mistaken for holes, along with an avoidance of high-gloss or shiny surfaces. The color palette consists of earth tones and wood, creating a contrast between the wall color, flooring, and trim. The furniture selected has a nice contrast from the floor, allowing patient easy orientation. The deep cushions with decorative pillows and blankets not only provide acoustic control but also help create a less institutionalized feel by offering furniture that is aesthetically pleasing. Armrests are provided on both the chair and sofa, issuing support when standing or sitting. The casework allows for contrast between the dark
wood and green walls, creating visual interest within the space without creating any visual impairments.

**Nature Distraction**

Two windows with operable blinds are located within the family zone for visual access from the patient bed and staff zone. Indoor plants are provided on surfaces, including countertops or side tables, to provide visual access to greenery (Tabar, 2018).

**California Pacific Medical Center - Van Ness Campus Hospital**

The California Pacific Medical Center (CPMC) Van Ness Campus Hospital was completed in March 2019, providing a one-million-square-foot site with 247 acute care patient beds within the eleven-story patient tower.

**Layout/Zoning**

The single-occupancy patient rooms (Figure 5.5) are equipped with a patient zone, patient bathroom, staff zone, and family zone. The family zone is located along the exterior wall, equipped with a pull-out sofa, visitor chair, and side table for family or visitor use. The bathroom is located at the foot of the patient bed for easy, unhindered access at a close proximity. Alcoves for staff are positioned in the hallways between two patient rooms with windows allowing a visual on the patient bed (Figure 5.6). The alcoves are equipped with high top tables, computers, and attached seating. The raised table height allows for visual access into the patient rooms without having lower the window sill height or having to stand up or reposition to look into the room.
Figure 5.5 CPMC Van Ness Campus Patient Room

Figure 5.6 CPMC Van Ness Campus Hospital Alcoves
Privacy

Privacy is established within the patient rooms by providing frosted glass doors to the patient bathroom, operable blinds along the window wall and staff alcove. Having a window view from the hallway or alcove can act as a privacy barrier during the night so the staff does not have to enter the room unless medically needed. There is a curtain that can be pulled, closing off the patient bed from the family and staff zone, if necessary.

Lighting and Acoustic Considerations

Ceiling-mounted lighting is used in the patient rooms, creating an ambient effect rather than installing direct lighting. An overhead light rests above the patient bed to assist with any procedural tasks, while another overhead light sits within the alcove of the family zone. Assisting the scattered overhead lights in the patient room, the wall of windows surrounding the family zone helps bring in natural light and dispense light into areas that could produce shadows. Acoustic ceiling tiles and padded furniture are placed to minimize and absorb excess noise.

Finishes/Materials

SmithGroup Interior Design focused their concept on creating a patient-centered experience by incorporating warmth and comfort throughout the hospital. The patient rooms were designed with hospitality-like finishes, including frosted barn doors entering the bathroom with a mosaic tile used as a backsplash above the sink. As pictured in Figure 5.5, a pop of blue is used as an accent color among the white walls to facilitate orientation and add interest to the room. A color palette of earth tones is used throughout the hospital, prompting a different nature-inspired theme on each floor for wayfinding and ease of navigation. In the public spaces, marble, wood, and various styles of furniture were used to emphasize a less institutionalized feel. The
furniture specified issues aesthetically pleasing qualities while also providing the support needed from patients when transitioning from a sitting or standing position. In Figure 5.6, the flooring throughout the hallways consists of a checkerboard pattern, which could cause visual confusion to older adults as the contrast between the light and dark brown could look like holes in the ground or a change in height.

Nature Distractions

The vast amount of daylight coming from the windows along the façade not only acts as a facilitator for ambiance, but also provides a visual to the exterior and the surrounding environment from the patient bed (DiNardo, 2019).

Erlanger East Hospital

The Erlanger East Hospital expansion located in Chattanooga, Tennessee, was completed in 2016 and delivered 58 new single-occupancy patient rooms. These rooms were designed with a patient-centered focus, creating a welcoming and soothing environment for the patient, family, and staff.

Layout/Zoning

Erlanger’s large patient rooms (Figure 5.7) incorporate a patient zone, patient bathroom, family zone, and staff zone. The family zone is located at the far end of the room, providing a pull-out bed and visitor chair, encouraging visitors. The patient zone is oriented with a clear view to the television and large window. The patient bathroom is located on the right-hand side of the patient bed, providing easy access without any tripping hazards. Nursing stations are positioned and distributed throughout the hospital floor and in close proximity to patient rooms (Figure 5.8).
A counter and computer station are provided within the patient room to facilitate tasks or minimal procedures.

Figure 5.7 Erlanger East Hospital Patient Room

Figure 5.8 Erlanger East Hospital Nursing Station
Privacy

Privacy is provided within the patient rooms by installing operable blinds on the large windows and a solid door along the wall adjacent to the hallway. Staff enter the patient room when necessary and are able to carry out their tasks within the patient room and then report back to the decentralized nursing stations. As shown in Figure 5.8, the decentralized nursing stations nest in between two patient entrances with windows for visual access, so entrance into the room is not necessary unless medically needed.

Lighting and Acoustic Considerations

Recessed lighting is used throughout the patient room with an overhead light placed directly above the patient bed for task lighting. A decorative fixture is placed over the family zone for use when blinds are closed. The large window encompasses the width of the wall, bringing in a vast amount of daylight that is dispersed throughout the room. Acoustic ceiling tiles, padded furniture, decorative pillows, and a pleated headwall act as noise minimizers creating sound absorption.

Finishes/Materials

The home-away-from-home feel was established by incorporating a spa-like color palette and a hospitality aesthetic. The color palette includes accents of green, blue, and orange to offset the taupe walls and wood headwall. Referencing Figure 5.7, a blue accent wall is provided to contrast the white built-ins along the left-hand side where the television and closet are housed. Decorative vases and flowers are placed on surfaces to add visual interest and emphasize the homelike atmosphere. The furniture was specified in bright colors, allowing a contrast between the bench and armrests on the sofa. This allows for easy visual contrast detection and orientation.
when transitioning from a standing or sitting position. Movable stools are stored for visitor use under the extra surface area so they are out of any circulation paths, upholstered in a material that is durable and easy to clean. These modern patient rooms feature large windows, colorful furniture, wood-like materials, and artwork brought in from local Chattanooga artists with pieces depicting attractions and views from around the city.

**Nature Distraction**

The large windows featured in each patient room provide a view to the surrounding environment from the patient bed and family zone. Flowers are placed on the night stand to offer comfort and a positive distraction to both patient and family (Uhl, 2017).

**CapRock Health**

CapRock Health is creating a prototype for a two-story hospital in Las Vegas, Nevada, that provides ten inpatient rooms that promote a better patient experience, a calming atmosphere, encompass a hospitality aesthetic, and provide greater amenities for patients, family, and staff.

**Layout/Zoning**

The CapRock patient room (Figure 4.8) provides a patient zone, patient bathroom, family zone, and staff zone. The patient zone consists of the patient bed, overbed table, and decorative headwall, with the patient bathroom located to the right of the bed. The family zone provides a sofa for visitor use. A stool is positioned for staff use adjacent to the patient bed, along with a monitor to access the patient’s information. A centralized nursing station is located on each floor, having views to all rooms. Large clerestory windows and glass curtain walls are incorporated
throughout the hospital design to allow light into the nurses’ stations, corridors, and hallways to alleviate patient, family, and staff stress.

Figure 5.9 CapRock Health Patient Room Prototype

**Privacy**

The single-occupancy patient rooms provide a sufficient amount of privacy, allowing for blinds to be recessed on large windows. A corridor separates the patient bed from being seen from the hallway, allowing the door to be left open without compromising visual or speech privacy.

**Lighting and Acoustic Considerations**

Large windows allow a significant amount of daylight to enter the patient room, dispersing the light throughout the room for both patient and staff satisfaction. An overhead light
is used above the patient bed to perform daily tasks or minimal procedures. A backlit panel on
the headwall can be accessed from the patient bed and used for soft, ambient light during
nighttime or when blinds are closed. Wall sconces are used along the footwall to provide both
decorative and functional use.

**Finishes/Materials**

In order to achieve the hospital’s goal of creating a space that appeals to the patient as a
consumer, major consideration is being put on the aesthetics of the patient room and hospital
environment. Materials of masonry, stone, and wood-like features are being utilized throughout
the patient room, waiting room, and nursing stations to offer a hospitality aesthetic while
achieving cost effectiveness, cleanliness, and durability standards. A serene color palette and
natural wood tones provide a warm and soothing environment, while achieving contrast between
the flooring and wall. Landscapes have been utilized through locally sourced artwork and
signage to promote a stress-free environment for both patients and staff. The backlit panel on the
headwall above the patient bed, two-toned wall behind the patient bed, and colorful furniture
provide decorative aspects that promote a hospitality-like atmosphere. Although the sofa meets
the needs of the patient room, there is little furniture provided to aid personalization and
familiarity.

**Nature Distraction**

Views to the outdoors and surrounding environment are available from the patient bed,
encouraging healing and a stress-free environment. Specified artwork that incorporates
landscapes, serene colors, and plants will be utilized throughout the patient rooms and other
hospital interiors. Fish tanks will be placed to offer a soothing distraction as well (Harney, 2018).
Results

In summary, the research findings from the case studies have shown that there are common design elements used within all ranges of patient room design as shown in Figure 5.10. Each patient room was designed to be single-occupancy with a designated space for family and visitors to stay over and a private bathroom. Depending on what type of services were offered, a centralized and decentralized nursing station were specified. Decentralized nursing stations offered an alcove adjacent to the patient room for easy access and storage. To provide adequate speech and visual privacy in the patient rooms, operable curtains and blinds were used over doors and windows. In patient rooms where two means of entrance were provided, the door with access to the alcove had a window with blinds giving staff visual contact to the patient without physically entering the room. Large windows, fixed nightlights, task lighting, and overhead lighting above the patient bed are used to supply sufficient lighting within the patient rooms. Sound absorption is achieved by specifying rubber flooring, carpet, padded furniture, and acoustic ceiling tiles. To achieve a soothing, serene, or calm environment, an assortment of earth tones were tones, adding pops of color on accent walls and wood features. Most rooms incorporated a decorative headwall, colorful furniture, and locally sourced artwork to create a less institutionalized feel. The large windows in each room provide a nature distraction, even if the view isn’t spectacular. Indoor plants and landscape artworks are placed throughout the rooms to improve moods, attitudes, and decrease stress levels.

The design elements assessed in the five patient rooms are correlated with the impacts of the ACE model on patient outcomes discussed on page 17. These impacts include reduced functional decline, reduced hospital admissions, patient and provider satisfaction, decreased fall rates, shortened length of stay, and lower costs. The relationship between the physical
environment and the patient outcomes are relevant in the success of the model of care.

Incorporating design elements that lessen stress, anxiety, delirium, and depression can yield a positive impact on the functional status of the patient. Providing a sense of control with lighting, audition, and temperature encourages independence and normalcy. Designing a patient room and family zone to cater to visitors increases the patient satisfaction levels and provides a patient-centric approach that appeals to both staff and patients. Staff satisfaction heightens when they are provided a convenient workspace with a layout that eases wayfinding and circulation.

Maintaining or improving the patient’s functional status is crucial to reducing hospital readmissions and length of stay. Providing an environment that supports the physical, social, and psychological well-being of the patient can enhance the patient’s perception during hospitalization and encourage a faster recovery.

Figure 5.10 Analysis on Design Elements in ACE Units
CHAPTER 6. DESIGN PROPOSAL

Throughout history, the main focus of hospital design has been providing a sterilized environment and accommodating specifically to staff and physician performance and functioning. There was little research on how the patient’s perception of their environment effected their immune system and the outcome of their health. After discovering a correlation between a positive perception of the hospital environment and the patient’s well-being, an emphasis has been put on a patient-centered approach, improving satisfaction of patients, staff, and visitors, and creating a positive environment during hospitalization (Rainey, 2019). Although a shift has been made in the design process, general building codes, ADA guidelines, and universal design continue to be the primary resources used when designing and planning for a healthcare facility (Wong et al., 2014). Competitiveness in the healthcare industry has resulted from the recognition that patients are attracted to user-friendly and aesthetically pleasing facilities. Implementing a guideline that focuses on design elements that maximize the physical, social, and psychological functioning of older adults in healthcare facilities, especially ACE units, is crucial to delivering the best form of care to the elderly at-risk patients.

Design Process

Considering layout and configuration, functionality, maximum distances, ease of servicing, and accessibility are all factors contributing to beginning of the design process (Demirkan, 2015). The main goal of designing the following ACE unit was creating an environment that adheres to the four ACE principles while integrating elder-friendly hospital design, benefiting the physical, social, and psychological well-being of the patient, staff, and family.
Zoning/Layout

The zones included within an ACE unit should contain a patient zone, patient bathroom, staff zone, and family zone. When configuring a layout of the four zones, adjacencies and maximum distances are considered. Referencing Hughes, he explained the three main patterns of staff that transpire in the patient room are within the patient zone, staff zone, or both. Because of these patterns, it is important to place the patient zone and staff zone adjacent to each other. A decentralized nursing station is part of the ACE model, so providing an alcove for staff that assures a fast response time to patient rooms is required. Because the alcove will house the staff zone adjacent to the patient room (supplying a desk, chair, and storage) a beside monitor or computer is needed to facilitate everyday procedures and monitor the patient’s status. This area will serve as another staff zone, referring to it as the treatment zone. The treatment zone should be directly next to the patient zone, within approximately two feet of the patient bed. Both patient and staff benefit from having the bathroom in close proximity to the patient zone, as the least amount of steps is preferred for both mobility and safety hazards. When entering the room, visual sight of the patient is encouraged for safety, but doing so in a way where the patient’s privacy is not compromised. Installing a hand-washing station directly when entering the room and close to the treatment zone is important for sanitation and infection prevention. Figure 6.1 shows an adjacency matrix used to configure the layout of the patient room. Included in the adjacency matrix are a patient zone, patient bathroom, staff zone, treatment zone, family zone, hand-washing station, and patient storage. Primary (full circles) are used to show mandatory adjacencies; secondary (open circles) are used to show preferred adjacencies; neutral (blank spaces) are used to show adjacencies that have no preference; and undesirable, (slashes) are used to show unwanted adjacencies.
Figure 6.1 Adjacency Matrix

Figure 6.2 Bubble Diagram
The bubble diagram in Figure 6.2 shows a preliminary layout of where each zone will be located on the floor plan. The size of the bubble represents the amount of space needed to fulfill each zone requirement. For example, less space is needed in the treatment zone compared to the family zone. A standard patient room averages from 260 to 320 square feet, which delivers enough room for the patient, standard equipment, and a family zone for a visitor to stay (Carpenter, 2011). According to the FGI Guidelines for Design and Construction of Hospitals, 2018, patient/family-centered care unit should meet the following requirements:

2.2-2.2.3 Patient/Family-Centered Care

A2.2-2.2.3 Patient/family-centered care. Where a facility chooses to provide a patient/family-centered care room, the room should be designed to meet the following requirements.

a. Capacity. The patient/family-centered room should be a single-patient room.
b. Area and dimensions. A patient/family-centered room should have a minimum clear floor area of 250 square feet with a minimum clear dimension of 15 feet.
c. Additional area. Additional area should be provided at a minimum clear floor area of 30 square feet per family member (permitted by the facility).
d. Environment of care. Consideration for a homelike atmosphere, furniture arrangement, and orientation to the patient bed and room windows should reflect the needs of the patient population.

Using the standard patient room square footage as a starting point and adding the minimum clear floor area of 250 square feet, an estimated 500 square feet will be used to configure the floor plan of the ACE unit. Because the staff alcove will be used to observe two patients at a time and is stationed outside of the patient unit, the square footage per patient unit will actually be less than what is estimated. Figure 6.3 shows a breakdown of the requirements and necessary accommodations in the patient room according to the FGI Guidelines for Design and Construction of Hospitals, 2018. The patient zone, hand-washing station, and patient storage have minimal requirements that affect spatial configuration, unlike the family zone, staff zone, patient bathroom, and treatment zone.
Figure 6.3 Estimated Square Footage Per Zone and Zone Necessities

The preliminary floor plan (Figure 6.4) was put together, assessing the square footage estimates in Figure 6.3. A rectangular footprint was used to provide standardization throughout the floors by allowing the patient room, bathroom, and alcove to be repeated the length of a building. As seen in Figure 6.4, this pattern of repetition allows every patient room to be oriented so all windows will be facing the east to provide the most sunlight in the patient room. The staff alcove will provide a staff to patient ratio of 1:2, with one staff member having access to two patient rooms. Because the patient rooms are mirrored, a storage area will take place in between every other room, alternating a staff alcove and storage area. The storage area will house extra wheelchairs, commodes, walkers, or other equipment that benefit from being in close proximity to the patient rooms. Figure 6.5 provides a preliminary plan showing where each zone will be located.
The following codes from FGI Guidelines for Design and Construction of Hospitals, 2018 were referenced during the design of the preliminary floor plan:

2.1-2 Patient care units and other patient areas

A2.1-2.1 Accommodations to encourage patient mobility. Patient care units should be designed to enhance opportunities for patient ambulation, including provision of ceiling track systems that support a harnessed patient walking with assistance (e.g. in patient unit corridors, a physical therapy clinic, and other patient rehabilitation service location).

A2.1-2.2 Equipment and architectural details for the patient room.

a. Standing assists. Aids to help patients stand from seated positions (e.g. bedrails, grab bars, and extended chair armrests) should be available.

b. Orientation of television. Space should allow for at least one television screen to be viewed from the patient chair, recliner, wheelchair, or other such device.
c. **Access to controls and communications.** Patient control of the environment should be accessible to the patient in bed, patients chair, recliner, wheelchair, or other such device.
d. **Trip hazards.** Chair legs should not extend laterally or forward beyond the chair seat.

**2.1-2.2.5 Hand-washing station in patient room**

**2.1-2.2.5.1 Location.** A hand-washing station shall be provided in the patient room in addition to that in the toilet room.

(1) This hand-washing station shall be located at or adjacent to the entrance to the patient room with unobstructed access for use by healthcare personnel and others entering and leaving the room.

**2.1-2.2.6 Patient toilet room.**

**2.1-2.2.6.1 General.** Each patient shall have access to a toilet room without having to enter a corridor.

**2.1-2.2.6.3 Room features.** The patient toilet room shall be equipped with the following:

(1) A toilet.
(2) A hand-washing station.
(3) A bedpan-rinsing device.

**2.1-2.2.6.8 Patient storage.** Each patient room shall have a separated wardrobe, locker, or closet suitable for garments and for storing personal effects.

**2.1-2.8.2 Administrative center or nurse station**

**2.1-2.8.2.1 This area shall include the following:**

(1) Space for counters.
(2) Hand-washing station(s)

(a) At least one hand-washing station shall be located in, next to, or directly accessible to the administrative center or nurse station.

(b) A hand sanitizer dispenser shall be permitted as a substitute for this requirement.

**2.1-2.8.3 Documentation area**

**2.1-2.8.3.1** Documentation area shall have a work surface to support the documentation process for the number of staff who will use it at the same time.

**2.1-2.8.8 Medication safety zones**

**2.1-2.8.8.1 General**

(1) Application. Medication safety zones shall be provided as defined in this section for preparing, dispensing, storing, and administering medication.

(2) Design requirements. Medication safety zone shall meet the following physical environmental requirements that promote safe medication use:

**A 2.1-2.8.8.1 (2) Medication safety zone design requirements**

b. The following surface and furnishings recommendations should be incorporated in the design of medication safety zones:

- Surface materials should be selected to reduce glare and reflectivity
- Use of materials with sound mitigated properties should be considered
- Built-in furnishings (where present) should be configured to provide visual and acoustic privacy, minimize visual and sound distractions and interruptions, and reduce staff fatigue through ergonomic design.

(a) Medication safety zones shall be located out of circulation paths

(b) Work space for medication safety zones shall be designed so that staff can access information and perform required tasks

**2.2-2.2.3.1 Family zone support features**
A2.2-2.2.3.1 Family zone support features
a. Storage. Storage should be provided for visitors’ personal belongings.
b. Work surface. A horizontal surface sufficient for eating, writing, and supporting a laptop should be provided that is separate and distinct from that used for clinical activities.
c. Sleeping accommodation. When family members or visitors are permitted to sleep overnight in the patient room, the following additional design issues should be considered:
   - Furnishing that offers a substantially horizontal, impervious sleep surface designed to accommodate an adult should be provided.
   - Such furnishings should be sufficiently comfortable for a night’s sleep and constructed to accommodate and retain bedding. When deployed, any such accommodation should not intrude into required minimum clearances around the patient bed.

(1) Space shall be provided in the patient room to support visitation by family members and others, including:
   (a) Space for movable seating with a minimum of one seat for a family member or visitor and one seat for the patient
   (b) Space for at least one chair for long-term sitting

(2) Where family members or visitors are permitted to sleep in the patient room overnight, space shall be provided for sleeping accommodation.

(3) Public communication services shall be provided in each patient room.

Design Summary

Figure 6.6 Zoning Plan
Privacy

Sufficient privacy is maintained within the ACE unit by providing a private patient bathroom and a decentralized nursing station. The patient bathroom is equipped with a toilet, sink, and shower, preventing any need to use a communal shower elsewhere on the hospital grounds. The window viewing the patient room from the staff zone is equipped with interior blinds, providing staff access to the patient without disrupting their sleep unless medically necessary. When staff do enter the room, the treatment zone, hand-washing station, and patient zone are all located within the front half of the unit, providing a circulation path that not only benefits the staff, but the patient and visitors as well. A solid frame door acts as the entrance door from the hall, which can be shut at the patient’s convenience and block out excess noise. The following codes from FGI Guidelines for Design and Construction of Hospitals, 2018 were referenced during the design process regarding privacy:

A2.1-2.1.2 Patient privacy

a. Visual privacy. Visual privacy can be achieved by using various means, including cubicle curtains, blinds, and electronically controlled vision panels. In single-patient rooms, the entry door can be used to achieve visual privacy provided the door is solid or has non-transparent glass. Where doors with vision panels or transparent glass are used, provisions for visual privacy should be made.

b. Speech privacy. Speech privacy should be addressed. Use of full-length of partitions and/or sound-masking can enhance privacy.

Figure 6.7 Furniture Plan
Lighting/Acoustic Considerations

The lighting was chosen within the ACE unit to provide efficient luminance throughout the room. The window sits in a position where it can provide and distribute sunlight throughout the length of the patient room. Overhead lighting is used above the patient bed, while recessed lights are used to create an ambient light when the daylight is not sufficient. A wall sconce sits above the nightstand by the patient bed to provide task lighting or a soft light during night time hours. Fixed nightlights are installed in the patient bathroom and directly outside to promote safety. In the family zone, hexagonal lights and acoustic tiles are positioned in a pattern to provide overhead lighting while absorbing noise. Other acoustic considerations that were made include providing padded furniture, LVT flooring, placing artwork and accessories on surfaces, and solid surface material to absorb excess noise. A ceiling-mounted chair lift is positioned above the patient bed to facilitate staff during transitioning.

Figure 6.8 Reflected Ceiling Plan
**Finishes/Materials**

Emphasizing a homelike atmosphere can help indicate that the focus of the hospital is on the patient and their well-being. Patients need to focus their energies and concentration on healing, architects often design hospitals to provide an atmosphere that offers security, cleanliness, and physical comfort (Horsburgh, 1995). A color palette, as seen in Figure 6.9, consisting of green, dusty orange, and neutral earth tones create a comfortable and soothing atmosphere, suitable for the elderly. The green wall, as seen in Figure 6.10, provides a sense of orientation from the patient’s bed. The surrounding walls within the patient room are a shade of taupe, so offsetting one wall, especially the wall that the patient faces while positioned in the bed, will help facilitate orientation and provide visual interest to the space. LVT was chosen for flooring because of its resiliency and cleanability. It provides a non-slip surface that matches the healthcare standards while offering a variety of colors, textures, and patterns that imply a residential feel. The dark floor creates a contrast with the lighter walls, furniture, and upholstery selection for easy positioning and maneuvering. The doors and casework are also a darker shade of brown to create contrast with the walls. Unlike the door entering the patient room, a sliding door is used to enter the patient bathroom to provide a less institutionalized feel. Textured, frosted glass panels are provided within the door to offer visual interest while still protecting the privacy of the patient.

Furniture selection within the patient room focused on durability, safety, and support. Both the visitor chair and the patient chair are equipped with armrests to facilitate transitioning and positioning, with armrests contrasting the upholstery. Two movable stools are stored for visitor use under the desk surface to avoid any tripping hazards or barriers within the circulation path. A rubber base occupies the bottom for easy cleaning and stability, while the top and sides are upholstered in a cleanable, tan-colored fabric. A pull-out bed is positioned under the window,
allowing for bench seating to take place when bed is not in use. The cushion is a green, cleanable fabric that can be taken off and set aside when the bed is to be in use. Decorative pillows and blankets are used to provide comfort and fund a homelike atmosphere. Extra surface space is provided on the opposite wall of the patient bed, as seen in Figure 6.10, to encourage the patient to continue daily tasks or hobbies, like writing, puzzles, or reading.

In the patient bathroom, the LVT flooring continues to deliver an easy and hazard free transition from zone to zone. Storage to the left of the sink allows for towels, excess soaps, or any other personal items to be stored. The vanity provides four drawers to be occupied, while accommodating wheelchair access under the sink. Levers are used with the faucet to accommodate any impairment. The grab bars in the bathroom are a black matte finish, allowing for an easy visual contrast among the dusty orange wall. The shower material consists of a textured, non-slip flooring with Corian solid surface surrounding the walls for an easy clean and mildew-free shower. A washable shower curtain is used for privacy, as a door or sliding door would have presented mobility and spatial challenges. Grab bars are positioned inside the shower to assist with balance and transitioning from the sitting to standing position, as a bench is provided within the shower.

In the alcove, or staff zone, an acoustic vinyl flooring was used to ease the stress on the body and feet due to the foam backing of the product. Acoustic vinyl flooring throughout the alcoves and hallways allows for more acoustic control while still providing an easy transition from patient room to hallway. The properties of acoustic vinyl flooring make it very durable and easy to clean, while also offering a wide range of colors and patterns. The desk and counter space provided are also utilizing the benefits of Corian solid surface. The desk provided allows space for a staff chair and computer. A file cabinet is provided for paper storage, while a full-
length storage cabinet is provided for miscellaneous accessories and equipment that could be used within the patient rooms. Positioning storage within the alcoves allows staff to have faster response time to patients when materials are needed and can prevent exhaustion by having items in close proximity. A decorative vase with greenery placed on the desk can encourage personalization and provide a positive distraction. The landscape artwork positioned above the desk allows for color and visual interest, while offering an encouragement for positive moods and attitudes from staff.

Figure 6.9 Color Palette

Figure 6.10 Patient Zone and Family Zone Elevation
Nature Distraction

To provide positive distractions throughout the room, landscape artwork was specified in the both the patient room and patient bathroom. The large window in the family zone is positioned to bring in lots of daylight into the rest of the space, especially to the patient bed.
Plants are used as an accessory on the shelf in the family zone and in the staff alcove to provide greenery. Vast amounts of counter space are provided for patients to bring in their own flowers, pictures, or other momentums that can encourage positive attitudes and ease the transition of hospitalization.

**Three-Dimensional Visualization of Space**

Figure 6.13 Patient Zone
Commentary on Figure 6.13 Patient Zone:

1. The headwall provides a lighted backboard for decoration and a less institutionalized feel, while also supplying staff and patient with easy access to various controls and equipment.
2. A nightstand is provided for patient personalization and storage.

Commentary on Figure 6.14 Family Zone:

1. The TV is oriented directly in front of the patient bed for easy visual distraction.
2. A full-length storage cabinet is provided for patient or family storage of personal items during their hospitalization. The solid doors allow for privacy.
3. Excess counter space creates more possibilities for task space, personalization, and accommodations to family and visitors.
4. A patient chair with armrest, visitor chair with armrests, two movable stools, and a pull-out bed is provided to encourage and accommodate the stay of family and visitors.

5. Landscape images and greenery are placed on the shelf in visual proximity of the patient bed and family zone to promote natural distraction, positive attitudes, and decrease the chance of depression.

6. Automatic blinds are placed on the large window with a remote available for patients allowing them a sense of control and normalcy.

7. Hexagonal acoustic ceiling fixtures are placed within the overhead lighting fixtures above the family zone to provide sound absorption and increase speech privacy.

Figure 6.15 Hand-washing Station
Commentary on Figure 6.15 Hand-washing Station:

1. A stool is offered for staff use and can be stored under the sink, out of the way of circulation paths.
2. Solid surface countertop provides a clean and durable work surface with rounded edges for patient safety.
3. The sink and hand sanitizer dispensers in visual proximity of the entrance doors encourages cleanliness from staff and visitors.
4. Shelving allows patients or staff to personalize the space and provide a sense of familiarity.

Figure 6.16 Staff Zone
Commentary on Figure 6.16 Staff Zone:

1. Acoustic vinyl flooring, mimicking the visual appearance of carpet, is specified to provide support on the staff’s feet and mobility, help prevent exhaustion, and allow sound to absorb into the material to promote speech privacy and avert excess noise.

2. Landscape images are provided to encourage positive distraction, increase moods, and keep morale high throughout the staff during long work shifts.

3. Storage for materials, equipment, and files needed to support the adjacent patient room offers convenient placement and can help avoid staff exhaustion compared to a centralized storage room elsewhere on the hospital floor.

Figure 6.17 Patient Bathroom
Commentary on Figure 6.17 Patient Bathroom:

1. A 27 x 30 inches clearance is provided under the sink for wheelchair accessibility, along with a clear floor area of 30 x 48 inches.

2. The walk-in shower is wheelchair accessible, providing a flush transition into the shower. A fixed bench is provided to offer support and safety.

3. Grab bars are placed throughout the shower, including a vertical grab bar attached to the shower head.
CHAPTER 7. CONCLUSIONS AND IMPLICATIONS

This research conducted an intensive literature review and case study in order to understand the impact of the ACE model on patient outcomes and specific design elements of the ACE unit. This thesis also suggests a design prototype of an ACE unit, which will be useful for interior and architects when an ACE unit. In this final chapter, the research procedure, case study, and prototype are summarized and discussed.

First, when compared to usual care, the impact of the ACE model on patient outcomes was exceedingly positive. Studies found rates of reduced functional decline, which includes a decrease in anxiety, sleeplessness, delirium, and depression. An improved or maintained score of ADL was found, along with an increase in independence. Hospital readmission and nursing home placement rates decreased, allowing patients to be discharged back to their homes or previous way of living prior to illness. Increased patient and provider satisfaction levels were noted, improving attitudes, morale, and stress. Decreased fall rates were achieved by implementing strength programs, having patients within view of a caregiver at all times, and designating daily walking times. Finally, shortened length of stay and reduced costs were identified, showing lower physical therapy, room, and medical supply costs. Length of stay was shown to be influenced by the functional status, which has been proven to be maintained or improved during hospitalization within the ACE unit, therefore the length of stay was shorter compared to usual care.

Second, specific design elements of ACE unit models were found within the literature review and case studies. To improve safety and reduce risk of hazards, lower beds, raised toilet seats, exit alarms, and grab bars are implemented. Clocks and calendars are placed to reduce disorientation and depersonalization. Non-sterile paint colors, space for personal belongings, and
visual interest through artwork is encouraged to present a homelike environment. Offering seating with armrests for patients is necessary and a pull-out bed for visitors is recommended to encourage visitors. The opportunity for constant observation is needed to eliminate safety risks. Windows or doors with windows are used by staff to monitor patients from an alcove or from the corridor in two- to four-room increments. Storage for equipment and materials is encouraged within close proximity of the patient room for efficiency of staff. ADA guidelines are followed within the patient rooms as a hospital standard.

Third, elder-friendly hospital unit models focused on more specific design elements and considerations compared to the ACE unit models. Due to aging, challenges in vision, audition, bodily function and mobility play a role in specifying materials, finishes, and furniture. Warranted by vision impairment, non-reflective surfaces, warmer color tones, contrasting colors, and increased illumination and even lighting levels are recommended. Access to natural light is crucial, along with visual contact to plants or landscape, animal, floral, or other nature artwork. Installing acoustic ceiling tiles and sound absorbent flooring, equipment, and furniture is beneficial to both patient and staff. Lever-styled handles on all doors to facilitate opening is necessary. Sturdy furniture with rounded corners is essential for safety reasons, with upholstery in a matte finish and solid color or low contrasting pattern. Similar to upholstery, flooring and wall coverings or paint should be a non-glossy finish, avoiding bold patterns, and easy to clean.

Fourth, the five case studies analyzed implemented many of these design elements. Where decentralized nursing stations were used, windows or doors with a window were used to allow staff visual contact to the patient. High contrast finishes between flooring, walls, and doors were used to help define boundaries. Color palettes consisted of earth tones, offering a serene and soothing environment to facilitate recovery. Rubber flooring, carpet, and LVT were used to
offer sound-absorbing qualities, along with acoustic ceiling tiles and padded furniture. Large windows, fixed nightlights, task lighting, and overhead lighting above the patient bed were used to create high illumination and even lighting levels. Landscape artwork and indoor plants were placed within the patient rooms to offer a positive attraction.

**Summary**

The research methodology used consisted of a qualitative approach to understand the ACE model and unit design considerations from an interior designer’s perspective. This research was supported by the notion that there is little information considering the interior design of ACE units other than the standard ADA and universal design guidelines.

The foundation of this thesis is that the healthcare facilities are going to encounter an emerging population of elderly patients and many standing hospitals are not prepared to provide a physical environment catered to this at-risk population. The research questions and objectives were used to guide the research during the literature review process. The literature review focused on acute illness, the ACE model of care and principles, and elder-friendly hospital design.

Applicable case studies involving patient rooms, elder-friendly hospital design, residential hospital design, patient-centered hospital design, and acute care design were reviewed and discussed. The evaluation of these patient rooms and hospital design concentrated on the zoning/layout, privacy, lighting and acoustic considerations, finishes/materials, and nature distraction. The analyzed and discussed data formed the basis of the designed ACE prototype.

The design proposal integrated the principles of the ACE model with elder-friendly hospital design and other patient room design considerations that provide a patient-centric approach. When designing an ACE unit, the following guidelines should be considered. The
specification of furniture should support the safety of the patient, providing a sturdy base and rounded corners. Upholstery should be durable, easily maintained and cleanable. When armrests are provided, a contrasting surface from the seat should be used to define the boundaries of the furniture. Built-in storage and surface area encourages patients to continue daily tasks and can help increase or maintain both cognitive and physical functional levels. Issuing an area where these tasks can be carried out can help improve the Instrumental Activities of Daily Living assessment. When selecting flooring, wall coverings, and casework, having a high contrast between the surfaces is important to define boundaries and assist with orientation of older adults. A color palette that offers a soothing, homelike atmosphere can ease patients into hospitalization and deliver a less institutionalized feel. Providing subtle pops of color on specific walls can help with orientation and give visual interest to the space. Using warmer tones is encouraged, along with lessening the use of colors close together on the color spectrum due to visual impairments that occur while aging. Acoustic ceiling tiles and sound absorbent flooring should be used to reduce excess noise and accommodate to the patient’s speech privacy. This can lessen unwanted stress and anxiety that can negatively affect functional status. Installing landscape artwork where applicable can positively affect staff, patients, and family during the hospitalization. Nature scenes, from both windows and artwork, imply faster recoveries and healthier attitudes by means of a positive distraction. A floor plan, reflected ceiling plan, elevations, and renderings are provided to display design considerations and elements used throughout the ACE unit.

Limitations and Future Research

Due to COVID-19, this thesis fails to provide more empirical research from observations, surveys, or interviews with patients and staff as originally planned. Thus, future research is needed to investigate the perception of older adults and staff about design considerations and
satisfaction levels within acute care facilities. To obtain empirical evidence on how older patients, family members, and staff use ACE units, behavior mapping and observational research could be conducted.

**Conclusions and Implications**

In this thesis, the author attempts to understand the importance of the built environment and patient outcomes within the healthcare setting, specifically patients sixty-five and older. The collected research from literature reviews involving acute illness, the ACE model, and elder-friendly hospital design were integrated to develop a design guideline for understanding this relationship. The proposed design provides a homelike atmosphere for elderly patients to maintain or improve their functional status by supplying furniture, materials, spatial configurations, and family accommodations that support their safety and well-being during their hospitalization. As population groups continue to age, the understanding of importance on positive elder-friendly hospital design, specifically ACE units, will be necessary.
REFERENCES


