Supportive Design Features in Kitchens and Bathrooms of Age-Restricted Retirement Community Homes

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ABSTRACT

The number of older persons is increasing, both in actual number and as a percentage of the population. As an individual ages his or her body changes and the ability to deal with the demands of an environment usually decreases. A well designed, supportive environment may help older persons to utilize their homes more fully, more safely, and allow them to live independently in their homes longer. Use of kitchens and bathrooms may present the greatest challenge and the greatest safety hazard and in order to remain independent, an older person must be able to use these rooms fully and safely.

The purpose of this study was to determine what supportive features are being included in the kitchens and bathrooms of homes being built for persons living in age-restricted retirement communities. A list of research and design recommendations based on empirical research was compiled and ordered into categories of supportive features for general, kitchen, and bathroom design for seniors. Design recommendations were provided for most elements in kitchens and bathrooms designed for senior citizens and point values were assigned to individual supportive features on the basis of safety and ease of use. Based on this evidence, two data collection tools were created to assess kitchens and bathroom of homes designed for senior living. Hypotheses were developed relating characteristics of the locations of the retirement communities, characteristics of the retirement communities, and characteristics of the individual homes to the percentage of possible points earned in kitchens and bathrooms of homes studied.

Age-restricted retirement communities were identified and contacted by telephone to determine if they met the criteria for inclusion in the study and permission to study the retirement communities was obtained from community representatives. Sixty homes in 23 communities from four states were surveyed using the data collection tools and photographed for this study.

Data were entered into a statistical computer program and a scoring system for evaluating and comparing kitchens, bathrooms of different types, and total homes was developed. Kitchens in the retirement community homes studied had 46% - 76% of the possible number of recommended supportive kitchen features. Bathrooms had 48% - 57%, bathtubs had 58%, and separate showers had 48% - 52% of the possible number of recommended supportive bathroom features. Kitchens in larger, more expensive retirement homes had higher Kitchen Percentage Scores and bathrooms in communities that were developed by not-for-profit communities had higher Bathroom Percentage Scores.

The kitchen and bathroom assessment tools created for this study are the result of compiling 40 years of research recommendations. These tools provide the means to compare kitchens and bathrooms of different homes, regardless of the configuration or combination of appliances and fixtures within the rooms. Scores of different rooms or houses can be compared using either the total score or the percentage score for number of supportive features. Comparisons can be made without consideration for the style, size, or degree of opulence in the homes. The assessment tools can be refined for use by members of different professions.

DEDICATION

To my wonderful husband, Dr. Abe Andes, without whom this would not have been possible. He is a role model for academic, professional, and personal accomplishment. His faith in me and the value of my work made the path easier to follow. And he has *earned* his new title: Saint Abe.

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CHAPTER 1 : INTRODUCTION

At the beginning of the 20th century, 50% of the United States population could expect to live to age 55. That life expectancy has increased to age 80 in the 21st century (Khaw, 1997). By the year 2030, persons over aged 65 will constitute 20% of the population. The fastest growing segment of our population is persons over age 85 (Desai, Zhang, & Hennessey, 1999).

As one ages, the way one interacts with environments changes, and the ability to meet the demands that environments place on the individual usually decreases. Many of the changing environmental needs of seniors have been documented. An environment that has been well designed to meet the different needs of older adults may enable these adults to stay in their homes for longer periods. Remaining in their homes, or aging in place, is the desire of most seniors.

Many professionals in different fields are working in various capacities to meet the changing needs of this rapidly growing segment of our population. Interior designers, architects, and other professionals in the building industry are faced with the challenge of assuring that seniors' environmental needs are clearly defined, and that the definitions are clearly based on empirical research findings. It is also imperative that the homes of older adults provide maximum, non-stigmatizing, support that enables seniors to remain independent as long as possible.

Statement of the Problem

As one progresses through life, from infancy to old age, one's body is constantly changing. Because of the physical challenges that face older persons, adapting to a home environment is more difficult for them than for most young people. Some gerontologists believe there may be greater variations in the way one progresses through life stages in the later stages than there were at earlier times (Blank, 1988). Elderly persons are unique as individuals and as a group.

The number of homes and the number of retirement communities being built for senior citizens is increasing in anticipation of the retirement of the Baby Boom generation. The "retirement-community developers are gearing up to create a

presence and a reputation in markets across the country" (Suchman et al., 2001, p. 5). Indeed, Gordon (1998b) comments on a study by the American Association of Homes and Services for the Aging that reveals an increase in the number of continuing care retirement communities from about 700 in 1991 to 1,300 in 1995. Gordon also reports that, in a nationwide survey, 73% of residential developers were interested in developing seniors' housing during the next five years

There is evidence to suggest, however, that available information is not being used in the design and construction of homes for older persons. Builders tend to continue to build what they have always built, much of which is not based on user needs, but rather, on traditional building paradigms (Belser & Weber, 1995). When the consumer is an older person seeking to buy a home in an active adult retirement community (AARC) "the lifestyle choice is more important to the consumer than the home itself" (Suchman et al., 2001, p. 3).

In many cases, the real problem between older people and their environments is

> . . . that the designers have failed to anticipate the requirements of their users; they have failed to design for a range of abilities broader than their own; they have failed to test their designs out with real people and they have failed to learn from the experience of the market (Stewart, 1992, p. 197).

Environments that present fewer challenges and are more supportive allow older residents to utilize the space more fully and with less difficulty. A more functional home environment allows seniors to safely remain in their home and live independently for a maximum period of time. This is called "aging in place" and is the desire of most older persons (ASID, 2001; Bayer & Harper, 2000; Lawton, 1981; Lawton, 1990; Wagnild, 2001).

Within the home environment, kitchens and bathrooms are rooms that a person must be able to use fully and safely in order to remain independent. Kitchens and bathrooms often represent the greatest challenges and greatest safety hazards to older persons as their adaptive abilities decrease.

Purpose of the Study

The purpose of this study is to determine the extent to which supportive features are being included in the kitchens and bathrooms of homes being built for persons living in age-restricted retirement communities. The study will also examine the relationship between the supportive features included in seniors' houses and characteristics of the facilities and the developer.

Objectives of the Study

The objectives of this study are:

1. to compile a list of design recommendations based on empirical research related to kitchen and bathroom design in the homes designed for seniors;
2. to develop a data gathering tool to determine what supportive features are being built into kitchens and bathrooms in homes built in age-restricted retirement communities;
3. to determine if supportive features in kitchens and bathrooms of homes built in age-restricted retirement communities meet design recommendations;
4. to describe the age-restricted retirement communities;
5. to describe the developers of age-restricted retirement communities;
6. to determine if there are relationships between supportive kitchen and bathroom features in homes in age-restricted retirement communities, the features of the communities, and the developers who build them.

Justification

With the promise of large numbers of "Baby Boomers" (those persons born between 1946 and 1964) retiring in the near future, many residential developers are entering, or considering entering, the adult retirement community development business (Suchman et al., 2001). When planning and designing for older populations, the plans for senior housing should be directed toward the future needs, as well as the existing requirements of the prospective residents of the dwelling (Goodman & Smith, 1992). So while the homes may be marketed to active and independent older adults, they should be designed in a way that allows the residents to remain in their homes, or to age in place, as their bodies change and they experience decreased environmental competence.

Since the independence of many seniors, especially those at more advanced ages, may be at risk, it is particularly important to design and build environments that are supportive of their needs. Because of the myriad of activities that take place in kitchens and bathrooms, and the requirements that people use their bodies in many different ways, these two rooms may demonstrate to individuals, more than any other areas of the home, that their abilities are lagging. It is, therefore, imperative to design and build these two areas of the home to support maintaining independence, control, and freedom for the older user (Scott-Webber & Koebel, 2001). It is important to add that the designs of the kitchen and bathrooms are the features in homes that draw the most comments from residents (Valins, 1988). Kitchens and bathrooms are the rooms most essential for maintaining independence for seniors, in addition to being the locations of most accidents and injuries (Ho, Ying, & Chan, 2001; Kallman & Kallman, 1989; Mullick, 2000).

The interface of the environment, technology, and design should be simple and should be designed with the user in mind. “If products were designed with the capabilities and limitations of older people in mind, and they are, after all, approximately 20% of the population, they should naturally be safer and more functional for all” (Haigh, 1992, p. 219). The same can be said with regard to the design of environments used by older persons.

Research and practice has established that individuals experience numerous physical and physiological changes as a result of the aging process. More than 30 years of research exists to identify supportive housing features for older adults (Grandjean, 1973; Green, Fedewa, Johnson, Jackson, & Deardorff, 1975). There are long established research and design recommendations for supportive environments for older adults (British Standards Institution, 1969; Faletti, 1985; Fozard, 1981; Golant, 1982; Grandjean, 1973; Green et al., 1975; Lawton, 1980b; Lawton, 1981; O'Bryant, 1982; Oberland, 1976; Parsons, 1981). More recent research indicates that many older persons would be able to live independently and remain in their homes if environments were more supportive of their changing needs (Feingold & Werby, 1990; Kochera, 2002; Mastrian, 2001; Pastalan, 1990; Quinn & Whitman, 1989).

This research will be of value to:

1. kitchen and bath designers, interior designers, and architects who are responsible for designing the floor plans and for specifying materials, finishes, and furnishing for homes for independent living retired persons;
2. builders and developers who need up-to-date recommendations upon which to base the design and construction of homes for independent living retired persons;
3. older adults who are remodeling their current homes with the intention of aging in place, evaluating independent living retirement communities, or moving their current residence to another location and seeking information about appropriate kitchen, bath, and interior design to meet their needs;
4. manufacturers and their sales representatives who seek to have their products installed in the homes of senior citizens;
5. housing, interior design, and gerontology educators and students who are seeking to transmit and acquire information about appropriate housing for senior citizens.

Limitations

This research study was conducted in a limited number of homes, within a limited number of retirement communities. Random sampling was not used and, therefore, the findings may not be representative of retirement housing throughout the United States or be representative of developers, builders, and retirement communities and homes for seniors throughout the country. The research also was limited to specific geographic areas and to the homes of independent living seniors.

Definitions of Key Concepts

For the purposes of this study, the following terms are defined:

Activities of Daily Living (ADL): This category of activities is essential to an individual's ability to care for himself or herself. These activities include dressing, getting into and out of the bed, rising from a chair, washing one's face and hands, eating and drinking, washing one's self completely, using the toilet, and moving around inside one's home and outside on flat ground (Kemper & Suurmeijer, 1990).

Age-Restricted Retirement Community: These communities are targeted to persons of a specific age, usually 55 years and older and are also known as age-qualified. Services, programs, and amenities are geared to mature adults and their interests and needs (Suchman et al., 2001).

Aging in Place: Aging in place is "not having to move from one's present residence in order to secure necessary support services in response to changing needs" (Pastalan, 1990, p. ix). Aging in place is facilitated by housing that can adapt to the changing needs of older adults, rather than require the relocation of the resident into different, more supportive housing as their needs change (Howard, Schless, & Edson, 1997).

Continuing Care Retirement Community (CCRC): These communities are also known as life-care facilities, and have been available in the United States since the 19th century. The facilities are designed to provide the resident with a home and the level of care needed by that individual, ranging from independent living to nursing care. The operators maintain ownership of the real property and charge residents a sizeable entrance fee plus a monthly fee to live there (Gordon, 1998b). Several housing options are available including independent living homes and apartments, assisted living and nursing care.

Fee Simple Ownership: After paying the purchase price, or obtaining a mortgage covering the unpaid balance of the purchase price, the purchaser becomes the owner of real property. Fee simple ownership is the most common form of homeownership in the United States.

Independent Living: A term used to describe people able to live in a home without consistently relying on others for assistance in carrying out Activities of Daily Living and Instrumental Activities of Daily Living. A home for independent living would not include pre-arranged services such as housekeeping or a meals program.

Instrumental Activities of Daily Living (IADL): These activities are indicators of an individual's self-reliant functioning within an environment. Examples of activities are preparing meals, keeping track of household expenses,

completing housekeeping chores, doing laundry, and shopping (Kemper & Suurmeijer, 1990).

Life-time Leasehold: An agreement between the resident of a continuing-care retirement community and the community which specifies that the resident has the right to occupy the premises for the duration of the specified agreement period, but carries no rights to real property within the retirement community. May also be known by such terms as Life Interest, Life Estate, Life Lease, Life Tenant (Gordon, 1998a).

Older Person: For this study, a person aged 55 years of age or older meets the definition since it is the qualifying age of most age-restricted retirement communities. This term will be used interchangeably with the terms “Senior” and “Retired Person”.

Senior Housing: Housing designed to be occupied by persons aged 55 years of age and older. Senior housing may include homes for independent living, assisted living, nursing care, CCRCs, and age-restricted retirement communities.

CHAPTER 2 : LITERATURE REVIEW

The demographic composition of the United States and the world is changing as the numbers and percentages of older persons increases. This chapter presents the changes that seniors may experience as they age and the effect that environments may have on the ability of older persons to live independently. Types of housing for seniors and the effect of supportive housing on older persons and their ability to remain independently in their homes are also discussed.

Demographics of Aging

In the United States, the number of persons aged 65 and older is increasing rapidly (Vaupel, 1997). The percentage of persons who are aged 65 or older, as compared to the general population has tripled since 1900, and the estimated number of older persons has increased by 11 times (Kochera, 2000). The fact that life expectancy has almost doubled is considered to be one of the great success stories of the twentieth century. This success is due in large part to the fact that individuals now survive into middle age in greater numbers because of reduced mortality rates in infancy and childhood (Khaw, 1997).

In addition to reduced mortality rates in infancy and childhood, mortality rates at older ages have successfully been reduced. Since 1950, and especially since 1970, mortality rates among older persons have dropped dramatically (Vaupel, 1997).

Of the group 65 years of age and older, the fastest growing segment is those aged 85 years and older (Desai et al., 1999). The number of centenarians, or those seniors who are one hundred years of age and older, is increasing at a rate of 8% per year. Vaupel (1997) credits improvements in survival rates at the oldest ages for the most important improvements in maximum human lifespan. As a result of increased life expectancy and the large number of “Baby Boomers”, or persons born between the years of 1946 and 1964, having reached middle age, the number of older persons is expected to increase from 33.5 million, or 12.8% of the population,

in 1995 to 69.4 million in 2030, an anticipated 20% of the population (Desai et al., 1999).

Health and Quality Of Life

Data collected by the National Center for Health Statistics indicates that, although those 65 years of age and older comprised only 13% of the total population, they accounted for 35% of the total personal health-care dollars spent. This amount is equal to $310 billion. Between the years 1985 and 1995, the rate of personal health-care expenditures for persons 65 years of age and older increased at an annual rate of 5.8% (Desai et al., 1999).

Among adults aged 55 and older, as their age increased, the percentages who self-reported fair or poor health increased substantially. Results of data collected in 1994 indicated that at ages 55 – 64 years, 21.1% of men and 20.8% of women reported fair or poor health; at age 65 – 74 years, 25.9% of men and 26.5% of women reported fair or poor health; and at age 75 and older, 32.8% of men and 34.4% of women reported fair or poor health (Campbell, Crews, Moriarty, Zack, & Blackman, 1999).

The Centers for Disease Control (CDC) defines a chronic condition as "illnesses that are prolonged, do not resolve spontaneously, and are rarely cured completely" (National Center for Chronic Disease Prevention and Health Promotion, 1999, p.1). In 1997, 30% of persons aged 65-74 reported that their activity was limited by a chronic condition. The most frequently occurring chronic conditions among older adults were: arthritis, hypertension, hearing disorders, heart disease, cataracts, orthopedic impairments, sinusitis, and diabetes (Kochera, 2000). The Centers of Disease Control and Prevention indicate "one important public health goal for an aging society is to minimize the impact of chronic disease and impairments on the health status of older adults, maintain their ability to live independently, and improve their quality of life" (Campbell et al., 1999, p. 1). Most chronic conditions are nonfatal and people learn to live *with* them rather than dying *from* them. However, chronic conditions will affect the way in which an individual interacts with his or her environment.

Aging and Health

". . .Since aging is a totally natural phenomenon it cannot be considered to be a pathological condition" (Holliday, 1997, p. 1796). However, as one ages, one experiences numerous physical and physiological changes. The process of normal aging includes vision and hearing changes, decreased size and strength of muscles, as well as decreased mobility, flexibility, and diminished bone density (Burnside, 1988). The changes in physical and psychological capacity seen in adults as they age affects the ability to function effectively in the community (Clark, Czaja, & Weber, 1990). Conditions that did not present a significant environmental challenge to an individual at age 40 or 50 may represent an insurmountable obstacle to the same person at age 70.

As in many other aspects of life, it is important to note that aging is an individual process leaving some people with very limited abilities and others capable of performing at higher levels than some young adults (Young, 1997). For example, a retired athlete may be able to perform at a level that exceeds that of a less active younger adult. However, the retired athlete will probably be functioning at a level of performance that is lower than it was 30 years earlier. Blank (1988) adds that a number of gerontologists assert that there is greater variation among adults in later life than there is in earlier ages and that these variations between individuals must be considered when planning to implement research findings. However, all individuals experience some common physical changes due to the aging process.

Physical Changes Due to Aging

The following is a brief overview of the physical changes that occur as an individual ages. The changes in vision, hearing, balance, muscles, bones, and joints are included as well as the most frequently occurring forms of arthritis.

Vision

The eye is the sensory system most vulnerable to the aging process and loss of vision is the second most dreaded consequence of aging (Cogan as cited in Verrillo & Verrillo, 1985). The Centers for Disease Control and Prevention (Campbell et al., 1999) report that in 1994, 18.1% of adults over the age of 70 reported vision impairments. This percentage of older Americans represents

approximately 3.6 million persons. Older persons who reported having impaired vision were more likely to have difficulty walking, problems going outside, and trouble getting into and out of a bed or a chair (Campbell et al., 1999). Visual impairments also place individuals at greater risk of falls (National Center for Health Statistics, 2001).

Normally, when exposed to light the pupil of the eye constricts and when exposed to a dark environment the pupil dilates. The pupil reaches its maximum responsiveness to light in the early teens and begins to decline after that age (Haigh, 1993). In addition to being less responsive to light, the diameter of the pupil decreases with age (Kallman & Kallman, 1989). The result is a decreased amount of light entering the eye and being transmitted to the retina. As a consequence, the older person needs much more light, as much as three times more light, to be able to see the shapes of objects and to perceive fine details, commonly referred to as visual acuity (Haigh, 1993).

Accommodation refers to the eye's ability to focus on near and far objects. The near point of accommodation changes as one ages from a distance of about 3" in front of us at age 16 years to a distance of about 39" at age 60 years. Objects need to be farther away to be in focus for the older eye. As a result, older people may need to wear corrective lens, commonly referred to as bifocals, or reading glasses. Since objects are farther away, the image is smaller, and requires greater acuity and illumination to be seen clearly (Haigh, 1993).

Another visual change experienced as age increases is the ability to perceive depth. Verrillo and Verrillo (1985) discuss a research study by Bell that reports few changes in depth perception before age 40. After 40, however, there is a rapid deterioration in depth perception. Altered depth perception can result in orientation problem within an environment and can contribute to the increased incidence of postural instability and falling in older adults (Verrillo & Verrillo, 1985).

Within the eye, the lens becomes more rigid, less transparent, begins to yellow, and, as discussed earlier, the diameter of the pupil decreases. These conditions contribute to the increased need for light in order for the older person's vision to be acceptable. Furthermore, older persons often experience difficulty in

adjusting to changes in the level of illumination (Kallman & Kallman, 1989). Another result of increasing opacity of the lens is a scattering of light within the eye itself which is perceived as glare (Haigh, 1993). The net effect is that bright, sparkling light and small, bright light sources can produce so many reflections that they are problematic for seniors (Goodman & Smith, 1992).

Between birth and age 30, humans are developing color perception. Decreased color perception begins at about age 30 with a reduction in blue-green discrimination, followed by a red-green deterioration at about age 55 – 60. The worsening of color vision is attributable to a yellowing of the lens, the effect of which is the filtering out of blues and violets (Haigh, 1993). Darkening of the lens is also responsible for loss of color vision, mostly in the blue-green areas of the color spectrum. The result is that these colors can appear dark or muddy. Lavender begins to be perceived as a muddy color and purple becomes brown. Elderly people can see yellow, orange, and red much easier than other colors (Goodman & Smith, 1992). This problem rarely shows up in persons younger than 60, but can be a significant problem for those in their 70s and 80s (Wagner, 1991).

Vision affects one's sense of balance, ability to ambulate safely, and ability to perform daily tasks. Peripheral vision declines and the older person sees less well to the sides of his or her head. Additionally, the ability to see in an upward direction of greater that 15° without moving one's head is lost. The result is a reduction in the older person's ability to drive, climb stairs, self-administer medications, cook, and remove objects from shelves above and below eye level (Kallman & Kallman, 1989).

In a study comparing young person's vision with that of older persons, researchers determined that older participants, even with visual acuity of near 20/20, had difficulty perceiving the human face under low contrast conditions (Kroemer & Grandjean, 1997). The researchers expressed concern that this difficulty with contrast sensitivity could also manifest itself with other areas of visual cueing and present a hazard to elderly people when they were required to detect silhouetted or partially silhouetted objects. They conclude that levels of contrast (1 being the amount of contrast needed for the age group 20 – 25) need to increase by 2.7 times to accommodate the needs of a 65 year old (Kroemer & Grandjean, 1997).

In areas where color and light values are nearly the same, as on stairs and on floors, seniors have difficulty perceiving where surfaces begin and end (Sekuler, Owsley, & Hutman, 1982). Further compounding vision problems experienced by many elders is the fact that changes in color of flooring may be perceived as a change in the level or height of the flooring surface (Goodman & Smith, 1992).

Sudden alterations in light level can also have serious consequences for elderly persons. This is most important when the person is using visual information to make decisions about their movement, such as at the top of stairs (Fozard, 1981). Most serious falls experienced by seniors occur in falls down stairs (Kallman & Kallman, 1989). Changing light level may be involved in these falls, and this may be particularly true when the stairwell has a bright window at the end that diminishes the older persons' ability to respond to a darker area of the stairwell (Fozard, 1981). The perception of sudden changes from light to dark is slower in older adults. The result of a rapid series of extreme high to low changes in light level may be disorientation and dizziness because it requires too much visual and mental adjustment (Goodman & Smith, 1992).

Hearing

In addition to changes in vision, older people also experience changes in their hearing. Approximately 6.7 million older Americans, or 32.2%, reported hearing impairments. Both vision and hearing impairments were reported by 8.6% of the older adults. Those seniors who reported having impaired hearing and vision were more likely to experience difficulty preparing their meals and managing their medications (Campbell et al., 1999).

As one ages, one first begins to notice changes in hearing high pitched sounds. These changes may begin as early as age 40 and result in hearing less audible and less discernible sounds. Seniors also lose sensitivity to lower pitched sounds, though this loss is usually less prominent. Seniors are less able to distinguish depth, quality, and subtlety of sounds. The result is eventually a diminishment in the ability to hear voices clearly and to be able to distinguish between speech and background noise (Goodman & Smith, 1992).

By the time we reach age 50, hearing loss may be such that there is "impairment in some of the more demanding listening situations, such as faint sounds, background noise and multiple sources. Such listening requires more effort and so becomes tiring and subject to error" (Haigh, 1993, p. 11). Unfortunately, hearing aids usually only amplify sounds, resulting in even louder confusing sounds (Blank, 1988).

Auditory reaction time and orientation also decline with age. These changes may be responsible for the fact that older persons are involved in more pedestrian injuries than younger persons since they cannot react quickly to auditory cues (Kallman & Kallman, 1989). Verrillo and Verrillo (1985) report that hearing loss occurs more often in older men than in older women.

Skin

The most obvious changes in the skin over time are wrinkling and sagging. Less obvious changes are skin that is thinner and more easily damaged with delayed wound healing, decreased circulation, altered thermal regulation, and decreased sensitivity to pain and pressure (Balin, 1990). The thinness and the decreased microcirculation of tissues beneath the skin of older persons cause excessive heat to be removed from the area more slowly than in younger persons. As a result, scalding injuries with water at the same temperature may be more serious in older persons than in younger persons (Stone, Ahmed, & Evans, 2000).

Balance

Dizziness is one of several terms used to describe an unpleasant sensation of insecure balance and can be separated into categories depending on the physiological source of the problem. The incidence of dizziness increases with age from an incidence of 4% to 9% of the population in their 60s to as high as 20% of people 84 years old. Generally, one's sense of balance is controlled by a complex interaction between neurological input from the eyes, an intricate labyrinth system within the inner ear, muscles, and joints. The neurological input is processed in the brain and produces the adaptive movements that are required to keep the individual from falling and to maintain their equilibrium. Age-related changes in all the systems sending information to the brain that allow us to maintain an upright stance, slowed

neurological responses, and reduced responses of the muscular and skeletal systems to the cerebral input, all contribute to the increased incidence of falls within the older adult population (Jonsson & Lipsitz, 1990).

A study done among nurses and non-nurses of different age groups, attempted to determine which factors related to diseases and symptoms had the greatest effect on the ability of elderly people to live independently. The study participants who were older than age 60 were most concerned about their sense of balance as a danger to their maintaining an independent lifestyle (Mastrian, 2001).

Muscles

Elderly persons experience a loss of muscle tissue as well as decreased strength of remaining muscle mass. The ability of aging muscles to take up oxygen also decreases, which limits the ability of the muscle to support performance of some everyday activities (Young, 1997). Additionally, there are factors outside the muscle, such as the functional denervation caused by neurological changes, which contribute to the changes attributed to aging muscle (Hamerman, 1990). In addition, between the ages of 40 and 80 years, men experience a 40-50% decrease in muscle force, with the most significant changes taking place after age 70 (Kirvesoja, Vayrynen, & Haikio, 2000).

Bones and Joints

The primary purposes of bones are to provide structure to the body and to provide the means for the body to resist the force of impacts without sustaining injury. Bone mass is at its optimal density during young adulthood and as one ages one's bones become less dense and more porous (Young, 1997). Joints are the connections between bones and joints allow various degrees of motion, depending on the type of joint (Anderson, Anderson, Anderson, & Glanz, 1998).

Stature. While there is insufficient anthropometric data for aging populations, especially those in the eighth and ninth decades of life, some clear patterns of anthropometric change emerge. Stature, or height, is one bodily dimension that frequently declines among older persons. One factor to be considered, however, is a general increase in stature of younger persons of approximately 0.5 inches (1cm) over the past century. The fact that the current

elderly came from populations who were smaller than corresponding age groups of today contributes to the appearance of a diminished stature (Kelly & Kroemer, 1990).

However, the normal aging process also affects the shorter stature of older people. The disks between the vertebral bodies, composed of cartilaginous material, become progressively thinner and the vertebrae themselves become thinner causing a reduction in overall height. Additionally, there is a thinning of the cartilaginous bodies in the weight-bearing joints. The greatest proportion of loss in stature occurs in the trunk, as a direct result of thinning of intervetebral discs in the middle years and later as a result of the decreased height of the vertebrae themselves in later life. Consequently, there is a reduction in sitting height that approximates the reduction in general stature. While people become shorter with age, they do not become lighter until much later in life (Kelly & Kroemer, 1990).

Though stature is decreasing with age, there is almost no reduction in the length of long bones. Interestingly though, there is a reduction in arm span in the seventh and eighth decades. This decease may be attributed to changes in the thoracic cage and / or to difficulty in straightening the joints of the fingers and the arm. This reduction in arm span affects the functional reach of older adults (Kelly & Kroemer, 1990).

Osteoporosis. Mosby (Anderson et al., 1998) defines osteoporosis as “a disorder characterized by abnormal loss of bone density and . . . may cause pain, loss of stature, and various deformities” (Anderson et al.p. 1169). Until a bone is unable to resist the force of an impact or is no longer structural, osteoporosis has no effect on the individual.

A textbook of geriatric medicine (Rowe, 1990) reports that osteoporosis is a very common crippling and expensive disorder for seniors (Rowe, 1990). Osteoporosis is particularly a problem for Caucasian women (Kallman & Kallman, 1989). By the time they reach age 65, one-third of all women will have experienced a vertebral fracture and by age 80, one-third of all women and one-sixth of all men will have experienced a hip fracture. The author adds that while osteoporosis used

to be considered a normal consequence of aging, research has now shown that bone loss can be blunted by moderate exercise (Rowe, 1990).

Joints. In addition to changes in the muscles and bones, there are changes in the joints, which exhibit decreased flexibility with increasing age. The decreased joint flexibility may be demonstrated in problems with fingering and handling, in bending and kneeling, and in decreased functionality of the lower extremities. One example of this is the inability of some elderly people to straighten their ankles, a necessary ability for those stretching to reach high objects (Kirvesoja et al., 2000).

Gait. Approximately 15% of seniors have gait disturbances. Many elderly men experience the gradual emergence of a broad-based, shuffling gait, decreased elevation of the foot and swing of the arms when walking, and a stooped posture that includes flexion of the hips and knees when walking. When they attempt to turn, many seniors experience uncertainty and stiffness. Elderly women more frequently walk with a waddling gait, walk with a more erect gait, and place their feet closer together. Elderly women also experience difficulty in stepping down from stools or benches (Kallman & Kallman, 1989).

Arthritis

According to the data collected by the Center for Disease Control's (CDC) National Center for Health Statistics (NCHS) (Desai et al., 1999) during the years 1995-1996, among persons aged 65 yeas of age and older, arthritis was the most prevalent chronic condition and the prevalence increased with age. More females experience limited activity as a result of arthritis than did males (Kelly & Kroemer, 1990). There are two primary types of arthritis: osteoarthritis and rheumatoid arthritis.

Osteoarthritis. Osteoarthritis affects as many as 50 million Americans, most of whom are over the age of 65 and it is the most prevalent arthritic condition. Osteoarthritis is a slowly progressive disease of one or more joints that occurs late in life. The joints most commonly affected are those in the hands and the large weight bearing joints. The disease is characterized by pain, deformity, and limitation in movement. The disease appears to originate in the cartilage and affect bone in

surrounding areas. The cause of the disease is unknown but emerging consensus appears to be that it is a heterogeneous group of diseases resulting from several factors. Women appear to have a higher incidence of osteoarthritis in the hands, knees, ankles, and feet; men have a higher incidence of osteoarthritis in the hips and spine (Ettinger & Davis, 1990).

There is no cure for osteoarthritis but physical activity may reduce the crippling effects of the disease. Pain may be controlled by over-the-counter or prescription medications. Exercise may also help to maintain or increase the range of motion in affected joints and increase muscular strength (Ettinger & Davis, 1990).

Rheumatoid arthritis. Rheumatoid arthritis (RA) is a systemic disease that is not accurately defined and has an unknown etiology. This disease affects people of all ages but the peak incidence is in the third and fourth decades of life and symptoms usually worsen over time. The prevalence of the disease in the United States is estimated to be at 1-2% of the population as a whole and as high as 23% of women and 14% of men at age 75 years of age (Csuka & Goodwin, 1990).

Rheumatoid arthritis is a systemic, inflammatory disease and the primary manifestations of the disease are in the joints. It is not known what triggers the first stage of the disease but the onset is usually insidious, progresses to an acute flare and inflammatory response which may progress to destruction of cartilage, ligaments, tendons, and bone. The disease is characterized by swelling, tenderness and pain, and loss of function in the affected joints. Rheumatologists Csuka and Goodwin (1990) state ". . . the therapeutic goals established for elderly patients with RA must fundamentally address the threat of loss of functional independence, leading to institutionalization" (p. 878).

Accidents and Injuries

Accidents are the sixth most common cause of death for people over age 65 and the rate increases each decade after age 65. By the time a person reaches age 85, accidents are the fifth most frequent cause of death, accounting for more deaths than diabetes mellitus. Approximately half of accidental deaths are a result of falls (Kallman & Kallman, 1989). Older women had three-quarter more injuries than

elderly men, and almost 82% of the injuries occurred in the home (Kelly & Kroemer, 1990).

Pynoos and others (Pynoos, Cohen, Davis, & Bernhardt, 1987) report that elderly women tend to be injured in the home more often than their male counterparts because they traditionally carry out more household duties. Older women are injured in falls around the house more often than are older men. Elderly men may be hurt outside more often by such things as lawnmowers, nails, tools, and saws. The incidence of injury in bathtubs and showers by older men and women is equal. Also, older persons who do not recognize their own limitations may place themselves at greater risk for an injury (Pynoos et al., 1987).

Injury incurred as a result of an accident often results in an increased number of complications: increased healing time, decreased functional ability, increased dependency, and immobility. Often, after an accidental injury, there is a persistent and gradual decline in general health and function resulting in the individual becoming bed or chair bound. Immobility contributes to mortality and morbidity (Kallman & Kallman, 1989).

Many older persons are so afraid of an accidental injury or fall that they restrict their activity and their socialization. Also, families are afraid of their older family members being seriously injured in an accident and statistics indicate this fear is a common reason for institutionalizing loved ones (Kallman & Kallman, 1989).

Fortunately, it may be possible to reduce the numbers of accidents and injuries in the home by augmenting homes of older adults with supportive measures and educating seniors about safety hazards (Hazen & McCree, 2001). A study done at the University of California at Berkley was able to significantly reduce the number of falls by 60% from 0.81 to 0.33 falls per person year ($p < .01$), scalds from 9 to 0 ($p < .01$), and burns from 7 to 0 ($p < .01$) by providing minor home modifications. Home modifications consisted of: removing clutter; installing handrails, grab bars and nonskid strips; and securing extension cords and rugs. The average cost per home was $92.80 and installation of grab bars was the most frequent augmentation to homes. The average elderly household received two and some households

received as many as four grab bars, which accounted for a little more than half of all costs (Plautz, Beck, Selmar, & Radetsky, 1996).

Falls

Researchers Yardley and Smith (2002) write that seniors report fear of falling as an anxiety that exceeds even fear of robbery or financial problems and that among those who have fallen previously the fear may be as high as 50%-65%. They conducted a study of community–living residents older than 75 years of age, and attempted to identify the most commonly feared consequences of falling and to try to determine if the fear of falling motivated people to reduce their activity levels. The study concluded that the seniors in their study did indeed avoid situations in which falling could be witnessed by others, embarrass them, and pose a threat to their identity (Yardley & Smith, 2002).

In the age group including those 65 years of age and older, falls are the leading cause of deaths occurring as a result of an injury. In the United States, 2.3 million people over the age of 65 are injured by falling, 370,000 are hospitalized, and almost 9,000 die each year (Plautz et al., 1996). Additionally, "fall related accidents are predisposing factors in 40% of the events leading to long-term institutional care in older people" (Masud & Morris, 2001, p. 5). Most (55%) of the injuries resulting from falls among seniors occur in the home. Furthermore, 28% of injuries occurring as a result of falling by older persons resulted in either short-term or long-term limitation in one or more Activities of Daily Living (Kochera, 2002). Locations associated with a greater proportion of falls are stairs, street curbs, the bathroom, and the bedroom (Kallman & Kallman, 1989).

While older adults experience a large number of falls, the majority of falls result in only minor injuries (Kallman & Kallman, 1989). Between one-third and one-half of seniors living in the community fall each year. After the age of 75, women are at particular risk of sustaining a serious injury or dying as a result of a fall and 40% of all falls in this group resulted in a fracture. Many falls occur because once an older person begins to fall they frequently are unable to correct their balance and they continue to fall (Kallman & Kallman, 1989).

The greatest hazard in the occurrence of falls is frequently identified as stairs, resulting in stairs being identified as the most hazardous consumer product. The most serious accidental falls on stairs occur on descent (Pynoos et al., 1987). People over the age of 65 are the victims of 85% of all stair-related deaths (Christenson, 1990b; Kallman & Kallman, 1989). This is especially alarming when associated with the fact that older persons avoid steps when possible (Pynoos et al., 1987).

Environmental features often associated with falls on stairs include visual and perceptual problems. An individual might not be able to identify the edge of the stair tread and rug or carpet patterns may distract the eye (stripes running parallel to the tread or strong patterns) and increase the possibility of an accident. Many individuals miss the last step while descending the stairs and fall. Handrails are particularly important to older people since they use them to support themselves and also to help pull themselves up or control their body while descending the stairs (Kallman & Kallman, 1989).

Behaviors associated with falls in seniors were: walking on a level surface, turning, changing position, getting into or out of the bed, and on and off chairs, and the toilet (Kallman & Kallman, 1989). Seniors described as more “vigorous” are more likely to fall as a result of an environmental hazard and during activities that displace their center of gravity. It is unclear whether less vigorous seniors have removed environmental hazards or tend to avoid hazardous situations or situations which could result in a loss of balance (Connell, 2002).

Christenson (1990b) also observes that fear of falling is the source of tremendous anxiety among older people and often leads to a refusal to go out and a general limitation of activity. Families may also become over-protective and attempt to restrict their loved ones’ autonomy and at times may cause the family to consider institutionalization to protect their older relative from the danger of falls (Christenson, 1990b).

Hip fracture. Almost all hip fractures occur as a result of a fall (Salkeld et al., 2000). Nearly 61% of all hospitalizations for fractures are due to fractures of the hip. Hip fractures account for two-thirds of all fracture-related discharges, and

among women 85 years of age and older, fractures were the second major cause of hospitalization (Desai et al., 1999). Adults 65 years of age and older account for approximately 88% of the total health care costs for fractures occurring as a result of decreased bone density, and hip fractures are responsible for 63% of total health care costs for osteoporotic fractures (Campbell et al., 1999).

It is important to note that hip fractures are a major cause of morbidity and mortality in older persons. For every fall that results in death, there are almost 20 falls that result in a hip fracture, the majority (84%) of which occur in persons aged 65 years and older. Of those who survive a hip fracture, almost half never recover normal function (Christenson, 1990b). This fact seems to be understood by seniors. In a study of hip fractures and quality of life among Australian women 75 years of age and older, researchers used the time-trade-off technique and found that most of the women would "trade off" a longer life span in order to avoid the reduced quality of life they feared as a consequence of hip fracture. In fact, "Nearly all women would trade off almost their entire life expectancy to avoid the state of being admitted to a nursing home. Eighty per cent of respondents said that they would rather be dead" (Salkeld et al., 2000, p.344).

Burn and Scalds

Fires and burns among those aged 65 and older are the third leading cause of death as a result of injuries in the home. Every year there are 156,000 injuries, 4,700 hospitalizations, and 1,600 deaths due to fire and burning (Plautz et al., 1996). The deaths that occur as a result of burns from flames are caused primarily by igniting clothing while either smoking or cooking (Christenson, 1990b). Older adults who are confined to their homes have a fatality rate due to fires that is two or three times higher than the national average (Fielo & Warren, 2001). Twenty percent of all persons admitted to the hospital with burns are 65 and older, many of whom lived alone or were known to have ingested alcohol prior to their injury. Flames and scalding water from the tap, shower, or bath are the most common causes of burn injury in older adults (Kallman & Kallman, 1989). In fact, one-third of all the persons who suffered hot water burns are older persons (Christenson, 1990b). The National Burn Information Exchange estimated that 50% of the burn injuries that occur in the

home yearly could be prevented by education and design interventions (Pynoos et al., 1987).

In a study of burn injuries among 1063 persons 60 years of age and older being treated in a regional burn center, it was determined that the vast majority (90%) of burns occurred in the injured person's home. Sixty-six percent of those injuries were the result of being scalded by hot water. Four of the seven deaths in the study were a result of scalding; the remaining three deaths were due to burns by flame. The authors attribute the increased susceptibility of older persons to severe injury by burning to the atrophic skin and decreased mobility characteristic of this population (Ho et al., 2001).

Disability and Debilitating Conditions

It is difficult to determine the exact numbers of persons with disabilities or with age-related limitations to functional ability since the estimates vary according to the definition used and the sources of the data. Additionally, there are a substantial number of people who have functional limitations, but have returned to the workplace and do not consider themselves to be disabled (Vanderheiden, 1990). It is important to recognize that most people, if they live long enough, will experience a period in their lives when some functions become impaired (Lawton, 1990).

A functional limitation is one that affects an individual's ability to function in his or her environment but does not affect the structure of body systems (Anderson, Anderson et al., 1998). Of persons over the age of 65, 45% have some type of functional limitation. This percentage increases to 72.5% for persons who live to age 75 years. It is probable that since more people are surviving to later ages, there will be more people with disabilities (Vanderheiden, 1990). Due to the advances in medical science and the ability of technology to sustain life, an individual is more likely to experience a disability and to live with a disability than to die from a disability (Starkloff, 2001).

Data from an Annual Housing Survey were analyzed to determine if more than one member of a household experienced similar disability problems. This is an important consideration for older husband-and-wife households because there is potential for the couple to help each other with activities. Interestingly, there are joint

frequencies for many health problems but not for mobility limitations. In only 5% of cases did respondents report that in their household, both husband and wife experienced mobility problems (Struyk, 1987).

***Mobility aids*.** Mobility aids, or prosthetic devices, are available for individuals with impaired mobility and take the form of canes, walkers, scooters, and wheelchairs. Mobility aids are very valuable assets for many individuals. However, there are problems for individuals using mobility aids since they limit the use of numerous environments. Wheelchairs and some walkers cannot get through narrow doorways or go up or down stairs. Most elderly person cannot afford to widen their doorways or to have mobility aids on every level of their home. The result is that mobility aids are helpful only within limited conditions that favor their use and do not eliminate the reality of impaired mobility (Blank, 1988).

In summary, the changes that occur as a natural part of aging are normal and are happening to everyone. Most people will be relatively fit and healthy until near the end of their lives. While the natural changes of aging may not be avoidable and ". . . can be debilitating, they should not be handicapping. It is the design of the technology, products and buildings we use which results in handicap and dependence" (Haigh, 1992, p. 219).

Characteristics of Senior Housing

In 1995, the American Association of Retired Persons (AARP) determined that 44% of seniors lived in the suburbs, 28% lived in the central city, and 28% lived in non-metropolitan areas. The majority of senior homeowners (59%) had lived in their current home for 20 years or longer, while the majority of senior renters (61%) had lived in their current residence for 10 years or fewer. Older renters spend what the AARP refers to as excessive amounts (greater than 30%) of their income on meeting their housing needs. Seniors who rent their homes are also more likely to be older, have lower incomes, be single, and be members of ethnic minorities (Citro, 1998).

Homeownership among citizens over the age of 65 is high, with 78% of this age group being homeowners (Citro, 1998). Most Americans over age 45 (77%) live in single family detached houses; 8% reside in manufactured homes; 5% live in

semi-detached houses, and 9% live in multifamily homes. Forty-two percent of older Americans live in a house with two or more levels. There are bathrooms on the first floor of 88% of the homes (Bayer & Harper, 2000). A large majority of senior homeowners own their homes free and clear and the mean value of those homes was $82,000 in 1997 (Citro, 1998).

The home that is owned by the senior occupant is the least expensive housing available for most elderly people. These homes were bought years ago with the more costly dollars of the past. Today they no longer pay a mortgage. Most seniors would find it difficult to find a living situation less expensive than the cost of maintaining their homes and paying taxes on the homes. Generally, renters pay a higher percentage of their income for housing than do homeowners (Lawton, 1980b).

There were 20.9 million households in America that were headed by older people in 1997, and 78% of those households were homeowners. It is estimated that almost half of these homes were built before 1960 and 6% had physical problems. In the same year, the median value of homes owned by seniors was $89,294 compared to a $98,815 valuation for all homes. Almost 77% of seniors had paid their home loans and no longer had a home mortgage (Kochera, 2000).

In 1998, 67% of seniors lived in a family situation (with a spouse or other relative). This percentage includes 80% of older men and 58% of older women. These percentages coincide with the marital status of the older population since 77% of older men and 43% of older women were married. A higher percentage of older women (45%) were widowed. As the age of this group increases, the percentage living in family situations decreases (Kochera, 2000). Of those older people living alone (31%), 41% were older women and 17% were older men.

In 1999, the median income was $19,079 for older men and $10,943 for older women. The median income of households containing families headed by older Americans was $33,148; 11.5% of these households had incomes below $15,000 and 46.9% had incomes of $35,000 or more. Seniors received income from Social Security, assets, pensions, and earnings (Kochera, 2000).

Senior Housing

People spend more than 90% of their lives within a building and yet we know little about how the built environment affects human health (Evans & Mc Coy, 1998). Housing serves several needs of the residents of all ages. Blank (1988) identifies the first and primary need satisfied by housing as the need for shelter, which includes protection from extremes of weather and protection from intrusion by others. Housing should also be convenient in the sense of having necessary things within the house that are easily accessible and in being convenient to other components of the community. Housing ideally will satisfy the resident's aesthetic needs, both inside the house and on the exterior of the house. "The house ought to also provide a minimum comfort level for the resident and the resident should not be stressed by inadequacies of the housing structure or the contents of the house" (Blank, 1988, p.43).

A house is supposed to also satisfy a resident's need for privacy and territoriality. Residents should be able to conduct their affairs in private and in order to do so they have to be able to have control of their territory and the ability to limit the access of others to the house. One must also have a feeling of security in the house; the sense that one will not be invaded from the outside. Safety, or the feeling that no harm will befall the resident from inside the house, is important as well. Residents want the feeling of independence and choice in one's housing in addition to a feeling that they are in control of how they live in their dwelling. "Because of the central role our housing plays in our activities and self-identity, housing satisfaction, in turn, is a central element in our overall feelings of satisfaction" (Blank, 1988, p. 43).

Other valuable considerations in housing selection are space, nearness to necessary services, and complexity of sensory stimuli, which, while needed at some level, may be measured in terms of appropriateness. Individual preferences for friendliness and neighborliness should also be considered. However, it is unlikely that any housing situation will deliver a high level of satisfaction on all categories of housing needs (Blank, 1988).

It is important to understand that elderly persons have the same need for housing satisfaction as other persons.

> . . . the crucial challenge in housing, regardless of who uses it, is how to balance these sometimes competing needs and preferences to end up with a home environment that is satisfactory and satisfying. The challenge in dealing with older persons and their housing is to fulfill the same needs and satisfactions as for other residents while taking into account the current differences between some elderly residents and those of other age groups (Blank, 1988, p.45).

Types of Housing for Seniors

Seniors live in three types of housing in the United States. The first is age-integrated, community housing, the same houses that the majority of Americans live in every day. The second type is age-segregated, or age-restricted housing, so called because it separates elders from persons of other age groups within a community of their peers. Age-restricted housing is called by many names such as retirement housing, senior housing, special housing for older adults, purpose-built housing for older adults, and planned housing for older adults, but all these terms refer to non-institutional housing, facilities, and services that have been designed and built deliberately for older persons (Golant, 1992). The third type of housing is supportive in nature and directed toward medical care and support of frail seniors. Supportive housing includes assisted living and nursing care, is the last segment of a continuum of housing for seniors (Goodman & Smith, 1992), and is often institutional in nature (Blank, 1988). This study focuses on age-restricted housing, the second type of senior housing.

Senior housing is a field that is experiencing rapid growth. Seniors comprise 21% of all new home buyers and 24% of all new custom home buyers in the United States in 2001 (NAHB Public Affairs, 2004). Of the 13,368,000 seniors who move into age-restricted communities every year, 7% are between the ages 55-64, 16% are between the ages 65-74, and 30% are older than 75 (NAHB Public Affairs, 2004). In a survey of member builders, the National Association of Home Builders

(NAHB) determined that 55% of home builders built age-restricted housing for seniors in the year 2002 (NAHB Economics Group, 2004).

Age–Restricted Housing for Active and Independent Seniors

Age-restricted housing has been in existence in the United States since the 1950s, and experienced a huge amount of growth in the 1980s. The seniors housing market of the 1980s was characterized by overdevelopment and highly leveraged properties that were designed to appeal to the more affluent seniors nearing retirement age. Unfortunately, these properties did not appeal to younger seniors and had "little or no capacity to meet the supportive care needs of older, more frail seniors" (Howard et al., 1997, p. 2.01[2][a]). The seniors housing market during the 1990s stabilized as it evolved into a need-driven housing product (Howard et al., 1997).

Planned retirement communities for seniors living independently take many forms, from new communities or subdivisions consisting entirely of retired persons on individual home sites with few services offered to residents, to apartment-type buildings with a wide range of services available to the residents. Within this range of possibilities, there are many options for dwelling types. These dwellings can exist on a large suburban or country-side campus, scattered throughout clustered building in a neighborhood, or in a single urban community building (Goodman & Smith, 1992).

With the diversity of lifestyles among older adults in mind, developers attempt to provide several alternate living arrangements to prospective occupants. Variety in dwelling unit, activities and programs, organization, size, and design provides the residents with choice and accommodates a greater variety of income levels (Green et al., 1975).

Homes for independent living seniors may exist in communities designed for younger, active adults of retirement age or clustered in neighborhoods on campuses of larger age-restricted communities that include a mix of housing types and levels of independence among residents. The communities may be either Continuing Care Retirement Communities (CCRCs) or active adult communities. Maintenance of the grounds and dwelling are usually part of the contractual arrangements between

residents and the community. Residents of independent living homes may or may not have access to the resident–support services available to residents of congregate living accommodations (Goodman & Smith, 1992; Valins, 1988).

Active Adult Retirement Communities

In 1992, Golant described seniors who moved into active and independent age-restricted communities as usually married, in their late 50s and 60s, predominantly white with middle- to upper-middle incomes. Most new residents purchased their new homes without financing, using proceeds from the sale of their previous home, and planned to live there year-round. Many residents were professionals or managers prior to their retirement and they seemed to be adventurous and have positive outlooks on life (Golant, 1992).

Homes within active adult retirement communities are usually for-sale and typically consist of: single-family, ranch-style homes; cottage style villas, or garden homes; and duplexes or row house arrangements on small lots. Some communities may also have two-family, multi-family, or townhomes and there may even be two-story homes available. Owners of homes in active adult retirement communities frequently have access to common recreational facilities and a wide range of social activities and programs (Suchman et al., 2001).

The size of these individual dwellings is usually smaller than the home from which the seniors came. Units are typically built on a single-story and designed to maintain independence for its residents. They consist of more than one bedroom, at least one bathroom, a living area, a kitchen, and dining area. Most dwellings also include a washer and dryer. There is often considerable variety in floor plans available within the same community (Golant, 1992).

Continuing Care Retirement Communities (CCRCs)

While much of the development of housing for seniors is currently associated with for-profit groups, religiously-affiliated and not-for-profit groups have been attempting to meet the housing and health care needs of older Americans since the 1800s. These groups developed long term housing and health care facilities for seniors using the “care for life” model of care which required that the resident bequeath the charity with their assets in return for a home and health care for the

duration of their lives (Howard et al., 1997). Typically, the cost of providing the residents with long-term care is covered by the entry fees and periodic fees, in effect providing residents with a long-term-care insurance benefit (Jones, 1997).

Continuing care retirement communities are often called life care communities because they offer multiple levels of shelter and care to residents within the same community. They can receive a wide variety of services for the balance of their lifetime as their physical and mental abilities change. Conceivably, a person could move from a detached home, to an independent living apartment, to assisted living, and finally be cared for in a skilled nursing facility during their last days – all within the same familiar community (Golant, 1992).

Entrants into CCRCs generally must sign a written contract describing the conditions of their tenancy. Commitments include a significant up-front entrance fee, which is refundable at different levels depending on the facility; and a monthly maintenance fee. Residents of CCRCs have confidence that movement to a higher level of care will be available if it becomes necessary (Golant, 1992).

Seniors do not move into a CCRC without considerable deliberation; usually two years of deliberation are involved before moving. The average age of persons moving into a CCRC is 79 years and most are white, female, better educated, and in possession of greater assets than the average American. This type of community appeals to a needs-driven rather than a lifestyle–driven individual (Golant, 1992).

Living Independently

Most elderly persons feel strongly about their independence and control over their environment and fear a loss of either (Feingold & Werby, 1990). Living independently and performing household tasks competently serves the individual's personal long term goals and helps the individual to maintain personal self-esteem (Lawton, 1990).

Some believe that the "best way to prolong independence is to reinforce the sense of competence which is endangered in an elderly person as his or her real physical and mental powers diminish" (Feingold & Werby, 1990, p. 27). In order to enhance competence, one must have choices and be able to make the choices that

effect control over one's life, even when strengths are ebbing (Feingold & Werby, 1990).

The Public Policy Institute of the AARP concludes that "home modifications are a central element of housing accessibility, because they allow older residents full access to the features of their home and thus promote independent living" (Kochera, 2002, p. 12). Unfortunately, when the same group analyzed the data from the 1995 American Housing Survey, it was determined that approximately 51% of older households, in which at least one person had a physical limitation, did not have any type of modification in the home; 23% had one modification; 10% had two modifications; 12% had three or more modifications. The most frequently added modifications were: extra handrails or grab bars (29%), extra wide doorways or hallways (10%), special accessibility in the bathroom (10%), ramps (9%), special accessibility in the kitchen (8%), specially equipped telephone (8%), door handles instead of knobs (6%), elevator or stair lift (6%), modified sink faucets or cabinets (4%), and push bars on doors (2%) (Kochera, 2002).

Aging in Place

"Aging in place means . . .not having to move from one's present residence in order to secure necessary support services in response to changing needs" (Pastalan, 1990, p. ix). To many seniors, living in one's home, wherever that dwelling might be, means living in an environment that promotes competence and independence in dealing with one's daily activities (Quinn & Whitman, 1989).

A study by the AARP determined that a large percentage (89%) of persons over the age of 55 strongly or somewhat agreed that they wanted to remain in their home for as long as possible and the percentage of persons with that desire has increased since 1992, when it was 84%. In the event that they need help with ADLs, 82% still want to remain in their homes (Bayer & Harper, 2000).

A study conducted by the American Society of Interior Designers (ASID) reveals that 77% of the 545 adult homeowners who participated in their survey were extremely or somewhat likely to remain in the homes in which they currently live past the time at which they retire (ASID, 2001). However, 57% of the participants want their homes to be easier to maintain and 40% want it to be easier to get around in

their homes. Those homeowners who were not likely to remain in the same home reported that stairs were a concern to them. Interestingly, the study found that many of the respondents were not sure what home modifications would be needed when they age (ASID, 2001).

Effective design for seniors requires that familiarity and consistency with routines and social patterns be maintained through thoughtful and adaptable designs. It is imperative that planning and design schemes are geared toward future needs and not simply providing adequate solutions for current needs (Goodman & Smith, 1992). It is also important to note that, in addition to being the desire of most older people, remaining in their home is also the most cost-effective and humane alternative to institutionalization (Struyk, 1987).

In a study designed to identify essential actions required to complete tasks critical to daily living, Clark, Czaja, and Weber (1990) videotaped 60 seniors, with a mean age of 72 years, grocery shopping, in the Laundromat™, and in their homes carrying out daily tasks. Rooms in the subjects homes were measured and locations of essential elements (light switches, shelves, surface heights, etc.) were recorded. Force required to operate moveable components (faucets, doors, appliances, etc.) was measured, and recorded, and all objects handled during the task performance were weighed and measured. Data from the videotapes were used to create task demand requirements for 25 tasks. These researchers determined that “if a person is able to lift and lower, push and pull, assume a precision grip, stand for extended periods, and reach from a relatively small angle, then that person should be able to complete most routine tasks” (Clark et al., 1990, p. 544).

It is advantageous to have an environment to which an older person can adapt because the individual will be able to make better use of the information the environment contains in remembering and in making decisions. Additionally, a person who is well-adapted to their environment is more likely to behave in a confident and efficient manner. Unfortunately, if a person is well-adapted to an environment he or she may experience a substantial disruption in behavior if the environment is changed radically (Fozard, 1981).

The currently owned home is the least expensive housing option for most elderly people. In addition, it is familiar and, even if it has deficiencies, the occupant often loves their home and their neighborhood. If the home has deficiencies, they are well known to the resident and he or she has some feeling of competence in dealing with them. The home has many memories, symbolic meanings, and attachments for the resident that cannot be duplicated in any other location (Lawton, 1980b). However,

> . . . questions continue to arise as to the suitability of older persons' housing relative to their own special needs. Homes that are too large and have stairs to climb, high cabinets, poor lighting, and slippery bathtubs would not necessarily be judged deficient for younger persons, but might be for older adults. Also, older adults often own older homes that are more difficult and expensive to heat and maintain (O'Bryant, 1982, p. 350).

Home Modifications and Assistive Devices

A survey of persons over 55 years of age reported that 8% of the study participants indicated that they, or a member of their household, have difficulty getting around in their house. Of those who have difficulty, 63% have difficulty often and 25% have difficulty sometimes. Among those reporting having problems getting around the house, the most commonly reported environmental challenge was the stairs (35%). Other frequently reported problems were generally with mobility and difficulty with walking (15%), and more specifically with knees, hips, legs, and arthritis (15%). Of those study participants who were 45 and over, 23% expect that they or another member of their household will experience difficulty getting around their home during the next five years (Bayer & Harper, 2000).

There are technologies available to enable residents to have fuller access to the environment. Examples of architectural support hardware and home modifications are grab bars, bathtub seats, elevated toilet seats, and other types of "special" furniture or equipment. Often the appearance of some of these features tends to alter the image or feeling of a home and make it appear institutional. This institutional look is very undesirable in a home, especially when the designer wants to promote independence and self-esteem (Oberland, 1976).

In a study by AARP, 31% of Americans aged 45 and over were very or somewhat concerned about being forced to move to a nursing home if they have trouble getting around in their own homes. A large majority (86%) of the participants had made at least a simple change in their homes to make living in their homes easier for them. Some of the minor changes most commonly made to homes were installing nightlights (63%); putting strips in the bathtub or shower to make them less slippery (50%); and increasing the wattage of light bulbs (32%). A smaller proportion of homeowners have added lever faucet handles (25%) and doorknobs (14%); larger numbers and letters on the telephone (22%); double sided tape to secure rugs (20%); emergency call systems (15%); and non-slip strips on steps (12%) (Bayer & Harper, 2000).

Seventy percent reported that they had made a major modification to their home to make their home more usable for them as they got older. The major modifications included: installing light switches at the tops and bottom of staircases (34%); adding handrails to both sides of steps or stairs (25%); installing handrails or grab bars in the bathrooms to aid in balance (23%). Thirty-four percent of the study participants made modifications that would allow them to live on the first floor. The groups who modified their homes believed that the changes would make it possible for them to live in their homes for another ten years (Bayer & Harper, 2000).

Acceptance of Home Modifications and Assistive Devices

At times, people may resist home modifications and the addition of assistive technology to their homes. Reasons for resistance may include the appearance of the devices, their resistance to having their homes appear institutional, or to have it appear that a disabled person lives there. They would rather be inconvenienced or place themselves at risk rather than be stigmatized. People will often substitute ordinary household items for assistive devices, such as using towel bars that were never intended to be used for support as a substitute for grab bars (Bakker, 1999).

Christenson (1990b) remarks on the importance of helping the older person to remain in their home in the safest possible surroundings and the need to make it easier for them to complete tasks that are essential for them to maintain their independence. With regard to assistive devices and products, she notes:

> The appearance of the traditional assistive devices, such as grab bars, reachers, raised toilet seats, have caused many older persons to reject their use. The frail elderly individual who has maintained independence rarely thinks of him/herself as disabled and therefore products that are designed and marketed for the disabled population are often not accepted by older adults even though they would benefit from their use (Christenson, 1990b, p. 63)

Researchers at the Yale University School of Medicine conducted a study of 1088 persons aged 72 years and older to determine if specific environmental hazards related to transfers, balance, and gait are more or less prevalent in homes of participants with specific deficits and persons without the same deficits. All participants were interviewed regarding their confidence in completing six personal care tasks (bathing, dressing, transferring from bed to chair, eating, using the toilet, and grooming) and deficits were identified using self-reported assessments and direct observations. Additionally, participants had their homes assessed for potential environmental hazards using a checklist derived from pre-existing instruments. Environmental hazards were considered to be: low or wobbly toilet seats or chairs; absence of grab bars in the tub or shower; loose throw rugs; obstructed pathways and curling carpet edges (Gill, Robison, Williams, & Tinetti, 1999). The results of the study indicated that persons with specific, identified deficits had as many environmental hazards in their homes as did persons with no deficits. The researchers concluded that there may be many opportunities to augment the everyday function of frail, older persons by reducing the presence of potential hazards in the home environment. An example of this problem is that of all the elders in this study who reported that they could not stand with their feet side by side without losing their balance, only 25% had grab bars in their bathtub or shower (Gill et al., 1999).

In most cases, the transition from able bodied to disabled is a gradual one. Therefore, it seems worthwhile to design for an aging population that is decreasingly able bodied. It is important to remember, however, that it is not possible to design so that every product is usable by every person (Vanderheiden, 1990). ". . .the

optimum environment for the aged and aging will promote independence of activity and provide challenges to the individual, as well as maximize safety and physical comfort" (Fozard, 1981, p. 8).

> The best solution is not to design technology specifically for older people; be it in products in the work place, in the transport, or the building we use, but to design technology for all. That is, not to deliberately design technology for older people since this is likely to result in specialized, expensive, and stigmatizing products, but to design for the majority of the population including older people. Thus, the job we start at 20 can still be done easily and safely at 65 and the products we buy at 40 can still be used when we are 70. It would also help those who experience poor eyesight, poor hearing, poor mobility, poor hand function, and poor cognition at a younger age (Haigh, 1992, p. 222).

Behavior and Environment Interaction: Theoretical Perspective

Since the importance of the interaction between the environment and behavior is so obvious, it is often overlooked. A person's behavior is directly related to the design of the space in which the behavior takes place and therefore, they cannot be studied apart from each other. Because the activity and the behavior within it cannot be separated, it is imperative to discuss the environments of older adults when discussing older adults (Christenson, 1990a).

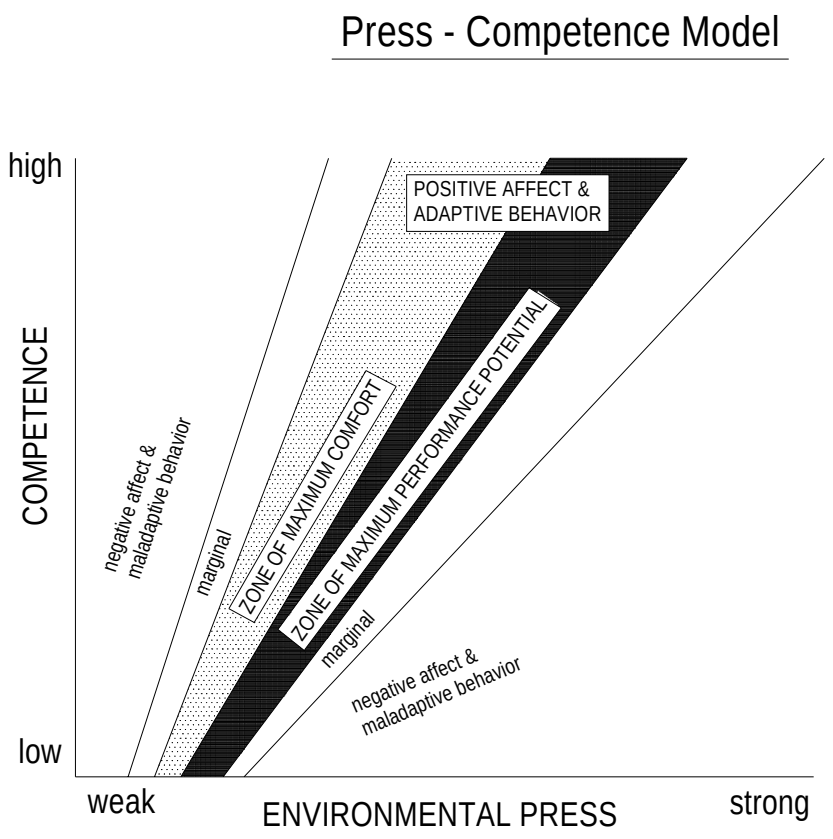
The Theory of Environmental Press, developed by Lawton and Nahemow (1973), describes the interaction between individuals and their environment. The theory defines the balance between environmental pressures requiring adaptation by the individual and the competence of the individual. Ideally, as the competence of the individual decreases, as in normal aging, a home environment would be more supportive and less demanding (Lawton, 1980a).

When the abilities of the user far exceed the demands or challenges of the environment, the environment can be perceived as boring and uninteresting, and sensory deprivation can result. When the demands of the environment are only slightly greater than the ability of the user, the result can be interpreted as stimulating or challenging. When the demands of the environment greatly exceed

the abilities of the user's competence, the result is maladaptive; the user cannot cope with the environment or adapt to it. Ability to deal with the environment is based on intellectual and physical ability, strength, endurance, and reserves of these qualities (Christenson, 1990a). Either high levels of environmental press, perceived as stress, or low levels of environmental stress, perceived as stimulus deprivation, are associated with negative outcomes (Lawton, 1977).

Figure 1: *Press – Competence Model*

Press – Competence Model: Diagrammatic Representation of the Behavioral and Affective Outcomes of Person – Environment Transactions



(from: Lawton, M. P. & Nahemow, L. (1973). Ecology and the aging process. In C. Eisdorf and M. P. Lawton (eds). *Psychology of Adult Development and Aging*. pp. 619-674. Washington, DC: American Psychological Assoc.)

Lawton (1981) describes the model of Environmental Press that he developed with Nahemow as an “ecological model” in that it describes the interaction of aged individuals with their environment. He also indicates that the “most positive outcome can be expected in an environment that affords the exercise of autonomy of the individual and one that simultaneously provides support for those areas in which autonomy cannot be exercised” (Lawton, 1981, p. 105). One’s competence level can be in the areas of biology, cognition, and psychiatry and can be described in those terms. An individual has an affective experience of relaxation and mild dependence when the demand quality of the environment is low in relation to the person’s level of competence. When the demand quality of the environment is slightly higher in relation to an individual’s level of competence, the result is increased motivation, learning takes place, and the person may enjoy the sense of mastery. Unfortunately, when the amount of press in the environment increases or the individual is at risk of institutionalization, he or she may respond passively. An insufficiently challenging environment, such as might be seen in institutional housing for older adults, also results in increased dependency since there are few environmental challenges (Lawton, 1981).

Successful completion of an activity is dependent on an individual being able to meet the challenges placed on him or her by that environment. Ordinary features of a home can present a formidable barrier to a senior citizen with problems associated with the normal aging process. An older person who is unable to successfully complete tasks encountered in daily life is experiencing a mismatch between their abilities and the intrinsic demands of the environment (Clark et al., 1990). A very difficult problem to deal with is the additional observation that particular physical features of the home, which may not have been a problem for the senior resident in the past, become a problem later as the user becomes limited in his or her ability to deal with a particular feature (Lawton, 1980b).

There are several types of barriers in homes that make them less livable for older people and the most formidable barrier is stairs. For example, 8% of participants in a Philadelphia Geriatric Center study reported that climbing up stairs was so difficult for them that they were planning to move into a different house

(Lawton, 1980). Many older persons fear a loss of control over their environment and this fear is closely identified with loss of independence, another common fear of seniors (Feingold & Werby, 1990). Briefly, “where one lives and what it means are crucial determinants of one’s feelings about oneself and one’s competency that go well beyond the basic requirements for shelter” (Blank, 1988, p. 6).

Lawton (1980b) writes that it is likely that often elderly residents can deal with at least moderately strong levels of environmental press because they are familiar with the problem and have long practice in dealing with it. This may be another reason for their reluctance to move – they are familiar with the problems and know how to deal with them. They are also reluctant to divest themselves of some of their possessions as well as to deal with new patterns and modes of use and avoidance in a new home.

Lawton (1989) was an advocate for a residential environment that is workable, predictable, and relatively stable. Additionally, an environment that is protective can solve some problems and reduce the complexity of external demands, which may be increasing with age. A protective and supportive environment may also allay fears about being able to cope and help to maintain a sense of security (Lawton, 1989).

Design of Senior Housing

In *Inquiry by Design*, Zeisel (1981) includes Rapoport’s description of how the gap between designers and those who use their designs had developed historically. In primitive cultures everyone could, and did, build their own dwellings. Dwellings were modified over generations to match cultural, environmental, physical and maintenance norms. Eventually tradesmen became increasingly common and specialization began. While most people still had basic construction knowledge, the tradesmen had greater and more detailed knowledge. Working together, tradesmen and clients introduced individual variation into culturally accepted models (Zeisel, 1981).

Since the Industrial Revolution the gap between the designer / builder and the user has grown. As the complexity of construction and design has increased, the user knows less about it. Market research has served to prevent the gap from

widening even further by bringing back to the designer the information collected by market research about what people want, as a group. The result is buildings that embody generally accepted cultural norms, even though users do not directly participate in their design (Zeisel, 1981).

A British Member of Parliament (Rowe, 1997) observes that builders find it difficult to deviate from well established norms for fear of damaging their competitive position. The example he used to make his point was steps to the front door of British homes. He writes that this building tradition was established about 1000 AD when there were few roads in England and sewerage flowed through an open drain in the center of the streets. Steps were added to the street entrance of homes to keep road muck and sewage out of the home. This tradition continues to this day even though many homeowners have trouble getting up the steps. Other out-dated building practices he cites are too narrow doorways, failure to provide a first floor toilet, too low electrical outlets, and windows installed at a height that a seated person cannot see out (Rowe, 1997).

Cooper Marcus and Sarkissian (1986) write that designers seeking what they refer to as a "socially responsible approach" to housing find little value in the critiques of fellow professionals. In researching the book, *Housing as if People Mattered,* they found that:

> With few exceptions, critiques in professional magazines focus either on building science and technology or on aesthetic principles and style. Rarely are buildings evaluated according to dwellers' responses or the way the buildings fulfill daily functions (Cooper Marcus & Sarkissian, 1986, p. 3).

Lawton (1980a) discusses the architecture tradition in which the client and the designer of a space work together, making use of the designer's expertise to produce a plan that is used by the client, who is also the user, to meet their design needs. The designer and the client meet on a face-to-face basis to discuss needs and plans and expect to have long-term contact with each other. Lawton observes, however, that this relationship is changing.

The designer of housing for older adults today has two clients. The first client is the sponsoring organization, the person or group with whom the designer is in

direct contact. The second client is the user, the older adult residents of the facility being designed who, in most cases, are not present during the design process. The sponsor becomes the advocate for older adult users of the dwelling, regardless of whether anyone in the organization knows about the housing needs of older adults. In the case of open-market building practices, sponsors and designers have assumed that, if the building product sells easily, the needs of the users are being met. However, if there is a limited quantity of housing available, buyers are likely to buy whatever housing is available, regardless of whether or not the housing is ideally suited to meet the needs of the buyer (Lawton, 1975).

Mismatch Between Seniors and Their Environment

In essence, a transactional model of performance, such as most person – environment fit models, analyzes problems of maintaining independent functioning of user populations as a problem of matching the user with the built environment. A transactional model suggests that performance of older adults might be improved by changing the design of the products they use and the environments in which they live (Clark et al., 1990). This is especially true since "most housing in which older persons live was designed and planned for younger, healthier people and does not facilitate independence among older adults (Pynoos et al., 1987, p. 277).

Part of the problem that the designer faces is insufficient social science information about user needs. It is easier for architects and builders to design for similar needs and tastes, rather than to design to accommodate different types of users. A consortium of home economists, architects, engineers, and horticulturists at the University of Nebraska at Lincoln gathered information from users of housing which they delivered to upper-level students for the purpose of designing housing to meet the needs as identified by the consortium. Thirty-four designs were created, and two were selected as being most responsive to the design program. The designs were sent out to 707 state residents with study questions to be answered. The results were summarized by the statement ". . .the two designs created in response to user input were not, in general, acceptable to these users (p. 21). The researchers concluded by stating that we need to have a greater understanding of housing norms, preferences, and symbolism and housing needs in general.

Additionally, while creativity is important and should not be neglected, the needs of the users should be the dominant factor in designing housing (Gabb, Lodl, & Combs, 1991).

Elderly persons often encounter problems while attempting to perform daily tasks such as grocery shopping, preparing meals, bathing and showering, and also may have more accidents while performing routine home chores. The ability to perform routine daily living tasks is essential to be able to remain independent in one's community (Clark et al., 1990).

Faletti (1985) writes that most consumer products, furnishings, and devices used in activities of daily living are designed to be used by young, able bodied people and can require more physical or mental ability that an older person may possess. The problem is not that the older person is unable but rather, that a higher level of ability is required to use the product or environment than older adult person possesses. He asks, ". . .what devices or modifications to the existing environment might allow those with reduced capabilities to still meet task demands" (Faletti, 1985, p. 57)?

> Many people blame the aging process for problems they encounter with daily activities, when instead quite often it is the design of the home itself that creates unnecessary disabilities. Even though there are more people over the age of 65 than there are under 25 years of age, the design of today's homes, including the products contained in them, is still based on the anthropometry of young healthy males (Bakker, 1999, p. 47).

Appropriate Design for Aging Populations

Gunts (1994), an architect, expresses concern that existing seniors housing is being built for a monolithic market with all the same needs and desires and states:

> More than most other kinds of architecture, housing for older adults can either limit what residents do or free them to live fuller and more productive lives. Unfortunately, too many housing complexes are still thinly veiled warehouses for older adults, rather than nurturing environments that promote health and independence (Gunts, 1994, p. 86).

One reason that Lawton (1990) is an advocate of new technology that would extend the abilities of people to live in their homes is that it would be cost effective by preventing the institutionalization of many elderly people. The costs to society for failing to design products, environments, or systems that are usable by more people are twofold. First, we must pay for people with functional limitations to receive special assistance to carry out activities associated with non-independent living. Secondly, society has lost the productivity that the person with functional limitations may have brought to society had he or she been able to be more fully functional (Vanderheiden, 1990).

In a survey of 200 members of the Oklahoma Home Builders Association, directed toward determining their attitudes toward building accessible homes for older adults, researchers detected a resistance on the part of the builders to depart from traditional ways of building. They also determined that builders who had been building for the longest periods were the ones who were the least knowledgeable about accessible products and features and had a more negative attitude toward aging. Builders were also concerned about consumer demand for this type of housing and the cost to build it (Belser & Weber, 1995).

Resistance to Using Supportive Environmental Features

The AARP contracted a study of Americans 45 and older. Seventy-nine percent of the 2001 persons interviewed for the study thought it was very or somewhat likely that they could stay in their current home for the rest of their lives. The majority of Americans interviewed thought that they were planners, that they were knowledgeable about housing options, and that they understood the associated costs of getting older. Unfortunately, they may not have taken into consideration the possibility of their health and physical abilities declining or anticipate that they will need to make changes in their home (Matthew Greenwald and Associates, 2003).

The AARP study participants identified housing features that they thought were very or somewhat important to age in place. Those features were full bath on the main level (88%), bedroom on the main level (87%), easily usable climate controls (83%), non-slip flooring (80%), bathroom aids (79%), and personal alert

systems (79%). Bathroom aids included having grab bars in the bathroom and a place to sit while bathing. Many of the homeowners already had several of the features in their homes, such as a full bath on the main level (85%), and a bedroom on the main level (83%), and easily usable climate controls (86%). Safety features were possessed by smaller percentages of participants. For instance, only 54% had non-slip flooring and 32% had bathroom aids (Matthew Greenwald and Associates, 2003).

Age played a role in the study participant's inclination to make changes in their homes. The majority of those participants ages 45 – 65 disagreed with the statement "It is pointless to plan for my future housing situation until specific needs arise". Oddly, the majority of those older than 65 agreed with the statement. Older homeowners were also less likely to perceive a need to make changes in their homes in order to age in place (Matthew Greenwald and Associates, 2003).

Mullick (2000) includes several reasons why older person fail to modify their bathrooms and continue to bathe in unsafe conditions. The first reason is that in the early stages of their functional decline they are able to make changes in their bathing practices and compensate for their changes. Later they see making changes in their bathrooms as an acknowledgement of their declining abilities and feel discomfited by it. Many older persons are uninformed about the types of environmental supportive features that are available and where assistance can be obtained. Financial considerations are prominent for some older persons. They live on limited, fixed incomes and making changes in their bathrooms represents too great a financial burden for these seniors to bear. Additionally, many older persons live in older homes that would be very difficult to retrofit. Some older people also feel that home modifications will adversely affect the value of their home (Mullick, 2000).

There is an odd disconnect between what we know about the housing needs of older person and types of supportive features that can help allow older persons to live independently for longer periods. In many cases these features are not incorporated into homes. Reasons for this failure include lack of knowledge about aging and supportive building features and unwillingness to adopt new building

practices. And even people who claim to value supportive features fail to include them in their own homes.

Summary

This chapter was an overview of the physical changes that older persons may experience as their age increases. A brief discussion of typical housing for older persons, the desire of older persons to live independently, and home modifications that may make living in the home easier and safer for older persons is also included. A model for and discussion of the interaction of persons and their environments is another component of this chapter.

CHAPTER 3 : METHODOLOGY

The purposes of this study are to determine what features are being built in the kitchens and bathrooms of homes designed for retired persons who live independently and to determine whether these features satisfy research and design recommendations for the design of kitchens and bathrooms of senior citizens. This research will also endeavor to determine whether there is a relationship between the supportive features included in new homes built for retired persons and characteristics of the communities in which they are being built and the developers and builders who build them.

Prior to surveying homes to determine which supportive features were present in them, it was essential to develop data collection tools. Three data collection tools were developed, the *Community and Home Information (CHI),* the *Supportive Kitchen Features Checklist (SKFC),* and the *Supportive Bathroom Features Checklist (SBFC).* A detailed description of the *SKFC* and the *SBFC* and their creation are contained in Chapter 4.

Information about the features being included in the homes was obtained through visiting homes and recording observations using the *SKFC* (see Appendix A), and the *SBFC* (see Appendix B), and taking photographs.

Information about the communities in which the homes are built and the builders who are building the homes was obtained using a *Community and Home Information* (see Appendix C) questionnaire. Information was obtained through face to face and telephone interviews with community representatives.

Development of the Data Collection Tools

The *SKFC* and the *SBFC* were developed by the researcher. An extensive review of literature was completed and the results of that review was used to create lists of design recommendations and research recommendations for supportive features which should be included in the kitchens and bathrooms of older persons. Chapter 4 contains details of the *SKFC* and the *SBFC.*

A *Community and Home Information* (see Appendix C) form was developed to collect information about the locale and the individual retirement communities in which the individual homes were located, as well as the individual homes.

The first part of the *CHI* form, Characteristics of the Location, included information about the states in which the retirement communities were located, the size of the immediate metropolitan community, and the distance of the retirement community from the nearest large urban area, as well as the size of the nearest large urban area. A Large Urban Area is one with a population greater than 90,000. This was done in an attempt to determine if the retirement community existed in a rural or urban location.

The second portion of the *CHI* collected information about the Characteristics of the Community and contained questions about the age of the community, the Number of Homes in the Community, the mean Price of Homes in the Community, the mean Size of Homes in the Community, the Type of Homeownership, the Type of Development, the Type of Community Ownership, the number of Same Type Communities the developer has been responsible for, and information about the developer. The form also contained questions about the available amenities within the retirement communities studied.

The third portion of the *CHI* contained questions related to the age of the home, the Size of the Home, and the Price of the Home. It also attempted to determine who designed the homes, and what types of upgrades to the plan, materials, and finishes the developer provided to the home buyer.

The Pilot Study

A pilot test was conducted to identify problems with the instruments and to assure clarity and consistency in their use. The purpose of the pilot study was to use the *SKFC,* the *SBFC,* and the *CHI* forms and make changes in these tools that would facilitate the collection of data for the study. Three homes in a local senior living community were studied using the three data collection tools. Each home was studied within a 45 minute period and an additional 10 minutes was required to photograph the homes at a later time.

As a result of using the tools in the pilot study, minor clarifications and language changes were made. Several additions and one omission were made to the tools. An item concerning cabinet pulls was removed, and a corner cabinet / lazy-Susan item was added to under cabinet storage in Cabinetry and Storage sections. An item addressing recessed soap dishes in bathtubs and showers was altered to count the number of advantageous storage features in bathtubs and showers.

The Sample

States

Originally, states to be studied included Virginia, North Carolina, Louisiana, and Texas. Unfortunately, only two communities falling within the study parameters could be found in Louisiana and both declined to participate in the study. The state of Florida was substituted for Louisiana.

At least two regions of each state were studied. In Florida, study regions included the east coast, the Gulf coast and the central region. A total of eight communities were included. In North Carolina, homes were studied in the Piedmont and the Raleigh – Durham area. Four North Carolina communities were included. In Texas, the Dallas / Ft. Worth metroplex, the Hill Country, and the Houston metropolitan area were studied. Texas had five communities that were studied. In Virginia, homes in northern Virginia, the central area, and the Richmond metropolitan area were studied. Six retirement communities in Virginia were included. One continuing care retirement community in Virginia declined to participate in the study. A total of 61 homes in 23 communities were studied. Descriptive information about the states included in the study is included in Chapter 5, Table 1.

Fewer numbers of homes in North Carolina were studied than in other states because fewer communities in that state met the study criteria. The most frequent reason for not including communities advertising themselves as retirement communities was the inclusion of families of all ages within those communities. The most frequent reason for not including continuing care retirement communities was

the community policy of including a meal plan and sometimes a housekeeping plan in the service fee agreement with their residents.

Retirement Communities

Names of retirement communities were obtained from advertising materials directed at persons interested in senior living, such as the *Senior Living Guides* and *Mature Living Choices* brochures, listings in the telephone book, magazines, or advertisements on the internet, and outdoor advertising. Additionally, Chambers of Commerce were contacted and asked to identify retirement communities in their area that fit the description. Information from the advertising was collected and the individual retirement communities were called on the telephone to determine their eligibility to participate in the study.

In order to participate in the study, a retirement community had to: 1) be designated as an age-restricted retirement or senior living community for homeowners 55 years or older, 2) have homes that were purchased outright or obtained through a life-time leasehold, 3) have individual homes that were designed for seniors who are able to live independently, 4) be free of services, such as housekeeping or meal programs that are provided to residents as part of an agreement to purchase the dwelling, 5) have homes that were less than 10 years old, and 6) dwellings that were single family homes.

If the retirement community met the criteria for the study, the community representative who provided the information on the telephone was told about the study. Permission to visit the community and conduct the study was obtained before any visits were made. Verbal permission to study the homes was obtained a second time when the community was visited by the researcher.

Procedures

Information on the Homes

Prior to conducting the survey, a representative of the community was personally contacted by the researcher and the study was explained. Permission was obtained from the community representative and then homes were surveyed and photographed. Anonymity was promised to the individual retirement communities. Previous discussion with and submission of study materials to the

Director of the Institutional Review Board at Virginia Tech indicated that, since no human beings were involved in the study, written consent was not necessary prior to conducting the study. All of the houses studied were vacant at the time of the study and most were being offered for sale.

When there were several homes to choose from, houses were chosen for their differences in order to get as wide a variety as possible. Houses were sometimes placed in price categories, in which case one from each category was selected and studied. At other times, houses seemed to be placed in groups according to size and numbers of rooms and a representative house from each group was selected for study. At other times, if only a few houses were available, all houses were studied.

Each home was studied individually by taking measurements, making observations, and taking photographs. Information for each of the rooms studied was recorded on separate data collection sheets in each home for later analysis.

Lighting measurements were all recorded in footcandles and measured using a SPECTRA ® Professional Exposure Meter Model P-251. Lighting measurements were taken in the approximate center of kitchens, facing exterior windows in order to obtain the highest possible reading. All measurements were taken during the day in late summer.

Analysis of the Data

After the houses were evaluated using the observational checklists, the results was entered into the statistical computer program SPSS ® 11.0 for Windows. Individual scores for kitchens and bathrooms were obtained for each dwelling. Statistical relationships between characteristics of the location, characteristics of the community and characteristics of the homes and scores for individual rooms studied within each home were computed. All statistics were computer using the .05 level of significance.

Hypotheses

The hypotheses to be tested were:

H_1 The percentage score for supportive features included in kitchens of homes built in age-restricted retirement communities will be related to:

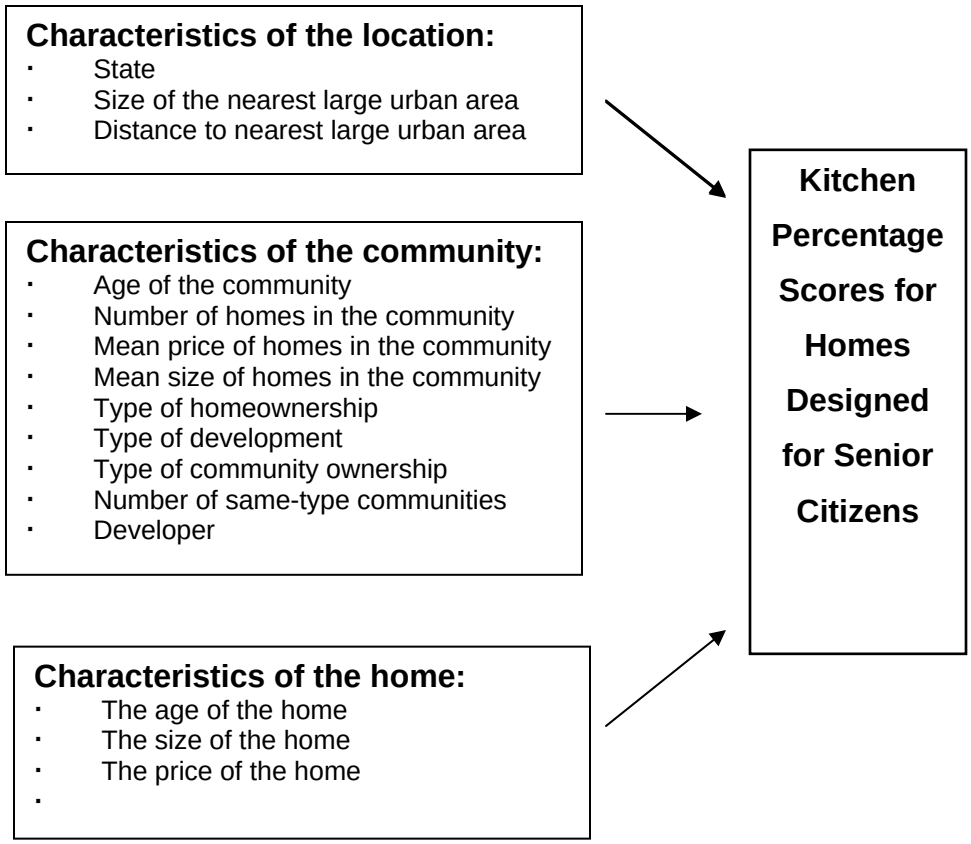
A. characteristics of the location of the community:
   i. state in which the community is located
   ii. size of the nearest large urban area
   iii. closeness to the nearest large urban area

B. characteristics of the community in which the house is built including:
   i. the age of the community
   ii. the number of homes in the community
   iii. the mean price of homes in the community
   iv. the mean size of homes in the community
   v. the type of development
   vi. the type of community ownership
   vii. the type of homeownership
   viii. the number of same type communities owned by this community
   ix. developer

C. characteristics of the home, including:
   i. the age of the home
   ii. the size of the home
   iii. the price of the home

Figure 2: ***Model for Hypothesis One***

Model for Relationship Between Location, Community and Home Characteristics and Kitchen Percentage Scores



H_2 The percentage score for supportive features included in bathrooms of homes built in age-restricted retirement communities will be related to:

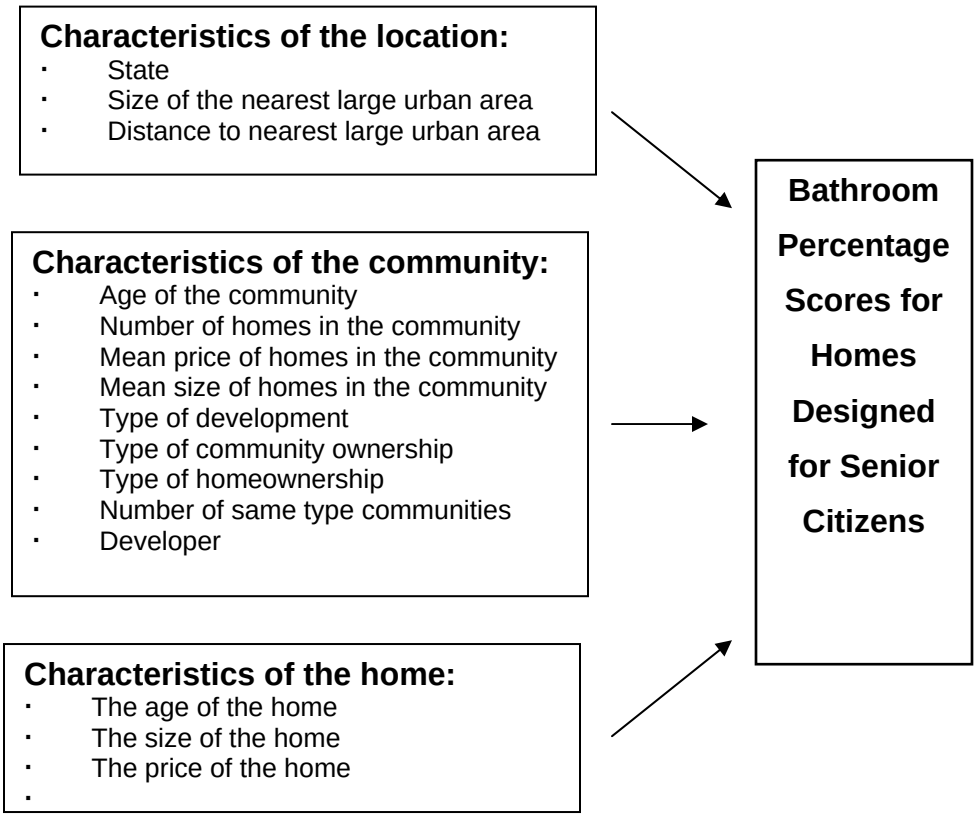
A. characteristics of the location of the community:
    i. state in which the community is located
    ii. size of the nearest large urban area
    iii. closeness to the nearest large urban area

B. characteristics of the community in which the house is built including:
    i. the age of the community
    ii. the number of homes in the community
    iii. the mean price of homes in the community
    iv. the mean price of homes in the community
    v. the type of development
    vi. the type of community ownership
    vii. the type of homeownership
    viii. the number of same type communities owned by this community
    ix. developer

C. characteristics of the home, including:
    i. the age of the home
    ii. the size of the home
    iii. the price of the home

Figure 3: ***Model for Hypothesis Two***

Model for Relationship Between Location, Community and Home Characteristics and Kitchen Percentage Scores



CHAPTER 4 : DEVELOPMENT OF THE HOUSING ASSESSMENT TOOLS

As individuals age they may find it increasingly difficult to fully and safely utilize their homes. If people are to remain independent, it is imperative that they be able to use the kitchens and bathrooms in their homes fully. This chapter investigates the literature related to kitchen and bathroom design and the older person in order to identify the important design and research recommendations in that field.

The purpose of this research is to determine what supportive features are being included in homes designed for seniors. In order to make this determination, checklists were developed for both kitchens and bathrooms to assess the presence of supportive features in those rooms.

An extensive literature review was conducted. Literature from professions concerned with supportive environments for the older individual, such as medicine, nursing, interior design, gerontology, physical therapy, occupational therapy, ergonomics, and environmental systems engineering, were searched. Beginning with studies as early as 1966, each available research and design recommendation related to the design of environments, particularly kitchen and bath design, for older persons was recorded.

Most of the recorded recommendations included in the study were based on original research by the author of the reviewed book or article. Some recommendations wee gleaned from secondary sources that reported the research work of another individual or group and added additional design recommendations. Each recommendation or research finding from each source was listed separately. The research findings and recommendations were placed in three broad categories: general recommendations, kitchen recommendations, and bathroom recommendations. There were 32 books or articles that addressed general design recommendations for seniors; 23 books or journal articles addressed kitchen design for seniors; and 17 books or journal articles addressed bathroom design for seniors.

The three broad categories of recommendations for supportive features were sorted again into more finite groups of recommendations. Some recommendations were omitted since they seemed more appropriate for frail individuals rather than for active seniors living independently. Recurring recommendation were grouped together and cited individually. The general design recommendations were summarized and added to both the recommendations for senior kitchens and the recommendations for senior bathrooms.

Eventually the groups of recommendations resembled the categories of supportive features that appeared in the *Supportive Kitchen Features Checklist (SKFC)* and the *Supportive Bathroom Features Checklist (SBFC)*. The *SKFC* and the *SBFC* were used to survey the homes in this study. This chapter focuses on the development of the two checklists and contains a description of the research and design recommendations made for kitchen and bathrooms in homes designed for older persons. The discussion of supportive features is in the same order and in the same categories as the data collection tools. The *SKFC* is contained in Appendix A and the *SBFC* is contained in Appendix B.

In all three areas of recommendations, the General Design Recommendations, the recommendations for the Senior Kitchen, and the Recommendations for the Senior Bathroom, a scale was used for assigning the point value for individual supportive feature items. If an individual item was thought to increase ease of use and increase safety for the user, it was assigned a value of three. If an item was thought to increase safety for the user, it was assigned a value of two points. If an item was thought to increase ease of use for an older user, it was assigned a value of one point. Ultimately, the assigning of values to individual items was based on the judgment of the researcher.

General Design Recommendations

Many design recommendations are common to all areas of the seniors' dwelling. These general design recommendations are included in the beginning of both the *SKFC* and the *SBFC* and precede the recommendations for the specific rooms.

Lighting

***Types of lighting*.** The most common types of lighting in residential applications are incandescent, fluorescent, and tungsten – halogen (Illuminating Engineering Society of North America, 1993). Each of these types of lighting has positive and negative features and appropriate applications in homes.

Fluorescent lighting is common and probably the most economical lighting form (Hazen & McCree, 2001; Valins, 1988). It is also probably the most controversial form of residential lighting. It is generally agreed that the light emitted from fluorescent tubes is associated with flicker that may affect basic brain-wave (EEG) patterns, may cause autistic children to become more distracted, interfere with eye movements during reading, and increase the incidence of headache and eyestrain (Hazen & McCree, 2001; Kuller & Laike, 1998). It is possible to reduce the effects of flicker on those in the area being lit with fluorescent light by using high quality, electronic, high-frequency ballasts (Kuller & Laike, 1998). Some researchers are positive about fluorescent lighting because the lamp is often larger, creates a more diffuse light source (Kwitko, 1985), and less glare (Wagner, 1991). Wagner (1991), however, is concerned about fluorescent lighting because this lighting type emits a blue-green light which may contribute to the foggy vision that older persons may experience. The *Lighting Handbook* reports, to the contrary, that carefully selected fluorescent lighting can produce high quality color rendering (Illuminating Engineering Society of North America, 1993). Regnier (2002) avoids fluorescent lighting because, unless the light is carefully balanced and skewed toward the warmer end of the spectrum, its use can make objects appear flat and occupants of the space appear sickly.

Several writers prefer incandescent lighting because, when used as an indirect source, this type of lighting creates less glare than other types. These authors, however, caution against using clear bulbs and unshielded fixtures (Aloia, 1989; Christenson, 1990b; Goodman & Smith, 1992; Regnier, 2002; Wagner, 1991). Incandescent lighting also has the advantage of probably being the type of lighting most familiar to older persons.

Halogen lighting creates a very bright light and when this type of lamp is used, care must be taken to make sure the lamp is shielded to diffuse the light and not create glare (Peterson, 1996). Halogen lighting has the disadvantage of creating more heat than other lamps. Some authors prefer not to recommend halogen lighting because of the risk of starting a fire or burning the user that the very hot bulbs could present (Fielo & Warren, 2001). Other authors do not preclude the use of halogen lighting but recommend that they only be used in fixtures that cannot be easily tipped over and accidentally start a fire (ASID, 2001). Because there is no unanimous recommendation for the type of lighting in the homes of older persons, the type of lighting in the kitchen and bathrooms will be recorded but not scored on the checklists.

Ambient lighting. Because of the changes that are known to take place in the eyes of older persons, there is no controversy about the need for increased levels of lighting in the homes of older persons (ASID, 2001; Goodman & Smith, 1992; Kroemer & Grandjean, 1997; Kwitko, 1985; Peterson, 1996; Pinto et al., 2000; Regnier, 2002). Insufficient lighting levels can increase apprehension about the environment and thereby decrease mobility for older persons, and reduce levels of communication since seniors may use lip reading to interpret words they cannot hear clearly (Brawley & Taylor, 2003). Additionally, inadequate lighting is also a contributing factor in falls in the homes of seniors (Carter, Campbell, Sanson - Fisher, Redman, & Gillespie, 1997).

In order to distinguish a figure from the background, older persons need an increased level of illumination. The increase in lighting levels suggested for the homes of older persons ranges from three (Regnier, 2002) to four and a half and five times (Leibrock & Terry, 1999) greater than the level recommended for younger people. Seniors in their 80s need five to eight times more light than people in their 20s (Brawley & Taylor, 2003). Kwitko (1985) simply suggests general levels of illumination of between 200 and 800 footcandles for seniors homes.

The *Lighting Handbook* recommends a general residential lighting level for all age groups, which would be appropriate for conversation, relaxation and entertaining, in the range of 5 – 10 footcandles (Illuminating Engineering Society of

North America, 1993). Using the recommendations for increased levels of illumination, the *Lighting Handbook* recommendations for general lighting (5 – 10 footcandles) are increased to proposed general range of lighting of between 15 – 80 footcandles.

The *Lighting Handbook* describes levels of lighting recommended for noncritical kitchen tasking and grooming in the bathroom in the range of 20 – 50 footcandles (Illuminating Engineering Society of North America, 1993). When the *Lighting Handbook* recommendations for noncritical kitchen and bathroom lighting are increased by the smallest level (3 times the general recommendation) and the largest level (8 times the general recommendation), the result is a proposed level of kitchen and bathroom lighting for seniors homes in the range of 60 – 400 footcandles.

Ambient lighting was included on both the *SKFC* and the *SBFC.* Light levels in both kitchens and bathrooms were measured with a light meter and if the levels fall with the 60 – 400 footcandle level, three points were assigned to this supportive feature.

Shades and diffusers. As discussed earlier, as a normal consequence of aging, older persons frequently have difficulty accommodating bright points of light, which can be experienced as glare (Goodman & Smith, 1992; Haigh, 1993; Kallman & Kallman, 1989). Lighting conditions that contribute to glare problems include inappropriately shielded light sources and daylight streaming into a too-dark room (Brawley & Taylor, 2003). Light bulbs should never be exposed to view without the use of a shade or diffuser as part of the light fixture (Aloia, 1989; Christenson, 1990a; Goodman & Smith, 1992; Hazen & McCree, 2001; Peterson, 1996). Monofilament light bulbs produced with clear glass should be avoided because they are also a possible source of glare (Peterson, 1996; Regnier, 2002).

Because light sources present a significant problem for many seniors, two observations were added to both checklists to record whether light fixtures were shaded and light bulbs were frosted or otherwise designed to diffuse the light and prevent glare. Each of these features was given a value of one. A higher score was

not given to these items since it is relatively easy and inexpensive to change either the light bulb or the lighting fixture if they present a problem to the homeowner.

***Task lighting*.** When a task requires extra attention because it is difficult or very important, extra lighting directed on the task is often needed to assure that the task can be accomplished in a proper way. This type of lighting is called task lighting or directional lighting (Illuminating Engineering Society of North America, 1993). Many critical tasks are performed in both kitchens and bathrooms and task lighting can facilitate the safe accomplishment of these tasks. For that reason the presence of task lighting in both kitchens and bathrooms will be recorded and one point assigned for each occurrence of task lighting, such as over the sink or under kitchen cabinets.

The *Lighting Handbook* (Illuminating Engineering Society of North America, 1993)*, Maintaining Seniors' Independence: A Guide to Home Adaptations* (Montreal General Hospital Department of Community Health, 1989) and others (Cheever, 1997) recommend additional lighting next to bathroom mirrors to facilitate shaving and the application of makeup. This item was added to the *SBFC* and given a score of two.

Regnier (2002) recommends an additional lighting fixture in the middle of the room and over the shower enclosure. He has determined that the increased lighting level is necessary for safety, personal hygiene, and skin inspection. Both of these items were added to the *SBFC* and given a value of two points each.

Electrical Controls

In order to be accessible to most people, controls should fall within what has been called the universal reach range. Items within this range are accessible to older children and to most adults, whether they are seated or standing. Opinions differ on the lowest point of universal from 9" above the finished floor (AFF) (Steven Winter Associates, 1997) to 15" AFF, the range accepted by the American National Standards Institute (ANSI A117.1) and others (Leibrock & Terry, 1999; Peterson, 1996). Raschko (1982) has a more restrictive range of lower universal reach of 27" AFF, with 11" AFF the lowest area reachable by bending at the knee; and 45 ½" defining the upper universal reach range. A more commonly accepted upper range

for universal reach is 48” AFF, which is the range accepted by ANSI (Leibrock & Terry, 1999; Peterson, 1996; Raschko, 1982; Steven Winter Associates, 1997).

The most commonly recommended universal reach range was found to be 15” – 48” AFF and that was the range chosen for this study. Light switches and electrical outlets are both essential features that should be within the universal reach range. Additionally, relocating either of these features would be difficult and expensive. For these reasons, both features were included on the *SKFC* and the *SBFC* and each feature was given a value of three points if they were within the universal reach range.

It is important to provide additional heating in the bathroom since many people get cold when bathing and may not bathe if it is too cold in the bathroom (Cheever, 1997; Mullick, 2000; Regnier, 2002). A timer switch should be added on ventilation fans or heaters so they will shut off automatically if someone does not turn them off (Cheever, 1997; Mullick, 2000). Both of these items, a bathroom heater and timer for the bathroom heater, were added to the *SBFC* and given a value of one point each.

In order to provide the older person with an increased sense of visual orientation at night when they get up to use the bathroom, it is important that there be a nightlight somewhere along the path between the bed and bathroom (ASID, 2001; Cheever, 1997; Fielo & Warren, 2001; Hazen & McCree, 2001; Parsons, 1981). While this feature may be essential for the older person to age in place, it may not be an essential feature for a person aged 55 since an individual this age may have few or no limitations. Therefore, the provision of an electrical outlet between the bed and bathroom for future needs is the supportive feature for an independently living senior.

It is also important to provide additional electrical service near the sink in the bathroom for personal grooming (Green et al., 1975; Montreal General Hospital Department of Community Health, 1989). An emergency call system is also essential to provide security later in life as seniors age in place (Green et al., 1975; Peterson, 1996). Both of these items were added to the *SBFC* and assigned one point each.

Flooring

The type of flooring material used in both kitchens and bathrooms was recorded on the *SKFC* and the *SBFC*. This observation was not scored.

Softer flooring surfaces are suggested for housing for seniors since a softer flooring surface is a more pleasing, and less fatiguing surface to stand on for prolonged periods (Rys & Konz, 1994), and may result in less severe injuries when older persons fall on it (Hartshorne, Haruff, & Alvord, 1996; Healey, 1994). Because resilient flooring has a relatively firm surface that has the ability to "give" and "bounce back" following compression, it fits the recommendations of several authors for use in senior housing (ASID, 2001; Fisher, 1985; Green et al., 1975; Hartshorne et al., 1996; Regnier, 2002). Common types of resilient flooring include vinyl composition tiles, vinyl composition sheet flooring, linoleum tiles, linoleum sheet flooring, rubber tile, and rubber sheet flooring (Resilient Floor Covering Institute, 2003). Because of its safety features and the expense of replacing flooring, the presence of resilient flooring was awarded two points on both the *SKFC* and the *SBFC*.

It is important to avoid irregularities in the flooring surface (ASID, 2001; Peterson, 1996). Elderly persons may experience diminished visual capacity and not see an irregular section of floor. In view of the fact that elderly persons often walk with a shuffling gait, they may not lift their feet high enough to avoid stumbling on an irregular flooring surface (Aloia, 1989). The presence of fairly smooth and regular floors was recorded on the *SKFC* and the *SBFC* and given a score of three.

Because of the increased risk of falls among older persons (Kannus et al., 1999; Masud & Morris, 2001; Salkeld et al., 2000), and the increased incidence of falling when floors are slippery, it is important that floors not be slippery, even when wet (Christenson, 1990b; Grandjean, 1973; Oberland, 1976; Peterson, 1996; Pinto et al., 2000). It is imperative for all flooring to be slip resistant, but it is especially important in the kitchen and bathroom since the floors in those rooms may often be wet and even more slippery than the floors in other rooms (Aloia, 1989; ASID, 2001; Cheever, 1997; Christenson, 1990b; Goodman & Smith, 1992). Floors with a matte finish are less slippery than shiny floors and, therefore, matte is the favored finish for

flooring (Peterson, 1996). Light sensitive homeowners will also appreciate the fact that matte finishes reflect less light and, as a result, cause fewer visual problems (Kwitko, 1985). Floors with a matte finish were given a score of three on both the *SKFC* and the *SBFC.*

Because of the yellowing and thickening of the eye's lenses it is difficult for older people to make a distinction between colors that do not contrast (Peterson, 1996). In order to better enable older persons to differentiate between various elements of the space, different colors can be used (Green et al., 1975) and it is generally a good idea to use contrasting colors in the environments of seniors (Wagner, 1991). In fact, color contrast becomes even more important with advancing age (ASID, 2001).

Flooring materials and fixtures of the same color may make it difficult to distinguish features and present a hazard to many older persons. For that reason, it is important to provide sufficient color contrast between the floor and bathroom fixtures (Valins, 1988). Older persons often wear corrective lenses to compensate for vision problems and it would not be unusual for a person to fail to don their glasses in the middle of the night to visit the bathroom. The observation of color contrast between wall and floor color was made on the *SKFC* and the *SBFC* and given a score of one. The *SBFC* contained an observation about contrast between floor color and the color of bathroom fixtures and was given a score of one.

Thresholds

In order to provide the safest environment, avoid trips and falls, and to accommodate wheeled conveyances, shuffling feet, and walking aids, the floors should be flat. Whenever possible, the designer should eliminate differences in the level of the floor caused by high door thresholds or floor coverings with different heights between rooms (Christenson, 1990a; Montreal General Hospital Department of Community Health, 1989; Peterson, 1996; Valins, 1988). If there are joints between unlike materials, they should be as smooth and as level as possible, with no raised edge strips or moldings (Goodman & Smith, 1992; Green et al., 1975; Kallman & Kallman, 1989; Kwitko, 1985; Montreal General Hospital Department of Community Health, 1989). When changes in level are required or are unavoidable

they should be clearly marked and changes in level must not occur in unexpected places (Green et al., 1975).

When unavoidable, it is imperative that thresholds be accessible. Their height should be no greater than ¼“ (ASID, 2001; Kwitko, 1985), or ½” at the maximum (Goodman & Smith, 1992). Furthermore, the edges of all thresholds must be beveled to reduce the tripping hazard as well as to allow access of all types of mobility aids as well as wheeled household aids (Christenson, 1990a; Goodman & Smith, 1992).

Because flooring is so important to the safety and comfort of the homeowner, as well as being expensive to change, the presence of smooth floors was recorded on both the *SKFC* and the *SBFC* and given a score of three. The presence of thresholds was given a score of one only if the threshold had beveled edges and a height of no greater than ½“.

Doors, Doorways, Locks, and Handles

After discussing the results of several accessibility research studies, Raschko (1982) concluded that 32” of clear space at doorways is sufficient for most persons, even those who use a wheelchair or other mobility aids, to pass through without difficulty. Since that is also the amount of clear space recommended by *Housing for Older Adults: The Development and Design Process* (Green et al., 1975), the American Society of Interior Designers (ASID, 2001), Fair Housing Accessibility Guidelines (Davies & Beasley, 1992), and others (Regnier, 2002), it was the recommendation chosen for this study. If doors had a clear width of at least 32”, a score of three was assigned to that space on the checklists.

Lever type handles are usable by most people and are the recommended type of door handle for seniors housing (Green et al., 1975; Raschko, 1982; Steven Winter Associates, 1997). Doors with lever handles were awarded three points on both checklists.

Bathroom doors should always open outwards. If a person should fall, need assistance, and be lying against the door, it would be impossible to reach them without destroying or removing the door (Christenson, 1990b; Goodman & Smith, 1992; Grandjean, 1973; Green et al., 1975; Valins, 1988). If the bathroom door has

a lock, it should be unlockable from both sides of the door (Christenson, 1990a; Grandjean, 1973; Green et al., 1975; Hazen & McCree, 2001; Valins, 1988). Both of these items are included in the *SBFC* and assigned values of two points each.

The door lock for bathroom doors is an important feature. A key type of release is not desirable since the key may become lost, or in the case of an emergency, there may not be sufficient time to locate a key (Christenson, 1990a; Green et al., 1975). Additionally, the lock should be easily manipulated and not require pinching or twisting to manipulate. This requirement precludes the common screw-tab in the handle type of lock (ASID, 2001). This feature, a lock that is easy to manipulate, was added to the *SBFC* and assigned a value of one point.

Cabinetry and Storage

Traditionally, in the United States, kitchen and bathroom cabinetry has been designed to industry standards that take advantage of efficiency of design, manufacturing, assembly, and shipping. With the exception of custom and some semi-custom cabinetry, cabinetry is constructed to pre-established height, width, and depth configurations. The cabinets are usually shipped to the building site, installed and, from that point on, are not flexible in position without the owner incurring considerable cost of money, time, and energy (Cheever, 1996a; Scott-Webber & Koebel, 2001).

Kitchens and bathrooms are the locations for storage of many items. Items that are stored in the kitchen include food; implements for food preparation, serving, and eating; cooking vessels; small appliances; dishes; glasses; and numerous other items. Items stored in the bathrooms include those necessary for personal grooming, bathing, toileting, and health. It is imperative that family members have safe access to all these items if they are to be able to function independently.

Base cabinets, the cabinets which are installed directly on the floor, are usually 24” deep and 34 ½” high. The major portion of the cabinet is attached to a subbase, also called the plinth, or more commonly, the toekick. The toekick is usually 3” – 3 ½” deep and 4” high. The presence of a toekick allows the cook to stand closer to the cabinet by providing a place for the toes underneath the cabinet. The lowest shelf in the base cabinet is usually a piece of building material that lies

on top of the toe kick and provides the base for the structure of the cabinet. Base cabinets usually contain storage in the form of drawers, fixed shelves, adjustable shelves, or roll-outs, shelves that can be pulled out like a drawer (Cheever, 1996a).

Base cabinets are covered with a countertop. Countertops are constructed from many materials and are usually 1 ½" thick and overhang the base cabinet by about 1 ½". The addition of the countertop to the base creates a working surface that is 36" high (Cheever, 1996a).

Wall cabinets are usually installed by screwing them directly onto the wall at a height of 15" – 18" above the level of the countertop. Wall cabinets are commonly 12" deep and between 30" – 42" high. Storage in wall cabinets is generally in the form of fixed or adjustable shelves (Cheever, 1996a).

Shelf Height and Upward Reach. The topics of shelf height and upward and downward reach are of concern to members of more than one profession, including medicine, nursing, ergonomics, physical therapy, occupational therapy, kitchen and bath design, interior design, and architecture . The research covered in the following discussions are from more than one of those professions and present recommendations from that professional frame of reference. Some recommendations include the size of the user and others do not. While recommendations and research findings may appear mutually exclusive, they should be viewed as products of different professional perspectives.

Many items in kitchens and bathrooms, as well as in other rooms, are stored on shelves. It is crucial that family members have access to these items. As a gauge of whether items are readily accessible, Kirvesoj, Vayrynen, and Haikio (2000) state that an upper shelf is too high if an individual has to support him or herself with one hand while reaching, has to grope around on the shelf for a moment before finding the items being sought, or is required to stretch on his or her toes or straighten the ankles to an extreme in order to reach the item. The height of upper shelves is appropriate if older adults can remove the item from the shelf, or place it on the shelf without any abnormal stretching (Kirvesoja et al., 2000).

An important ergonomic admonition for people in lifting objects is to avoid lifting above shoulder level. When lifting above the level of the shoulder the force of

movement on the shoulder is increased by 42%, as compared to lifting an object at the level of the waist (Pekkarinen & Anttonen, 1988). It is important to provide more storage within easy reach for older persons, especially those who may be experiencing problems with their muscles, bones, or joints (Montreal General Hospital Department of Community Health, 1989). *Maintaining Seniors' Independence: A Guide to Home Adaptations* recommends adding shelves below wall cabinets or lowering shelves to compensate for limited reach and muscle weakness in arms and for poor vision (Montreal General Hospital Department of Community Health, 1989). Kitchen designer Peterson (1995) recommends the use of tambour units or appliance garages on kitchen counters to store heavy objects at countertop height.

Knowing the height a person can reach helps to determine the height at which shelves can be attached for safe use by individuals. Some believe that the maximum height an elderly person can safely use is one into which the user can see, or eye level (Kallman & Kallman, 1989). Others agree and are more specific stating that heights into which most elderly people can see is generally 52" AFF (British Standards Institution, 1969).

Several attempts have been made to determine what the comfortable upward reach is for an individual. Grandjean (1973) reports ergonomic studies in Holland by Hemelrijk and Sittig and in Sweden by Berg, Boalt, and Leander that concluded that tall women can grasp an object that is 81" above the finished floor (AFF), an average height woman can grasp an object 74" AFF, and a short woman can grasp an object 67" AFF. He also reports findings by Wenke of a comfortable reach of 55"; by McCullugh of 54"; by the Ministry of Housing of 67"; and studies in the Woningbrow Houses of up to 67". Additionally, in a 1970 study, Thiberg determined that an average height woman, 5'3" tall, had a vertical upward reach of 79½" to the tip of her thumb (Grandjean, 1973). Grandjean's report seems to indicate that a woman can usually comfortably reach as high as 67" AFF without difficulty and some taller women may reach heights as high as 81" AFF easily. If one were designing a custom kitchen, the maximum upward reach for the owner could be determined by taking the owners height and multiplying by 1.24 (Grandjean, 1973).

As a result of their research Clark, Czaja, and Weber (1990) concluded that simply redesigning some elements of an environment could dramatically reduce the problematic demands placed on many seniors. For example, when putting away groceries in the kitchen, the researchers determined that the average high shelf height was 72", with a range of 61" – 88". In their sample the women had a mean high reach of 73", with a range of 66" – 79". This seems a reasonable match until one remembers that the depth of the shelf, which was a mean of 12" in the study, effectively reducing the high reach to much less than 73". In order to reach into the highest shelf, the individual must either stand on tiptoe, reducing the stability of their stance, or stand on a step stool, increasing the likelihood of a fall. The authors considered redesigning the environment and the use of assistive technology, such as spring-loaded, pull-down shelves, or using a reacher (Clark et al., 1990).

Other writers simply state the height of the top shelf that older individuals should have in their homes. In *Housing for Elderly People: A Guide for Architects and Clients*., Valins (1988) states that the top height for shelving should be 4'-7", or 55" AFF. Other upper height shelf recommendations range from no higher than 48" AFF (ASID, 2001), a maximum of 4'-8", or 55" AFF (Oberland, 1976; Pekkarinen & Anttonen, 1988), or 63" AFF (Kirvesoja et al., 2000; Oberland, 1976; Pinto et al., 2000), or as high as 66" AFF (Green et al., 1975). To summarize, the maximum recommended height of the upper shelf in homes of seniors could be as low as 48" AFF to as high as 81" AFF for a tall woman.

In cases where the upper cabinets or shelves are above a base cabinet, or obstructed, the height of the upper shelf that can be reached safely by an older person will be lower because the person is farther away from it. The highest shelf above a counter or base cabinet should not be higher than 55" AFF (Green et al., 1975; Pinto et al., 2000).

Since there is no uniform recommendation for the height of the top shelf, and homeowners were of different heights, the height of the highest shelf in the wall cabinets was recorded, but not scored. Kitchens and bathrooms with adjustable shelves in cabinetry received one point for providing greater adaptability to the homeowner. Kitchens with wall cabinets installed at a height of 18" or less above

the level of the countertop were assigned two points for providing greater amounts of storage within an easily accessible range.

Shelf Height and Lower Reach. Just as shelves can be too high for appropriate use, they can also be too low. Shelves are too low if the user has to bend his or her knees noticeably or squat, has to bend the upper body, support the body with his / her hands on the body or kitchen features, or has to force the body straight when rising from a position used to access contents of a shelf (Kirvesoja et al., 2000). Additional loading, or stress, on the back is caused by lifting from low heights (Pekkarinen & Anttonen, 1988).

Avoidance of stress on the low back is one rationale for recommending that large objects be stored within the range of 16" – 30" AFF and that shelves below the height of 16" should be reserved for items that are used infrequently (Valins, 1988). The lowest shelf in the homes of elderly persons should not be lower than 12" AFF (British Standards Institution, 1969; Kirvesoja et al., 2000; Pinto et al., 2000). *Ergonomics of the Home* is more conservative in recommending that the lowest shelf in the home should be no lower than 16" AFF (Grandjean, 1973). If the shelf is deeper than 12" it should not be located lower than 27" AFF (Green et al., 1975).

Another factor affecting appropriate shelf height is the depth of the shelf. At any given shelf height, once a certain depth is exceeded, the remainder of the shelf is inaccessible without excessive stretching, standing on tiptoes, climbing, or stooping. All of these positional options place the user, particularly the older user, at risk for accident or injury. *Anthropometric and Ergonomic Recommendations for Dimensions in Designing for Older Adults* reports that a shelf 12" deep should not be lower than 30"; a shelf 14" deep should not be lower than 32"; a shelf 18" deep should not be lower than 36" for a person to reach the objects on it without stretching, standing on tiptoe, or stooping. These writers conclude that the maximum usable depth of a shelf at shoulder height is 18" AFF (British Standards Institution, 1969), while others write that at shoulder height the shelf 24" AFF can be reached with ease (Grandjean, 1973). Generally, since wall cabinets are usually above shoulder level they should be of reduced depth (Montreal General Hospital

Department of Community Health, 1989) and probably not deeper than 12” deep (Green et al., 1975).

In his book, *Ergonomics of the Home*, Grandjean (1973) proposes that shelves 79” high should not be more than 6” deep; shelves 63” high should not be more than 20” deep; shelves 47” high should not be more than 24” deep; and shelves 32” high should not be more than 21” deep in order for them to be fully accessible in an efficient way. One way to deal with problems with shelf height and shelf depth, is to use fewer wall cabinets and more base cabinets (ASID, 2001) or to use wall cabinets, with the addition of a toe kick, as base cabinets (Peterson, 1995).

In order to avoid unnecessary bending, leaning, stretching, and climbing, most researchers recommend that shelves in the homes of older adults should always be adjustable, so that they can be set at a height to meet the user’s needs (Grandjean, 1973; Kroemer & Grandjean, 1997; Peterson, 1995). In addition, it is possible to replace shelves in base cabinets with deep drawers or roll-out shelves (Green et al., 1975; Peterson, 1995).

Toe kicks in cabinetry should be higher than 9” since this raises the height of the bottom shelf into a more accessible range and provides clearance for wheelchair footrests (Peterson, 1995). Generally, it is advisable to have as much storage as possible within the universal reach range of 15” – 48” AFF (Cheever, 1996b).

Since there is no uniform recommendation for the height of the bottom shelf, and homeowners will be of different heights, the height of the lowest shelf in the base cabinets was recorded, but not scored. Kitchens with base cabinets that have the lowest shelf installed above a height of 5” (the height of the standard toekick and the thickness of the shelf above it) were assigned two points for providing greater amounts of storage within an easily accessible range. Additionally, the location of storage in bathrooms was recorded but not scored.

Under-counter storage. Because drawers and roll-outs make storage in base cabinets more easily accessible to homeowners, each of these features were assigned one point in kitchens and bathrooms. Standard, fixed shelves were assigned no additional points.

Door and drawer openers. Instead of knobs, all drawers and doors should have “D” shaped, wire or architectural-style handles, or other handle types that can be used by older hands that may have difficulty grasping (Goodman & Smith, 1992; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995). Touch-latch openers can also be used on cabinet doors (Oberland, 1976; Peterson, 1995). Kitchen and bathroom cabinetry that did not require pinching or twisting to open was given a score of two points.

Towel bars. The *SBFC* also contains three items related to the presence of towel bars in safe, convenient locations for the homeowner. Bathroom linens should be stored near the point of use (Cheever, 1997; Montreal General Hospital Department of Community Health, 1989). Therefore, a score of two was given to towel bars located near to the tub or shower because of the safety considerations for a wet bather having to walk any distance to obtain a towel after a bath or shower. One point was given to a towel bar near the vanity sink.

There should be a towel bar in the bathroom for each user of the bathroom (Cheever, 1997). Many homeowners who buy retirement housing will be married and share a bathroom and it would not be unusual for more than one person to visit at a time and use the guest bath. Therefore, if there were at least two towel bars in each full bath, the bathroom was given two points on the *SBFC.*

Faucets

For the safety of all users, especially seniors, the maximum temperature of water delivered to any of the taps in the house should be controlled by a mixer and an antiscald safety valve contained within the faucet itself or the temperature of water in the hot water heater should be kept within a safe range. In order to compensate for tactile deficiencies, sensory loss, and increased response time in older homeowners, the temperature of water delivered to any faucet, all faucets should be equipped with a temperature regulating or limiting device. These devices mix hot and cold water in a way that does not exceed a pre-set temperature. The maximum temperature is viewed differently by different researchers and ranges between 110° F (Regnier, 2002), 115° F (Montreal General Hospital Department of Community Health, 1989; Peterson, 1996), 120° F (Oberland, 1976), and 130° F

(Christenson, 1990b; Fielo & Warren, 2001; Montreal General Hospital Department of Community Health, 1989) were recommended.

Pressure balancing controls within the faucet can also be provided to compensate for changes in hot and cold water pressure within the system. These types of controls should be included in the faucets of older persons (Cheever, 1997; Fielo & Warren, 2001). Unfortunately, there is no easy, definitive way to determine if a faucet contains a pressure balancing or temperature regulating control; this feature was not included in either the *SKFC* and the *SBFC.*

Faucets should be operable with one hand and should not require grasping, pinching, or twisting in order to operate them (Davies & Beasley, 1992). Recommendations for appropriate faucets include single handle lever controls (Cheever, 1996b; Green et al., 1975; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995), and paddle type handles (ASID, 2001). Or if the homeowner prefers separate hot and cold water controls, they should be of the blade- or cruciform-type (Cheever, 1996b; Fielo & Warren, 2001; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995). Round and square knobs present the greatest challenge to persons with limited finger and hand dexterity and should be avoided (Fielo & Warren, 2001; Peterson, 1996).

While integrated lever type controls are recommended by several experts, at least one researcher finds that their use may be confusing or difficult for some older persons (Mullick, 2000). In a study of 26 bathers (25 elderly persons and 1 person with paraplegia) and 14 care providers, the researcher discovered that the majority of subjects in the study had problems using this type of control. Even as they agreed it was easier to use the single lever, integrated control, they had problems understanding the color-coded signage for water temperature and flow. At times the complex movements of the faucets, such as simultaneous push and pull or rotating while pulling, were difficult for some of the subjects. Problems may be compounded by the lack of standardization for these faucet controls (Mullick, 2000)

There are faucets in numerous locations in kitchens and bathrooms. In each of the probable locations for a faucet, the faucet will be scored. If the faucet had one

or two accessible features it was awarded one point; if the faucet had three or four accessible features it was awarded two points.

Clear Space

Because it is essential for an individual to be able to have full access to his or her kitchen and bathroom if that person is to remain independent, it is imperative that he or she be able to approach and use all appliances and fixtures in both rooms. One frequent recommendation is that an adaptable seating area be included at or near some or all appliances and fixtures (Cheever, 1997; Davies & Beasley, 1992; Fielo & Warren, 2001; Grandjean, 1973; Montreal General Hospital Department of Community Health, 1989; Peterson, 1996), so that the area could be converted in the event the homeowner requires the use of a wheelchair for extended periods.

One observation that will be recorded in this study is the area in front of all appliances and fixtures in the kitchens and bathrooms. The minimum amount of clear space in front of appliances for approach and use can be defined as 30” x 48” (Cheever, 1997; Peterson, 1996; Regnier, 2002) , with either dimension being next to the appliance or fixture. Different exact dimensions are recommended by other researchers (Grandjean, 1973), but this is the dimension used by the Americans with Disabilities Act and Fair Housing (Davies & Beasley, 1992) and the dimension chosen for this study. Kitchens and bathrooms should also accommodate a 60” radius (Peterson, 1996; Regnier, 2002) so that a person using a wheelchair can turn his or her chair with ease without damaging vertical surfaces. Because older homeowners experience diminished strength and agility and are more likely to be involved in a home accident, they are more likely to use mobility aids. This possibility makes it even more important to provide a 30” x 48” clear space in front of all fixtures and appliances (Peterson, 1995; Regnier, 2002).

The *SKFC* and the *SBFC* both contain a section in which fixtures and appliances are listed. If there was a 30” x 48” clear space in front of the fixture or appliance, two points were assigned. Additionally, if the room allowed a 60” turning radius, an additional two points were allotted.

In order to make scoring for the overall checklist less ambiguous, non-essential elements in both kitchens will be listed individually. For example, a

bathroom must contain a lavatory and a toilet. A bathroom which contains only a lavatory and toilet is often called a half-bath or a powder room. The addition of a bathtub or shower, or both, is often called a full-bath. Similarly, a kitchen must contain a sink, a cooktop, an oven, and a refrigerator. Dishwashers and microwave ovens are highly desirable but non-essential appliances. These non-essential fixtures and appliances were scored separately from essential elements. Clear space and other supportive features for non-essential fixtures and appliances was included with the section of the checklist that include those items.

Recommendations for the Senior's Kitchen

The kitchen functions as a place in the home where meals are prepared and where friends and family socialize, in addition to other functions (Peterson, 1995). Even though the residents moving into a senior community may not have younger family members living in the home with them, it is important to remember that the kitchen may still be seen as the center of the home. The family members may still view this area as an important location from which to enact their traditional roles (Valins, 1988).

The housing guide *Housing for Elderly People: A Guide for Architects and Clients* (Valins, 1988) reports that kitchens have often been planned to meet minimum standards because of needs to remain within a budget. A minimal kitchen may satisfy residents who have left minimal kitchens. However, since the population of planned retirement communities includes persons who are used to larger, well-equipped kitchens, they are less likely to be satisfied with minimal kitchens in a retirement home. Indeed, comments about kitchen size reflect this concern. In addition to the size of the kitchen, comments from users of existing kitchens designed for seniors indicate that storage space is inadequate and often inaccessible (Valins, 1988).

Counters and Countertops

The kitchen is the location of many family activities including socialization, meal preparation, and storage. One expects the kitchen to be attractive and functional and to be supportive of all the activities that take place within it. As a part of meal preparation, the cook may engage in washing, cutting and chopping,

whipping, rolling, or kneading. Most of these activities take place on the kitchen counter and, therefore, the height of the kitchen counter, and other work surfaces are of prime importance to the family, regardless of age. In fact, the changes an individual undergoes with increasing maturity may make the height of the work surface even more important for the aging family members.

In consideration of the older adult person's decreased strength and stamina and to accommodate the smaller kitchen worker, it is advisable to provide a place where the homeowner can sit to work. This seating area at a lowered counter can also serve as a breakfast or snack bar (British Standards Institution, 1969; Cheever, 1996b; Hazen & McCree, 2001; Montreal General Hospital Department of Community Health, 1989; Pekkarinen & Anttonen, 1988; Peterson, 1995; Valins, 1988). The American National Standards Institute (Cheever, 1996b) recommends a counter height of 30" – 32" AFF, Valins (1988) recommends a counter height of 30 ½" AFF, while the British Standards Institution (1969) recommends a lower height of 27½" AFF. The *SKFC* contained an item awarding two points for the provision of a place where the cook can work while seated.

The ideal height of a work surface is dependent on the task being performed and on the individual doing the work. If the work surface is too high the individual is required to raise his or her elbows sideways and away from the body and raise the shoulders while working (Kirvesoja et al., 2000). This unnatural position may eventually lead to cramps in the neck and shoulders (Kroemer & Grandjean, 1997). If the work surface is too low the individual has to bend forward while working, and extends the forearm below 70°, a less than optimum working position, and in some cases the individual may even be forced to support his or her body by holding on to the work surface (Kirvesoja et al., 2000). When the individual is forced to work with the back bowed on a too low work surface many will develop a backache (Kroemer & Grandjean, 1997).

Ergonomic researchers have recommended working surface heights that range from 33 ½" above the finished floor (AFF) for older adults (British Standards Institution, 1969; Kirvesoja et al., 2000) to 35" – 37" AFF for the "average western woman" (Kroemer & Grandjean, 1997), and from 31 ½" – 37 ½" (Pekkarinen &

Anttonen, 1988). The range of recommended counter heights for the average woman is therefore, between 31 ½" and 37 ½".

Kroemer and Grandjean (1997) determined that the average working height for a western man, while standing to work, should be between 38" – 40" AFF. These researchers also believe that working heights should be set for the tallest user since it is easier to accommodate the smaller user.

In addition to the height of the worker, the task being performed determines the ideal counter height. Some (Grandjean, 1973) believe that the height of the working surface should be reduced when working with vessels on a cooking surface. The height of the cooking surface should be reduced so that the rim of the pot placed on the cooking surface is not higher than 35 ½" AFF (Pekkarinen & Anttonen, 1988). Others generalize and state that the height of the cooking surface should be no higher than 34" in order to accommodate the height of the cooking vessel (Green et al., 1975).

Some researchers maintain the best working surface height should be determined by calculating the difference between the cook's elbow height and the height of the finished floor. Two to three inches would be subtracted from the floor to elbow dimension to determine the ideal counter height for the individual worker (Cheever, 1996a). Grandjean (1973) describes work done in Germany by Bloch and Gfeller that determined that 4" was the preferred amount to subtract from the elbow to floor dimension in order to determine the ideal counter height. This measurement system would be most appropriate if one were designing a kitchen for an individual user.

The ideal height of the work surface can also be determined by establishing what work will be performed and then calculated by subtracting a predetermined number of inches from the height of the worker's elbow. For example, for cutting and mixing 6" – 8" should be subtracted from the elbow height (Pekkarinen & Anttonen, 1988) and the height of the mixing counters at baking centers should be approximately 5" lower than the baker's elbow to floor dimension (Cheever, 1996b).

Since individuals are different sizes and numerous different tasks are performed in the kitchen, several writers recommend that the kitchen contain several

different counter heights in order to accommodate as many people as possible without placing them in awkward working positions (ASID, 2001; Cheever, 1996b; Grandjean, 1973; Peterson, 1995). It has been recommended that there should be at least two different counter heights in the kitchen. One counter should range in height from 28" – 36", and one should range from 36" – 45" high (Cheever, 1996b; Peterson, 1995).

In summary, it is possible to determine the ideal height range for work surfaces in the kitchen if one were designing for a specific individual or family, but not possible to determine an ideal height for an unspecified population of users. Therefore, the recommendation is for more than one counter height and for each counter height to fit within a range of recommended heights, as in the design recommendations from universal kitchen designers (Peterson, 1995) and from the National Kitchen and Bath Association (NKBA) (Cheever, 1996b). This study recognized counters at more than one height to be an advantage and assigned one point for this feature.

Corners and edges on counters and countertops. Corners and edges should all be rounded or beveled whether on doors, drawers, countertops, or shelves for the safety of all people (Peterson, 1995). The absence of sharp edges on countertops is particularly important in the homes of seniors to avoid tearing the more easily damaged skin of elderly people (Green et al., 1975).

Contrasting elements and raised edges on countertops help persons with vision impairments to define the edges of the counters (Peterson, 1995). Raised edges also help to contain spills, prevent a spilled liquid from falling to the floor, and presenting a slipping hazard. This feature was assigned one point on the *SKFC.*

In the event of a fire, the older cook should be able to move a heavy pot off the burner without having to lift it. Since many older people have diminished strength, stamina, and ability to grip objects, the older cook may slide pots off the burner, rather than lifting them, more often than younger cooks. In order for hot heavy pots to be slid off hot burners and not lifted, spans of continuous countertop between the cooking surface and other food preparation areas in the kitchen are recommended. A minimum of 9" should be provided on one side of the cooktop and

15” on the other. The countertop should also be heat resistant (Cheever, 1996b; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995). The presence of heat resistant surfaces on both sides of the cooktop was assigned two points.

The *SKFC* contains an item listing five possible supportive features (more than one counter height, contrasting countertop edges, raised countertops edges, clipped countertop edges, and rounded countertop corners) available on kitchen countertops. The presence of any of these supportive feature was awarded one point.

Work Triangle

In the 1950s, the University of Illinois Small Homes Council promoted the concept of the work triangle as a measure of efficient kitchen design. The three points of the triangle, the refrigerator, the cooktop, and the sink, are the major work centers in a kitchen. These areas should be located at a well-established distance from each other to allow the greatest efficiency. The ideal distance between work centers is usually identified as being 4’ – 9’ (Cheever, 1996b). In order to provide more room for maneuvering in a kitchen, the designer should consider eliminating a kitchen island (ASID, 2001).

Many authors recommend that the distance between work areas should be limited in the kitchens of older families (Cranz, 1987; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995) in order to reduce the amount of walking and energy expenditure involved. Other authors warn that compression of space in a very small kitchen can also cause problems (Cranz, 1987) and the clear space in kitchen aisles between kitchen cabinets should be no less than 42” (Goodman & Smith, 1992; Green et al., 1975).

Kitchens with legs of the work triangle that are between 4’ and 9’ and have continuous countertops between the work areas were given a point for each feature. If the total length of the work triangle was less than 26’, an additional two points was awarded.

Cooktop

For the purposes of this study, a cooktop is considered to be an essential kitchen appliance. It can be a separate appliance or part of a range which would also contain an oven. It is imperative that controls for the cooktop be positioned in the front or on the sides near the front of the appliance so that the cook does not have to reach over a hot pot or burner to adjust the heat and to accommodate cooks with limited reach (Cheever, 1996b; Goodman & Smith, 1992; Green et al., 1975; Kallman & Kallman, 1989; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995). Either location for the controls, the front of the appliance, or the side, will be awarded three points on the *SKFC* because this feature is so important for ease of use, as well as safety for the cook.

Burners on the cooktop should be staggered to make reaching the back burners safer for the cook (Cheever, 1996a). The smaller cook, or the cook who prefers to sit while working at the stove, might prefer using two-burner units and having the burners line up parallel to the front edge of the counter. This arrangement would allow the cook easier access and make it possible to use all burners without having to reach over a hot heating element (Peterson, 1995). Staggered burners are given two points on the checklist.

Electricity is preferred to gas in the home of senior citizens because older adults have a decreased olfactory sensitivity and may not be able to detect the warning smell of a gas leak (Green et al., 1975; Hazen & McCree, 2001; Kallman & Kallman, 1989; Peterson, 1995). An electric cooktop received one point on the *SKFC.*

Oven

Placing the oven at an appropriate height helps to prevent back strain when lifting things into and out of the oven. Poor grip, limited range of motion, muscle weakness, poor balance, and limited vision may make the older cook more inclined to be hurt while using the oven (Montreal General Hospital Department of Community Health, 1989). When locating the oven in the kitchen, if the oven is not a part of a range, it should be located at eye level for easier access (Green et al., 1975; Pinto et al., 2000). The most used oven rack, or the bottom rack, should be at

counter height (Cheever, 1996b; Peterson, 1995) or the bottom of the oven should be about waist height, or 27” AFF (Green et al., 1975). The height of the bottom of the oven was recorded and not scored. If the height of the bottom of the oven was 26” – 28” AFF or one of the oven racks approximates the height of the adjacent transfer surface, the oven received one point.

It is important to provide a convenient, heat resistant surface to place hot dishes on when they are removed from the oven. Researchers have advocated movable carts (Montreal General Hospital Department of Community Health, 1989), pull-out shelves below the built-in oven (Montreal General Hospital Department of Community Health, 1989; Peterson, 1995), or counter space immediately adjacent to the side of the oven (Montreal General Hospital Department of Community Health, 1989; Peterson, 1995). If there was a heat resistant surface next to the oven or a pull-out shelf below it, the oven received two points.

The oven door should be hinged on the side in order to swing to the side (Green et al., 1975; Leibrock & Terry, 1999; Montreal General Hospital Department of Community Health, 1989; Peterson, 1995). This arrangement allows the cook to approach the oven, and remove hot contents without having to lean over a door that could be at a temperature of 350° or hotter. Ovens that were hinged on the side were given two points on the *SKFC.*

Refrigerator

A refrigerator is an essential element in kitchens. Automatic ice-makers are desirable features because they eliminate the difficult task of carrying water filled trays from the sink to the freezer (Cheever, 1996a), a task made more difficult by increasing age. The risk of spilling the water from hand carried ice trays and causing a fall are significant. Ice and water dispensers in the door are also desirable since they require less hand strength and coordination (Leibrock & Terry, 1999; Peterson, 1995) in order to use. If the homeowner had access to ice from an automatic ice maker, one point was awarded.

It is important for the door of the refrigerator to swing at least 180° for easier access (Peterson, 1995). Kitchen designer Peterson (1995) and others (Montreal General Hospital Department of Community Health, 1989) prefer side-by-side

refrigerators because both refrigerator and freezer sections are at an easily accessible height. Refrigerators with a freezer compartment on the bottom are also acceptable (Cheever, 1996a). A refrigerator with a door swing of 180° was awarded two points. If that appliance also has side-by-side or bottom access to the freezer, it received an additional two points.

Optional Appliances

Microwave ovens and dishwashers are often considered optional appliances but their inclusion in the kitchens of senior citizens is encouraged because of the convenience they offer. If either of these appliances were present, the kitchen was assigned two points.

Microwave oven. A study conducted at Virginia Tech's Center for Real Life Kitchen Design determined that 59% of the participants used the microwave oven as often, or more often, than they used the range and cooktop in their kitchen (Emmel, Beamish, & Parrott, 2001). If they are included, microwaves should be mounted at a height of between 24" – 48" AFF (Cheever, 1996b; Hazen & McCree, 2001). If the bottom of the microwave oven was less than 48" AFF, two points were allocated to that kitchen for improved access.

Dishwasher. Dishwashers should be elevated for easier access. The American Society of Interior Designers (ASID, 2001) prefers a height of 12" AFF and kitchen designer Peterson (1995) specifies a range of 6" – 16" AFF. If the dishwasher was simply elevated above the standard height, it was awarded two additional points in return for superior access for senior homeowners.

Recommendations for the Senior's Bathroom

The bathroom is one of the most dangerous places in the home (Mullick, 2000; Regnier, 2002). The bathroom is particularly dangerous for older adults because they may be experiencing decreased levels of physical capability and because the bathroom and bathing equipment is poorly designed (Mullick, 2000).

Mullick (2000) believes that safety was never a major issue in the design of bathrooms in the residential environment. This is particularly true in meeting the needs of older users. Mullick also writes that adaptive features seen in many bathrooms today are only "Band-aid" solutions to more complex design issues.

The first item on *The Supportive Bathroom Features Checklist* recorded the type of bathroom being studied (full bath or half bath) and the location of the bathroom. No value is placed on this item.

Medicine Cabinet and Mirror

A large mirror in the bathroom is important to provide the user with a view of themselves and to assist in grooming (Green et al., 1975). The bathroom mirror is often attached to the wall and frequently the wall chosen is the wall behind the lavatory. This is unfortunate because it usually requires reaching and leaning across lavatory countertops. This is a particularly regrettable location for those with poor vision (Green et al., 1975). Ideally the bathroom mirror should be adjustable and magnifying so that the viewer can tilt the mirror and adjust the height of the mirror, as well as the distance of the mirror from the viewer. This supportive feature allows the user to remain in a stable, comfortable position while using the mirror (Montreal General Hospital Department of Community Health, 1989; Regnier, 2002). An adjustable mirror was included on the checklist and assigned a value of two.

Since the bathroom mirror is usually fixed to the wall, the ideal height of the bathroom mirror is important so that seated and shorter users have a view of themselves. In 1970, ergonomists Huser, Grandjean, and Suchantke proposed minimum size and location of bathroom mirror. They determined that the lower edge of the mirror should be 51.2” AFF and the upper edge of mirror should be about 74.8” AFF (Grandjean, 1973). Other recommendations are for a lower installation with the lower edge at maximum 42” and the upper edge at minimum of 64” (British Standards Institution, 1969). More recent recommendations have lowered the bottom of the mirror, probably to accommodate a child, seated user, or short person, and allow them to see themselves in it. In the *Bathroom Industry Technical Manuals: Bathroom Planning Standards and Safety Criteria*, Cheever (1997), determined that, in order to have a full view of head and shoulders, fixed wall mirrors should have the lower edge at maximum 42”, or 48” AFF if the mirror is tilted. Leibrock and Terry (1999) have a slightly lower recommendation for the height for the bottom of the mirror and suggest it should extend to the top of the back splash on the vanity top.

The *SBFC* contains an item for scoring the bathroom mirrors. If there is a mirror behind the sink and if the height of that mirror is at approximately the height of the backsplash on the vanity, the bathroom received one point for each feature. If there was an adjustable mirror the bathroom received an additional point.

Medications have traditionally been kept in the bathroom, even though the taking of medicines is one of the activities frequently carried out in the family kitchen (Emmel et al., 2001). There should be a medicine cabinet so that medications can be stored in a convenient location, within easy reach, and out of sight. The ideal location for a medicine cabinet is next to the sink so that reaching and leaning is not required in order to access the contents of the cabinet (Green et al., 1975; Leibrock & Terry, 1999). The *SBFC* contained an item awarding one point for bathrooms with medicine cabinets located adjacent to, but not on the wall behind, the sink.

Lavatory and Vanity

There should be a seating area in the bathroom so that a person can sit at least part of the time while grooming or dressing (ASID, 2001). Also, a space for sitting at the vanity will allow an individual to sit while shaving or applying make up (Cheever, 1997). The *SBFC* awards one point for a seating area at or near the vanity and one point for a seating area near the lavatory, or any other location.

In order to allow the user full use of the lavatory without bumping adjacent walls, the centerline of a single lavatory should be at least 15” from any side wall. The centerlines of two adjacent bowls in a lavatory should be at least 30” apart (Cheever, 1997). If the location of the bowl in the lavatory was planned to allow the required 15” from a side wall, the bathroom was awarded one point.

Toilet

It is not unusual to see the toilet seats in the bathrooms of older persons featuring various types of added-on products that serve the purpose of elevating the height of the seat. The original toilet seat was replaced with a higher one to make it easier for the older person to sit upon and rise from the seat. As one ages one loses strength in the large muscles of the legs that are needed for raising and lowering the body weight to and from a seated position. A taller toilet is easier to sit upon and rise from (Grandjean, 1973; Green et al., 1975; Hazen & McCree, 2001; Oberland,

1976; Peterson, 1996; Regnier, 2002). Additionally, the strain of bending to a lower seat is dangerous for older persons since it causes spinal flexion and could lead to vertebral fractures (Aloia, 1989).

There is some controversy about the height of toilet seats, however, since some authors report that the most anatomically advantageous position for defecation is squatting, which requires a lower seat (Grandjean, 1973; Kira, 1977). Grandjean (1973) recommends a toilet seat height of 15.7" for this reason. Most toilets sold at this time have a seat height of 15 ½" (Kitchens and Baths, 2003).

The more frequent recommendation is for a higher toilet seat (ASID, 2001). Some writers recommend seats 17" high (Green et al., 1975); some specify a range of 17" -18" (Regnier, 2002); others recommend 18" high seats (Hazen & McCree, 2001; Peterson, 1996; Valins, 1988); and some authors recommend seats as high as 19" (Goodman & Smith, 1992). If the user is in a wheelchair, the recommended seat height is as high as 20" (Green et al., 1975).

Unfortunately, there is no ideal toilet seat height for all people and a seat that is too high can be problematic for persons of smaller stature. A seat that is too high could compromise the circulation of people with shorter legs (Peterson, 1996) and possibly add to their risk of slipping and falling when rising (Regnier, 2002). Another recommendation for the toilet seat is that it be the long oval shape since this larger size and shape provides more support to the seated user (Hazen & McCree, 2001).

Since the majority of recommendations regarding toilet seat height fall within the range of 17" – 19", this is the range that was considered a supportive feature for this study. If the height of the toilet seat fell within this range, the bathroom was awarded two points on the *SBFC.* If the shape of the toilet seat was long and oval, an additional two points were granted.

The toilet should be located in an area that is large enough to allow the user to move freely without striking adjacent walls or other objects and to facilitate the installation of grab bars. Suggestions are for the toilet to be in the center of a space 30" wide (Green et al., 1975); 32" wide (Cheever, 1997); 36" wide (Davies & Beasley, 1992); and 48" wide (Regnier, 2002). Toilet spaces that are at least 32" wide received two points on the checklist.

The toilet space should also include a side wall to facilitate the installation of grab bars (Peterson, 1996; Regnier, 2002). The side wall should be between 52" long (Green et al., 1975), 54" long (Peterson, 1996) and 66" long (Regnier, 2002). All bathroom walls adjacent to the toilet should be backed with ¾" plywood so that grab bars can be installed at any time without damaging the wall in an attempt to find framing members (Regnier, 2002). If the toilet space included a side wall, it received three points.

The ideal position for the toilet tissue holder is 8" in front of the seat and 26" AFF (Cheever, 1997; Peterson, 1996). If this position is not available for some reason, the tissue holder should be installed in the front of and beside the toilet in a location where the user is not required to lean or twist to reach it (Cheever, 1997; Green et al., 1975; Regnier, 2002). A recessed tissue holder is acceptable (Peterson, 1996). If the toilet tissue in any bathroom surveyed was located on a side wall and in front of the edge of the toilet seat, it received one point for each feature.

Grab Bars

Grab bars are helpful to individuals of all ages and may be particularly useful to older persons. A grab bar can be used to assist a person in changing positions, in rising from a seated position, in providing steadiness while lowering the body to a seated position, or to help stabilize a person with unsure footing and prevent a fall. For these reasons grab bars are recommended in bathtubs, showers, and at toilets in the bathroom (ASID, 2001). Because some people associate conventional stainless steel grab bars with institutions, some authors prefer brass, wooden, or nylon bars (Goodman & Smith, 1992; Regnier, 2002) or bars that coordinate with other fixtures in the bathroom (Hazen & McCree, 2001). Floor mounted grab bars are not recommended since they project into the room and could present a tripping hazard (Green et al., 1975). Fold down bars are particularly useful if the toilet and bidet are adjacent to each other (Peterson, 1996). Towel bars may not be substituted for grab bars (Cheever, 1997) and Hazen and McCree (2001) suggest replacing towel bars with grab bars to eliminate confusion about support capabilities.

Some researchers suggest vertical bars (Green et al., 1975; Hazen & McCree, 2001) and some prefer angled bars (Green et al., 1975). Other experts

prohibit the use of vertical bars because of the danger of the hand slipping along the length of the bar (Peterson, 1996). However, the bars installed horizontally are usually the most basic, useful, and preferred choice (Cheever, 1997; Goodman & Smith, 1992; Peterson, 1996).

When selecting a grab bar, one should choose a bar with a non-slip, or flat finish to prevent reflected glare off the surface and to provide a more secure grip (Peterson, 1996; Valins, 1988). The diameter of the bar should be between 1¼" and 1½" and it should be installed 1½" from the wall (Cheever, 1997; Peterson, 1996). Grab bars should be installed between 32" and 36" AFF (Cheever, 1997; Goodman & Smith, 1992; Peterson, 1996).

Since grab bars are so essential for safety and ease of use, particularly among older homeowners who would like to age in place, they are included in *The Supportive Bathroom Features Checklist* in several locations. If there was a grab bar in the toilet area, the shower, or the bathtub, the grab bars were awarded two points in each location. Additionally, if the grab bar had a non-stigmatizing, residential appearance, it was awarded an additional two points.

Bathing

Modern bathtubs and showers are not designed to meet the physical needs of persons other than the young and physically fit. Grab bars and bath mats serve to highlight the failures of design and failure to resolve design problems with these fixtures. Design shortcomings of bathing fixtures place considerable demands on children, older adults, and persons with disabilities (Mullick, 2000). A discussion of studies done by Budnick and Ross in 1985 revealed that populations with the least amount of control over their environments, the very young and the very old, are at the greatest risk of drowning in their bathtubs (Mullick, 2000).

Abir Mullick (2000) of the Center for Inclusive Design and Environmental Access at the State University of New York at Buffalo reports surprising rates of accident and injury that result when older persons are bathing. He reports findings from the National Safety Council and Consumer Product Safety Commission that as many as 70 individuals over age 65 die each year as a result of using their bathtub or shower. Also, during the years 1987-1989, more people of all ages died in

bathtub related deaths than died in handgun accidents, ladder and scaffolding falls, and deaths resulting from the ignition of individual's clothing (Mullick, 2000).

Bathtub. Inclusion of bathtubs in housing for seniors is a divisive issue. Some authors view the bathtub as difficult to get into and out of (ASID, 2001), in addition to being unsafe and rarely used by older adults (Regnier, 2002). Others feel it should be included because of the pleasure provided by a tub bath and the therapeutic benefits of a sitz bath (Green et al., 1975).

Since tubs are notoriously slippery every effort should be made to reduce the chance of slips and falls in the tub by making sure the bottom of the tub is flat (Green et al., 1975; Leibrock & Terry, 1999; Peterson, 1996; Valins, 1988). Additionally the bottom of the tub should have a non-slip surface, or have non-skid mats or safety treads applied to the bottom (Aloia, 1989; Fielo & Warren, 2001; Green et al., 1975; Hazen & McCree, 2001; Leibrock & Terry, 1999; Valins, 1988). One point each will be awarded for tub bottoms that are flat, have some type of texture to reduce the likelihood of slipping, or have safety strips.

Getting into and out of the bathtub can be a dangerous occasion because the body is in motion, surfaces and the body are often wet and slippery, and at times in positions when it is not balanced (Lawton, 1975; Mullick, 2000). For safety reasons, steps should never be included at the bathtub (Cheever, 1997). Also, the inclusion of glass shower doors limits access to the bathtub and for this reason they are not recommended (Green et al., 1975; Peterson, 1996). If there are no steps at the bathtub, it received three points. If there is no glass shower enclosure as part of the bathtub, it got two points.

The location of faucets in the bathtub is an important consideration. Green (1975), Peterson (1996), and Cheever (1997) advocate for placing the faucets in a location that is easily accessible from outside the tub without the bather having to reach or stretch. Application of the faucets on the end wall nearest the drain side of the tub would appear to be preferable, since this is usually the flattest side of the tub and the bather can approach with less risk of slipping. An asymmetrical application with the faucet controls nearer the exterior of the tub or shower would allow the bather to adjust water temperature and velocity before entering the tub or shower

(Cheever, 1997; Peterson, 1996). If water temperature and velocity controls were off-set to allow adjustment before entering the tub, one point was awarded.

To increase the ease of use of the shower or bathtub by all persons and in order to provide the bather with as many options as possible, all bathtubs and showers should have a showerhead which is adjustable in height and has a detachable head (Green et al., 1975) or a handheld shower (Cheever, 1997; Goodman & Smith, 1992; Hazen & McCree, 2001; Lawton, 1975; Montreal General Hospital Department of Community Health, 1989; Peterson, 1996; Regnier, 2002). One point was assigned to bathtubs with shower heads and one point for handheld showers.

Inadequate storage in the bathing area causes people to leave articles in inopportune places, creating hazardous situations, and organization of bathing space difficult. However, the use of shelves and soap dishes that project into the bathing space is ill advised since it may become a place where the bather can strike his head while falling (Green et al., 1975). Sharp, protruding fixtures are the most common agent of injury in slips and falls in the bathtub (Mullick, 2000). If the soap dish in the bathtub was recessed, the bathtub got an additional two points.

Shower. Showers are preferred over bathtubs because they use less water, do not have high sides to lift the legs over, present no danger of dozing off and drowning, and can be more easily fitted with a seat (Cranz, 1987). Additionally, showers are safer to use than are bathtubs (Green et al., 1975; Regnier, 2002). Finally, showers seem to be more effective in extending the span of independent living for older adults (Green et al., 1975). The presence or absence of a separate shower in the bathroom was noted, but given no value.

The floor of a shower can be continuous with the bathroom floor and gently sloped towards the shower drain in order to avoid having a curb on the shower. This design feature eliminates a tripping hazard and facilitates the use of mobility aids in the shower, should that need ever arise (Cheever, 1997; Goodman & Smith, 1992; Regnier, 2002). Regardless of the configuration, an entry curb should be avoided (ASID, 2001; Green et al., 1975). Regardless of the presence or absence of a curb, the floor of a shower should always be slip resistant (Montreal General Hospital

Department of Community Health, 1989). If a shower did not have a curb, it was awarded two points. If the floor of the shower was made of non-slip materials it received three points.

The dimensions of the shower should be such that the bather can sit or stand outside of the area of the water spray to soap his or her body (Green et al., 1975). Cheever (1997) believes that a minimum sized shower is 34" x 34", while Regnier (2002) believes that a shower should be no smaller than 36" x 36". If a shower was at least 34" x 34", in size it was awarded two points.

As in the case of bathtubs, glass shower doors are not advisable in showers because they limit access into and out of the shower (Green et al., 1975; Mullick, 2000; Peterson, 1996). However, if the shower does have a door, as in the case of bathroom doors in general, it is imperative that the door swing out of the shower and into the room (Christenson, 1990a; Goodman & Smith, 1992; Grandjean, 1973; Green et al., 1975; Valins, 1988). In the event that the bather falls, it will be much more difficult to reach them without destroying or removing the shower door Showers without doors were given two points. If a shower had a door that swung into the room, it got two points.

As limited range of motion, muscle weakness, poor balance, and decreased stamina take their toll on some elderly persons, their independence can be prolonged if they are able to bathe without assistance (Green et al., 1975; Hazen & McCree, 2001; Montreal General Hospital Department of Community Health, 1989). The provision of a place to sit inside either a tub or shower provides this asset to bathers (Aloia, 1989; ASID, 2001; Christenson, 1990b; Goodman & Smith, 1992; Grandjean, 1973; Green et al., 1975; Hazen & McCree, 2001; Regnier, 2002). The seat should be 17" – 19" high and at least 15" deep and it should not reduce the amount of clear space on the interior of the shower (Cheever, 1997). If the shower simply had a seat or bench it received two points. The bench or seat received additional points if it was 17" – 19" high, if it was at least 15" deep, and if it did not reduce the amount of clear space on the interior of the shower below 34" x 34". One point was awarded for each additional supportive feature.

The shower received the same number of points as the bathtub for supportive features that they should both have. Those features are accessible faucets, grab bars, recessed soap dish, and handheld showerhead.

Summary of the Data Collection Tools

Data collection tools were created for the collection of information in both kitchens and bathrooms. The determination for inclusion of individual items was based on existing research and design recommendations for home environments for older persons. Individual items were grouped in more general categories.

The Supportive Kitchen Features Checklist

The *SKFC* contained 15 categories of individual supportive features considered important for seniors to be able to live independently and use their kitchen safely and fully. Based on their perceived importance individual items were assigned a point value, the sum of which was 99 possible points.

The Supportive Bathroom Features Checklist

The *SBFC* contained ten categories of individual items considered essential supportive features for seniors' bathrooms in research and design literature. Individual items were assigned value on a point system and the points total 93 for full bathrooms and 81 for half baths.

Since it is possible for bathrooms to have a varied combination of bathing fixtures, separate checklists were created for showers and bathtubs. Separate categories were not created within these checklists. The checklist for showers contained 14 individual supportive features and a total of 29 possible points. The checklist for bathtubs contained 12 individual supportive features and a total of 23 possible points.

At the time a bathroom was surveyed, scores for individual bathrooms were recorded and the type of bathroom was recorded. Additionally, the scores for each bathing fixture within each bathroom were recorded separately and the type of bathroom in which the fixture was located was recorded. The basic score for each bathroom was compiled and the separate scores for bathing fixtures were added to the basic bathroom score.

CHAPTER 5 : RESULTS

Results of the Study

The purpose of this study was to determine what supportive features are being included in the kitchens and bathrooms of homes being built for independent living retired persons. The study also examined the relationship between the number of supportive features included in seniors' houses and characteristics of the location, the community and the home.

Sixty-one homes were found that met the criteria for the study. One dwelling, which was under construction at the time of the visit, was later eliminated from the study because of the large amount of data that could not be collected. Elimination of this one dwelling resulted in a total of 60 of homes included in the study. Table 1 describes the distribution of homes and communities within the four states.

Table 1: ***Distribution of Homes and Communities by State***

Distribution of Homes and Communities Included in the Study by State

State	Number of Communities	Percent	Number of Homes	Percent
Florida	8	35	18	30.0
North Carolina	4	17	4	6.7
Texas	5	22	23	38.3
Virginia	6	26	15	25.0
Total	23	100	60	100

Nearest Municipality

Within the four states, the retirement communities studied were located in municipalities that varied in size from 2,644 to 88,769 in population (*M*=26,590, *SD*=26,623). The mean distance between the retirement community and the town center was 1.92 miles. A distinction was made between local municipality and Large Urban Area, with the latter having a population of greater than 90,000. The population of the nearest Large Urban Area ranged from 94,911 to 3,047,460 and

the retirement communities were located between 11 and 106 miles from the Large Urban Area center (*M*=38.37, *SD*=22.123). Appendix D-1contains more information about the size and distance of the retirement communities from local and nearest large municipalities. .

Facility Information

The retirement communities studied were between one and 43 years old and had between 8 and 20,000 homes in the facility. The distribution for Age of the Community was positively skewed (1.871); the mean age of the communities was 9.57 (*SD*=12.550); there were more homes that were newer than the mean. Homes within the facilities were priced between $32,000 and $700,000 (*M*=$219,000.67, *SD*=$58,503.61, skew statistic=.361) and were between 486 sq. ft. and 5000 sq. ft. (*M*=2074.60 sq. ft., *SD*=398.05 sq. ft., skew statistic =.071) in size. Because both of these skew statistics fall within the -1.0 - +1.0 range they are not considered to be fundamentally skewed (Huck, 2000; SPSS, 2001) Details about the facilities studied are in Appendix D–2.

Most of the homes included in the study were in active adult retirement communities (93%), operated on a for-profit basis (95%), and offering homes for sale on a fee-simple basis (95%). Table 2 shows the associations between the Community Ownership types and the Development Types. Table 3 shows the associations between Development Types and Home Ownership categories.

Table 2: *Association Between Types of Development and Ownership*

Association Between Types of Community Developments and Types of Community Ownership

Development Type	**Community Ownership**	
	For-profit	Not-for-profit
CCRC	1	3
Active Adult	56	0
Total	57	3

Table 3: *Association Between Types of Home Ownership and Development*

Association Between Types of Home Ownership and Types of Community Development

Development Type	Home Ownership Types	
	Life-time leasehold	Fee simple
CCRC	3	1
Active Adult	0	56
Total	3	57

With one exception, the CCRCs in this study were operated on a not-for-profit basis and provided their residents with a life-time leasehold. Additional information about the types of developments are in Appendix D–3.

A wide range of amenities were offered to residents of the retirement communities studied. The majority of communities offered a gym, a swimming pool, golf, a community or recreation center, walking trails, and activities and programs. A complete description of amenities is included in Appendix D-4.

Home Information

Individual homes studied varied between new homes and homes that were 10 years old. The mean age of homes studied was .450 (*SD*=1.8633, skew statistic= 4.285) and the skew statistic indicates that there were many more homes newer than the mean. The price range of individual homes included in the study was between $78,000 and $357,900 (*M*=$202,448.2, *SD*=$57,908.76, skew statistic=.262) and the size range was between 1259 square feet and 3177 square feet (*M*=1259 sq. ft., *SD*=475.907 sq. ft., skew statistic=.365). Detailed information about the individual homes is compiled in Appendices D-5 and D-6.

Supportive Kitchen Features

Sixty kitchens were studied. The Total Kitchen Score was calculated by first tabulating the points earned by individual supportive kitchen features using the *SKFC* to survey kitchens in the homes. Descriptive data obtained using the *SKFC* is contained in Appendix E.

Nine kitchens (15%) did not contain refrigerators and received a score of 0 for that category of features. An additional nine (15%) kitchens did not contain

microwave ovens and also received a score of 0 for that category of features. Some kitchens had open doorways with no door casing and no door. Since these 19 kitchens had greater accessibility than they would have with a with a lever door handle, these kitchens were given the same three points as kitchen doors with lever handles were given.

Supportive Kitchen Feature Categories

After compensating for the missing refrigerators and microwave ovens, individual items were summed and the totals were cited in the same categories that appear in the *SKFC*. In order to determine what percent of possible features were present in each category of supportive features, the sum of features was divided by the number of possible features to obtain the category percentage score. The category percentage scores appear in Table 4. The means of the total scores for each category also appear in Table 4 where they are ranked from the largest percentage of possible points earned to smallest percentage of possible points scored.

The totals for each category of supportive kitchen features were summed again to obtain the Total Kitchen Score for each of the 60 houses. Details of the Total Kitchen Scores appear in Table 7.

Description of Kitchen Scores

The following is a description of the kitchen scores. Categories of features are discussed in the order in which they are ranked and appear in Table 4.

Faucets

Kitchen Faucets earned the largest percentage of possible points (*M*=1.97, *SD*=.181, 98%). The skew statistic for this category of features was -5.334; there were many more high scores than there would be in a normal distribution. Faucet controls that were large, easily manipulated, and operable with one hand received both possible points for this category. Single-lever faucets with integral temperature and volume regulators were very popular and earned two points. Results for this item are included in Appendix E-1.

Table 4: *Kitchen Design Feature Categories*

Supportive Kitchen Design Feature Categories – Descriptive Statistics

Feature	Max. Poss.	N	Mean	Category Percentage Score
Faucet	2	60	1.97	98%
Electrical controls	6	60	5.75	96%
Clear space	10	60	9.03	90%
Doors and doorways	6	60	5.00	83%
Floors and flooring	9	60	7.17	80%
Thresholds	3	60	2.20	73%
Work triangle	8	60	5.72	71%
Dishwasher	6	60	4.20	70%
Refrigerator	6	51	4.06	68%
Microwave	6	51	4.04	67%
Cabinetry	7	60	5.27	66%
Lighting	6	60	5.02	63%
Cooktop	6	60	2.62	44%
Counters	6	60	2.45	31%
Oven	4	60	2.10	26%

Electrical Controls

Electrical Controls also received a high percentage of possible points (96%). This category of features was very skewed (-3.093) due to a large number of high scores for this feature. All electric receptacles were within the universal reach range (15” – 48” AFF). Most outlets were either on the wall slightly above the level of the standard height kitchen counter or installed in some part of a backsplash placing them well within this range, though some required lateral reaching.

Five light switches were out of the universal reach range and received a score of 0. All noncompliant switches were on the wall and were placed too high to be within the universal reach range. The non-compliant banks of switches were also usually installed above another, compliant, bank of switches.

Compliance with various state building codes regulating switches and outlets probably also contributed to high scores in this category. Descriptive information for this category of features is included in Appendix E-2.

Clear Space

Clear Space points were earned by providing 30" x 48" areas in front of the sink, cooktop, refrigerator, and oven and a 60", or 5', turning radius within the kitchen. Most kitchens surveyed in this study were very spacious, a condition contributing to the fact that only two kitchens did not have clear space in front of the sink; one kitchen did not have clear space in front of the cooktop; two kitchens did not have clear space in front of the refrigerator; and one kitchen did not have clear space in front of the oven.

Twenty-three kitchens (38%) did not provide a 60" turning radius, usually the result of including a center island in the kitchen, as exemplified by Figure 4. The mean score for this category of supportive features was 9.0333 and this category was very skewed (-3.190) due to the high number of high scores for these supportive features. Details of the findings are in Appendix E-3.

Doors

If a kitchen had doors that were at least 32" wide and had lever handles, all six points for this category of supportive kitchen features were awarded. Originally, if no door was present in the kitchen, the item received 0 points. Nineteen kitchens had no doors in the kitchens and these kitchens received three additional points. While many kitchens had an open plan and no doors, 13 kitchens (22%) had doors that were not wide enough to qualify. These doors were usually between the kitchen and either the dining room or the garage.

Seven doors did not have lever handles and had knobs. While not an item on the *SKFC*, knobs were also used on cabinetry and bi-fold doors. The Doors category was negatively skewed (-1.370) due to the larger number of higher scoring kitchens in this category. The results of the survey for the individual items in this category are in Appendix E-4.

Figure 4: *Limited Clear Space*

The addition of a center kitchen island restricts access to some parts of this kitchen and reduces clear space in front of appliances.

Floors

Floors and Flooring points were earned if floors were resilient, fairly smooth and regular, had a matte finish, and contrasted with the walls in color. Only 10 (17%) kitchens had resilient, sheet vinyl, floors. The remaining floors were ceramic tile (34 floors, 57%) with some wood floors (16 floors, 27%).

Only one tile floor had texture sufficient to be considered not smooth or regular. One floor did not have a matte finish. Four kitchens had monochromatic color schemes that did not provide enough contrast to qualify for that additional point. The mean score for this category was 7.1667 (*SD*=.97714) and the distribution of scores was fairly normal (skew statistic=-.234). Appendix E-5 contains results for individual items in this category of supportive features.

Thresholds

Thresholds were considered to be either smooth or accessible. If there was no threshold, or if transitions between flooring materials could not be detected by a shoed foot or presented only a slight bump and no tripping hazard, kitchens were given three points. If, however, there was a raised threshold it could be no higher than ½" and needed to be made accessible by the addition of beveled transition strips on both sides to earn the alternative of one point. The survey results for this category of items are contained in Appendix E-6. This category contained only two items and they were an "either / or" score. Because many thresholds (73%) received the maximum number of points, the mean was high (*M*=2.2000, *SD*=1.03825, skew statistic=-.605).

Thirty-seven kitchens (62%) had either no threshold or smooth thresholds. Twenty-one of the remaining 23 thresholds were considered to be accessible and two were neither smooth nor accessible. These thresholds were simply rectangular pieces of building material that may not have been designed to be used as a threshold, placed across the threshold with no beveling on either side. An example of these thresholds is shown in Figure 5.

Work Triangle

It was possible to earn two points for each of the three segments of the Work Triangle; one for having a continuous countertop between the triangle points and one for being more than 4' and less than 9' in length. An additional two points were awarded if the sum of the three segments of the work triangle was less than 26'. Seven (12%) kitchens had a work triangle greater than 26'.

Thirteen kitchens received no points for the sector between the refrigerator and sink, usually because the distance was greater than 9' in length. This distance was often too great because of the placement of a kitchen island. For the segment between the sink and stove, six received no points and 33 received both points; for the segment between the refrigerator and stove, five received no points and 29 received both points. Fifty-three (88%) of the 60 kitchens had work triangles smaller than 26'. This category of features was only slightly skewed (-1.098) and had a mean score of 5.7167 (SD=1.71821). The results are included in Appendix E-7.

Figure 5: *Threshold*

This threshold is too high and failure to provide a beveled edge presents a difficult transition for those using mobility aids, and a tripping hazard for those who are not.

Dishwasher

It was possible to earn six points for providing a dishwasher, elevating the dishwasher, and providing a clear space in front of this appliance. The mean number of points earned was 4.05 (*SD*=.798) or 70% of the possible points for this supportive element and the distribution was not appreciably skewed (.860). All homes surveyed had a dishwasher, 97% (N=58) of homes provided a clear space in front of this appliance, but only eight (13%) had elevated the appliance. Appendix E-8 compiles the results of surveying Dishwashers in the study homes.

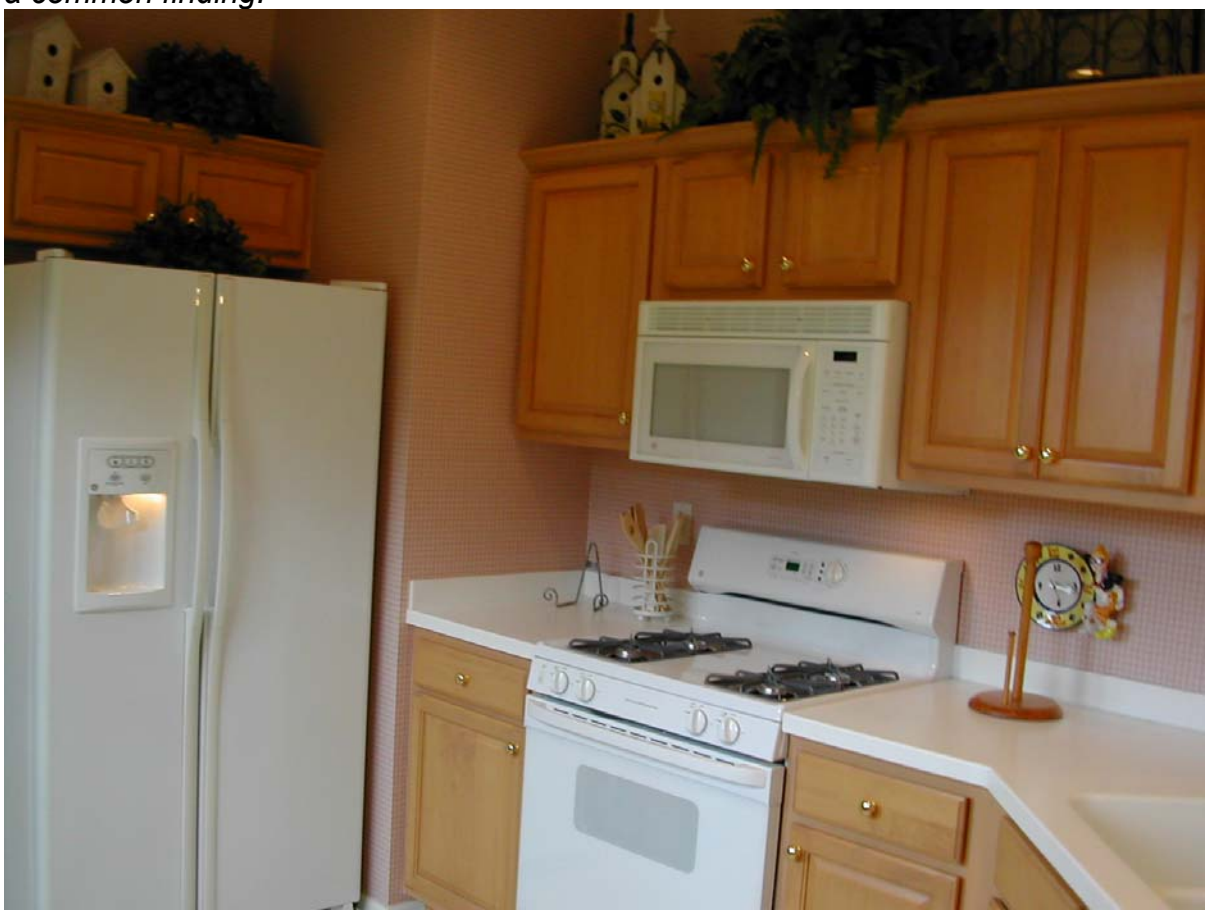
Refrigerator

Fifty-one homes (85%) provided a refrigerator. In order to allow compilation of scores for the Total Kitchen, the nine homes that did not provide this essential appliance received a final score of 0. Freezers were located on the side or the bottom of 39 refrigerators. Forty-nine refrigerators included an ice maker and 40 of those ice makers were within the universal reach range. Refrigerators that had side

or bottom freezer compartments also had ice makers within the universal reach range. The distribution of scores for this feature was not notably skewed (-.466).

Refrigerator door swings were limited by the design of the appliance as well as by the location of it's installation, with the result that 31 (52%) refrigerator doors could not swing 180°, thereby reducing access to the interior of the appliance. Examples of limited doors swings are included in Figure 6. The findings for the category of Refrigerators is included in Appendix E-9.

Figure 6: *Limited Door Swing*
It is not possible to open this refrigerator door beyond 90°, limiting access to the interior. The installation of a microwave oven above the range, as shown here, was a common finding.



Microwave oven

Fifty-one kitchens provided a microwave oven. As in computing the scores for the Refrigerator category of supportive features, kitchens that did not provide a microwave oven received a 0 for use in computing Total Kitchen Scores. Positive

supportive features were locating the bottom of the microwave oven at a height less than 48” AFF and providing a clear space in front of the appliance. Many microwave ovens were part of a single appliance that also provided ventilation for the cooktop and most (N=47, 78%) microwave ovens were installed above the cooktop. Microwave ovens installed above the cooktop were not located low enough to qualify for the two points. An example of this type of installation is shown in Figure 6. Fifty microwave ovens had a clear space in front of their location. This distribution of scores was slightly negatively skewed (-1.294). Findings for the Microwaves category is included in Appendix E-10.

Cabinetry

The recommended height of the bottom shelf in base cabinets ranges from 12” – 15” AFF (British Standards Institution, 1969; Grandjean, 1973; Green et al., 1975; Kirvesoja et al., 2000; Pinto et al., 2000). Kitchens in this study had bottom shelves in base cabinets that ranged from 3” to 6.75” (*M*=5.58, *SD*=.83). While 5” AFF is lower than the recommended heights, it is higher than the usual height of a toe-kick and was selected as the limit for this study. The presumption was that this increase, while inadequate to meet research recommendations, was made to increase accessibility for the homeowner. Forty-seven (78%) of the bottom shelves in base cabinets were higher than 5” AFF and received two points.

Research recommendations for height of top shelf in wall cabinets in homes for seniors are usually for shelves to be less than 70” AFF (ASID, 2001; British Standards Institution, 1969; Grandjean, 1973; Green et al., 1975; Kallman & Kallman, 1989; Kirvesoja et al., 2000; Montreal General Hospital Department of Community Health, 1989; Oberland, 1976; Pinto et al., 2000). The maximum height considered in the kitchen of a tall woman is 81” AFF (Grandjean, 1973). Top shelves in cabinetry in the homes studied ranged in height from 56” to 87” AFF (*M*=80.23, *SD*=6.26). The more opulent kitchens seemed to have taller wall cabinets.

The usual distance between kitchen counters and the bottom of wall cabinets is 18” and 54 of the kitchens had cabinets installed at this height or lower. Cabinetry storage was defined as drawers, roll-outs, adjustable shelves, and corner carousels.

The mean number of supportive cabinetry storage features was 1.9 (*SD*=1.09) in a distribution of scores that was slightly negatively skewed (-1.182). Findings for individual Cabinetry items are detailed in Appendix E-11.

Lighting

The purpose of the Lighting category was to collect information used to determine if the lighting in kitchens was adequate to meet the increased need for illumination experienced by older persons and to determine if their increased sensitivity to glare was being addressed. Ambient light was measured and light sources were evaluated. Overall scores for the supportive feature Lighting were low (*M*=5.0167, *SD*=1.53481, skew statistic=-.233) because only 63% of possible points were scored in a relatively normal distribution of Lighting scores. The results for individual Lighting items are in Appendix E-12.

One major problem encountered was the actual measurement of light levels. All kitchens had windows and on most days it was very sunny and bright outside and this brightness had an effect on the light levels measured inside. There was no way to determine how much light was from natural daylighting and how much was generated from interior light sources. Recorded light levels ranged from 20 – 125 footcandles (*M*=58.38, *SD*=19.76) and 58% of the kitchens studied did not have the minimum recommended 60 footcandles of ambient light during the daytime. Dark cabinetry and countertops contributed to insufficient lighting in many kitchens by reducing the amount of light reflected back into the rooms, as seen in Figures 7 and 8.

Most kitchens had incandescent lighting (N=57, 95%). Twenty kitchens (33%) had fluorescent lighting and it was used most often for accent lighting, such as up-lighting above cabinetry and under-cabinet lighting. Halogen lights were less common (N=5, 8.3%) and were most commonly found in the task lights seen in ventilation hoods.

Figure 7: *Dark Kitchen Materials*
Dark appliances and cabinetry reduce the amount of light being reflected back into this kitchen and make it difficult to distinguish individual kitchen features.

Cooktop

The mean score for supportive Cooktop features was 2.62 (44%) of six possible points and the distribution of scores was relatively normal (-.127). The most common type of cooking appliance in kitchens studied was the range (N=45, 75%). Scores were low because 22 (37%) kitchens had cooktops with controls that were not on either the front or side of the unit, 58 (97%) did not have staggered burners. Thirty-nine (65%) provided electric cooktops and the non-electric cooktops were all gas. Results for this supportive feature category are contained in Appendix E-13. This category had a small number of items and low variability.

Figure 8: *Dark Kitchen Materials*
Even though this kitchen has dark cabinetry, dark counters and dark backsplashes, the glossy finishes on cabinetry and appliances present glare problems.

Counters

Kitchen counters were not highly ranked because they scored a mean of only 2.45 of six possible points, or 31% in a relatively normal distribution of scores (.155) for this feature. The houses did not provide seating areas within most (N=52, 87%) kitchens. Often seating areas within kitchens seemed to be intended to be used as a desk, rather than as an area for food preparation. Slightly more than half (N=34, 57%) of the kitchens provided heat resistant surfaces on both sides of the cooktop. Details of the Countertop surveys are in Appendix E-14.

Oven

The category with the lowest percentage of possible points (26%) was Ovens. The scores were fairly normally distributed (.311). Supportive oven features were low because most ovens were part of a kitchen range, placing the bottom of the oven below the recommended height. The mean height for the bottom of the oven was 12.68" AFF, and the bottom of at least one oven was only 4.5" AFF. As a result of this location, the bottom of the oven was too low, few oven racks were adjacent to a transfer surface and only 10 (17%) ovens met the criteria to be awarded points for location. No ovens had side swing doors. Results for these items are in Appendix E-15.

The Total Kitchen Score and Kitchen Percentage Score

It was possible for a kitchen to score 99 total points if all supportive features in the *SKFC* were present. To facilitate comparisons, to give an estimate of the degree of supportiveness for each kitchen, and to provide a ranking of kitchen scores, the total score was divided by the total possible points to derive a Kitchen Percentage Score. The lowest score earned by a kitchen was 46 of 99 possible points, or 46%, and the highest score was 76 (77%). The mean Total Kitchen Score was 65 (66%, *SD*=6.322) within a relatively normal distribution of scores (-.576).

Summary of Findings in the Kitchens

The following section describes environmental challenges common to many older persons that have not been adequately addressed by many of the kitchens in homes included in this study.

Ambient Lighting

All of the kitchens studied had windows in the kitchens and all light measurements were taken in the day time with the light meter facing the window in order to maximize the readings. Even with the introduction of daylighting, most of the kitchens included in this study did not have sufficient light during the day to meet the needs of older persons as expressed in the literature.

A large majority of kitchens had incandescent lighting as the primary source of ambient light. While one-third of kitchens had fluorescent lighting, it was used mainly for accent light and under-cabinet lighting. There were few locations for task

lighting other than over the sink and over the cooktop. The problem of insufficient ambient light was at times compounded by the use of dark cabinetry and countertops which failed to reflect light back into the room. Given that more than half of the kitchens were not adequately illuminated during the day, the ambient light in the kitchens is probably much lower at night. Figure 9 is an example of the results of using more light fixtures, lighter materials and finishes, and light colored appliances can make in the appearance of a kitchen.

Figure 9: *Kitchen Comparison*

It is much easier to see the details of this kitchen using lighter colored finishes, materials and appliances. This kitchen also has more light fixtures than the kitchen shown below.

The kitchen shown below is more difficult to visualize because the finishes, materials, and appliances are all darker in value.

Designs that Require Excessive Reaching

With increasing age individuals may experience a limited ability to reach objects in high or low locations. Few adjustments in design to accommodate the challenge of limited reach were observed in the kitchens under study. For example, most kitchens had a range for cooking. While economical to purchase, the use of this appliance requires the cook to reach down to place food in the oven or remove hot items from the oven. Additionally, since all the ranges in this study had doors that opened down, in addition to bending down, the cook must twist and reach over the hot oven door in order to remove hot items from the oven cavity. The location of the oven in a range also eliminates the possibility of having an adjacent surface to place hot items on when removing them from the hot oven – the cook must raise the

hot item to the level of the countertop before being able to put it down. While the oven in a range presents problems for the cook in terms of reaching, no advantages in the design of the cooktop were observed. Figure 10 shows a typical kitchen range installation.

Figure 10: *Typical Range Installation*

A common finding was a range installation such as this one, with the microwave installed above the cooktop. This configuration of appliances forces the cook to reach down to use the oven and reach across the hot cooking surface to reach oven and cooktop controls. Additionally, the microwave oven's location requires the cook to reach up to access the interior of that appliance.

The opposite problem, reaching high, was encountered in the location of the majority of microwave ovens because they were one component of a ventilation system installed above the cooktop. This location caused the bottom of the microwave oven to be outside the universal reach range. Additionally, the location over the cooktop is hazardous since, in addition to a high horizontal reach, it requires a vertical reach over a hot surface if the cooktop is in use. In addition to

Figure 10, Figure 6 shows the usual configuration of range with the microwave oven located above the cooktop.

Separating the cooking appliances makes it possible to place appliances at more appropriate heights. By raising the height of the oven and lowering the height of the microwave oven, as shown in Figure 11, it is possible to place both appliances within the universal reach range and make them more accessible. Additionally, selecting a cooktop with controls on the side, as in Figure 11, make the cooktop more accessible and safer to use.

Figure 11: *Wall Oven and Microwave Oven*

The location of both the oven and the microwave oven in kitchen cabinetry places both appliances within the universal reach range.

Kitchen cabinetry also represented reaching problems in many kitchens. The mean height for the bottom shelf in base cabinets (*M*=5.58”) was less than half the height recommended by researchers and designers. The mean number of supportive features in base cabinets was less than two (*M*=1.90), one of which was the standard drawers present in most kitchen base cabinetry. The height of the

bottom shelf in base cabinets made accessibility a problem for many older persons, a situation which was not made easier by the addition of supportive features that would increase accessibility since they were still below the universal reach range.

Reaching into wall cabinets was also a problem in many of the kitchens in the study. The design recommendation is for the top shelf in wall cabinets to not be higher than 70" AFF. The mean height of top shelves in the kitchens in this study was 80.23".

An impression that the researcher had while surveying the kitchens was that the kitchens were spacious. A finding that would support this impression is that kitchens had 90% of the total clear space suggested in research. The individual clear space item with the lowest percentage score was the 60" radius in the center of the kitchen, usually the result of the introduction of a kitchen island.

Supportive Bathroom Features

For this study, 124 full bathrooms and 9 half baths were studied. All 60 homes studied had at least two full bathrooms. A full bath is one with a toilet, a lavatory, and a shower or bathtub, or both. In 59 cases, Bathroom 1 was a full bathroom immediately adjoining the master bedroom; in one case Bathroom 1 was near but not open to the largest bedroom in the dwelling. In all cases, Bathroom 1 was located on the first floor.

Bathroom 2 was most often located off a hallway in the home and in four homes the second bathroom also opened to a bedroom. The majority (*N*=56, 93%) of the 60 second bathrooms were on the main floor and did not require going up or down stairs.

Bathroom 3 was described as a half bath (a bathroom without a shower or bathtub) and nine half baths were found in the homes studied. All half baths were located on the main floor.

Three homes had a third full bathroom. In two cases, Bathroom 4 was located off a hallway and in one case located off a bedroom. One home had four full baths and in this home Bathroom 5 was located off a hallway. All fourth and fifth bathrooms were located on the second floor or in the basement of the home. All

homes had at least one full bathroom on each floor, if the home had more than one level.

Only the findings in Bathroom 1, Bathroom 2, and Bathroom 3 were analyzed. Bathroom 1 was included because it was most often a master bathroom, the bathroom most frequently used by the homeowner, at night and for bathing. Bathroom 2 was included in this study because it was very different from Bathroom 1 in appearance: the room was always smaller, contained less luxurious features, and often fewer fixtures. In homes where residents are sleeping in separate bedrooms, are not a "couple", are living together for convenience, or simply prefer to not share a bathroom, Bathroom 2 would be used by homeowners in much the same way as Bathroom 1. Bathroom 3 was included because it was a third type of bathroom and was usually located closer to the living areas of the home and more convenient for the homeowners to use when not in the master bedroom. As a result, this study includes the results from 120 full bathrooms and nine half baths.

A Total Bathroom Score was calculated for each bathroom by first tabulating the points earned by individual supportive bathroom features using the *SBFC*. Results for individual items are included in individual tables, identified by category of features, in Appendix F.

When calculating scores for individual supportive features, some substitutions were made. For the variable considering whether the bathroom door swung into the bathroom or not, if the room had a folding door it was given the same score as a door that swung into the bathroom. Folding doors within the bathroom could possibly present the same hazard to the homeowner as a door that swings into the bathroom; in the event of an emergency that caused an individual to fall against the door, the position of the person against the door could prevent the door from being opened from the outside. Since a pocket door and an entrance without a door had the same advantages as a door that swung out of the bathroom, they were given the same two points.

There was no reason to think that a builder would not use the same door and door hardware throughout an entire home. For that reason, if a door had been removed in a model home to improve traffic flow in one room, but a door in another

room was still on its hinges, instead of recording the missing door as missing data, it was given the same score as doors in other parts of the home. While pocket doors allow greater accessibility, they also have hardware that is difficult to manipulate and were given the same score as a difficult to manipulate or non-lever door was given.

Supportive Bathroom Feature Categories

Results of studying the 129 bathrooms are compiled in Table 5. This table includes the number of points it was possible to earn in each supportive feature category, the mean number of points scored in each category for each of the types of bathrooms, and the mean percentage of possible points earned. The total of all possible points in all of the categories is included, as well as the mean number of total points scored, and the percentage of total points earned. Table 5 also includes the number of possible points, mean number of points scored, and the percentage of points scored to possible points for supportive features in bathtubs and separate showers in bathrooms. Scores in Table 5 are ranked from largest to smallest percentages of possible points earned, using the master bathroom as the determining ranking for each of the supportive features.

Description of the Bathroom Scores

The following is a description of findings about individual items in the categories of supportive features studied using the *SBFC*. The categories of bathroom features are discussed in descending order by their rank in the master bathroom and as they appear in Table 5.

Flooring

The supportive category receiving the largest percentage of possible points was Flooring. Seventy-nine percent of possible points were scored in both master bathrooms and second bathrooms. Half baths received 80% of all possible points in the Flooring category. The distribution of scores in master bathrooms (-.291) and in second bathrooms (-.492) was fairly normal but could not be computed for half baths since all bathroom scored the same number of points. Findings for the individual items in the three types of bathrooms are included in Appendix F-1.

Table 5: *Bathroom Design Feature Categories*

Supportive Bathroom Design Features – Categorical Summary Means
(Ranked by percentage of possible points scored in Master Bathrooms)

Feature	Max. Poss.	Master Bath			Second Bath			Half Bath		
		N	Mean	%	N	Mean	%	N	Mean	%
Flooring	10	60	7.85	79%	60	7.93	79%	9	8.00	80%
Clear Space	6	60	4.33	72%	60	2.50	42%	9	0.44	7%
Electrical Controls	11✶	60	7.67	70%	60	7.58	69%	9	6.22	69%
Medicine Cabinet and Mirrors	4	60	2.48	62%	60	2.55	64%	8	1.00	25%
Toilets	15	59	8.31	55%	57	5.35	36%	8	8.5	57%
Lighting	14	60	7.50	54%	60	7.5	54%	9	4.22	30%
Cabinetry and Storage	13✶	59	6.08	47%	59	4.93	38%	8	1.00	11%
Doors and Doorways	11	60	4.80	44%	47	4.74	43%	8	5.75	52%
Sinks and Lavatories	6	60	2.52	42%	60	2.37	39%	9	1.78	30%
Thresholds	3	60	1.67	39%	60	1.57	52%	9	2.56	85%
Bathtubs and Separate Showers										
Bathtubs	23	43	13.42	58%	50	13.24	58%		NA	
Separate Showers	29	53	13.92	48%	10	15.0	52%		NA	

✶ The Total Maximum Possible Points in this category is less for Half Baths

Descriptive information about the results of individual flooring items is included in Appendix B-3. Three percent (N=2) of floors in master bathrooms did not score points for having a matte finish. The majority of floor tiles in these rooms had a matte finish, but highly polished tiles had been added to the floor as decorative borders and accent features making portions of otherwise compliant flooring highly reflective and slippery. Figure 12 is an example of the addition of shiny and slippery floor tiles as a decorative border in a bathroom floor.

Clear Space

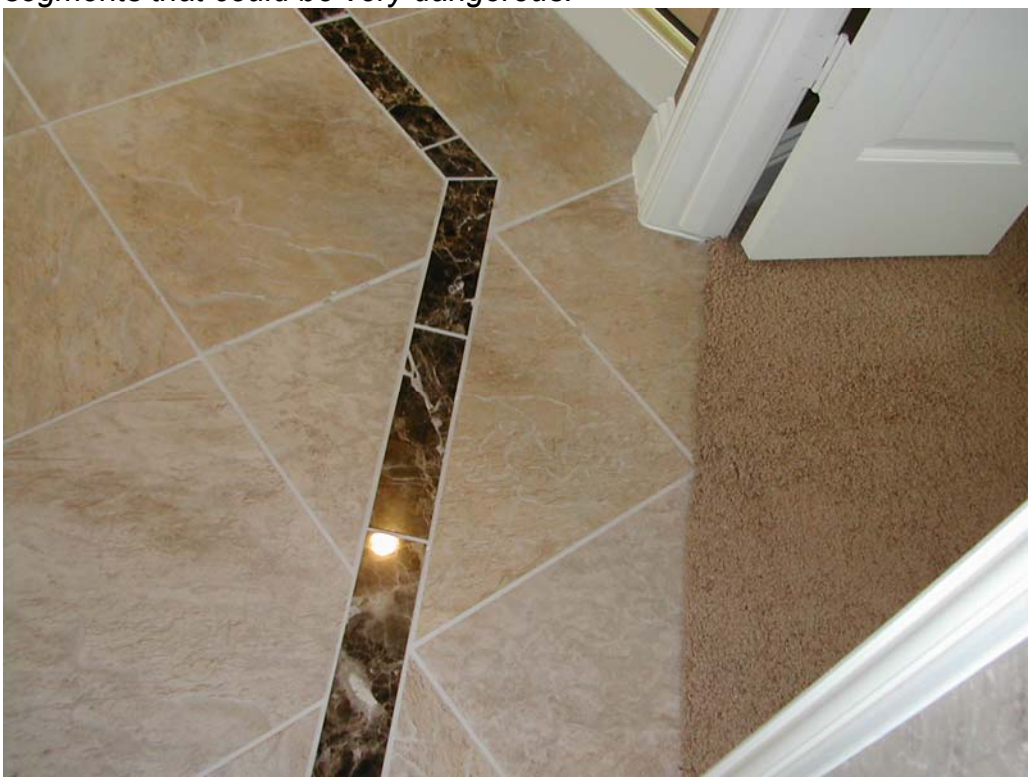
In this study, master bathrooms were often large rooms designed so that the central part of the room was open and unencumbered by fixtures or furnishings. This characteristic greatly increased accessibility in the master bathrooms. Master bathrooms scored 72% of the possible points for Clear Space in the bathroom.

In contrast, second bathrooms were commonly a 5'x 7' room with all the plumbing fixtures on a common plumbing wall, a bathtub at one end of the room, a vanity at the other end of the room ,and a toilet occupying the area between the tub and vanity. Forty-two percent of possible points for Clear Space were awarded to second bathrooms. Half baths were much smaller than the other two types of bathrooms and earned 7% of the possible points. Appendix F-2 includes descriptive data for all three types of bathrooms.

In master bathrooms, there was clear space in front of the toilet in 55% of cases and in second bathrooms, there was clear space in front of the toilet in slightly lower percentages (50%). While the master bathrooms were much larger than the second bathrooms, the toilets were frequently placed in separate toilet rooms which often presented accessibility problems and reduced the amount of clear space. The differences in room size were also exemplified by the presence of a 60" turning radius in each of the rooms. In 67% of master bathrooms, there was sufficient room for a 60" turning radius in the center of the room. In 7% of cases in second bathrooms, there was sufficient room for a 60" turning radius in the center of the room. No half baths were large enough for a 60" turning radius.

Figure 12: *Shiny Bathroom Tile*

The introduction of highly reflective tiles into a bathroom floor creates slippery segments that could be very dangerous.



The distribution of scores for Clear Space in master bathrooms (-.919) and in second bathrooms (-.161) was not appreciably different from a normal distribution. The distribution was positively skewed in half baths (3.000).

Electrical Controls

Eleven points were the maximum number possible for Electrical Controls. Master bathrooms scored 70% of the possible points for Electrical Controls. Second bathrooms and half baths each scored 69% of the possible points. The distribution of points for Electrical Controls was not normal for any type of bathroom and ranged from -1.031 in second bathrooms to -1.730 in half baths. Appendix F-3 contains frequencies for the individual *SBFC* items in this category.

Compliance with national and local building codes was probably one reason for the high scores for this category of supportive features. A large majority of homes (92%, 92%, 78%) earned the three possible points for having light switches

at the appropriate height and 100% of all bathrooms had electrical controls at the appropriate height.

Medicine Cabinet and Mirrors

Sixty-two percent of possible points for supportive Medicine Cabinet and Mirror features were scored in master bathrooms. In second bathrooms, 64% of possible points were awarded. Half baths had 25% of the supportive features. Five (8%) master bathrooms and five second bathrooms did not have a medicine cabinet and no half bath had a medicine cabinet. In master bathrooms, the distribution of scores was negatively skewed (-1.783) and in second bathrooms the distribution was considered normal (-.950). The scores in half bathrooms were all the same. Findings from the *SBFC* are described in Appendix F-4.

Points were awarded for having a mirror behind the sink and having it located at the approximate level of the vanity back splash. Ninety percent of master bathrooms and 92% of second bathrooms received the maximum number of points for this feature, while 89% of half baths did not earn any points in this area. Failure to have satisfactory mirrors in half baths was usually related to having decorative mirrors framed and installed as a picture on the wall behind the sink.

Toilets

Master bathrooms had 55% of the supportive Toilet features and the distribution of scores was positively skewed (1.262). Second bathrooms had 36% of the supportive toilet features and half baths had 57% of the features. The Individual data on the toilets studied are contained in Appendix F-5.

Five (8%) toilet seats in master bathrooms, four (7%) toilet seats in second bathrooms, and one (11%) toilet seat in a half bath were within the recommended 17” – 19” height. While few toilets were high enough, most were the preferred shape. Long oval toilet seats are the most supportive shape and only four (7%) toilets in master bathrooms and five (8%) in second bathrooms did not have seats of this shape.

Lighting

It was possible to earn 14 points in the category Lighting in bathrooms. In master bathrooms and in second bathrooms, the mean total number of points scored

was 7.5 or 54% of the possible points. In half baths, the mean total number of points scored was 4.22, or 30% of the total number of possible points. The distribution of scores in all three types of bathrooms ranged from .375 in master bathrooms to .568 in second bathrooms and were within limits considered normal. Appendix F-6 details information from the Lighting section of the *SBFC*.

A large majority of bathrooms had light fixtures above the bathroom mirror (97%, 100%, 100%), but some times this was the only lighting fixture in the bathrooms. The result is that even though all master bathrooms had windows, only 24 (40%) had light levels greater than the recommended 60 footcandles. Some second bathrooms had windows, but only 17 (28%) had light levels greater than 60 footcandles. Few half baths had windows and none (100%) of these bathrooms had light levels greater than 60 footcandles.

The majority of bathrooms had light fixtures that included diffusers (65%, 52%, 78%), but the majority of exposed light bulbs did not emit diffused light (58%, 65%, 78%). This is probably a reflection of the current popularity of the clear glass globes used in light bars across the top of bathroom mirrors. This location above the mirror provides reflection of light back into the room but casts unflattering shadows and light on the face seen in the mirror. The bare light bulbs with no frosting on the bulb also present a glare problem in both dimly lit rooms, as in Figure 13, and in more well lit rooms, Figure 14.

Cabinetry and Storage

In the area of Cabinetry and Storage, master bathrooms scored 47% of the possible points and had a relatively normal distribution (-.334). Second bathrooms were awarded 38% of the 13 possible points and had a normal distribution (.140). Half baths received 11% of their nine possible points and had a normal distribution (.000). Appendix B-6 is an account of information collected about the Cabinetry and Storage found in the bathrooms studied.

Figure 13: *Glare*

Bright points of light in an otherwise dark room may present problems with accommodation and / or glare

While bathroom vanities were found frequently in this study, the majority of master bathrooms (55%), second bathrooms (75%), and half baths (22%) had no supportive under-cabinet storage features, such as drawers, roll-outs, or adjustable shelves. Seven of the half baths had pedestal sink and therefore, had no under-cabinet storage at all.

The number of locations for bathroom storage, such as linen closets, wall cabinets, base cabinets, medicine cabinets, and open shelving, were counted for the study. The majority (78%) of half baths had no storage locations. The most frequently occurring number of storage locations was two, with 55% of master bathrooms and 53% of second baths having this number of storage locations. The two storage locations most frequently found were vanity cabinets and medicine cabinets. Only two (3%) master bathrooms had four storage locations. Most of

bathroom storage takes place in vanity cabinets and medicine cabinets and vanity cabinets have few supportive features to increase the accessibility of this sole storage area.

Figure 14: *Glare*

Bright points of light may present problems with glare in a room with daylighting

Sixty-seven percent (N=40) of master bathrooms had at least two towel bars and 62% of second baths did not. One of these towel bars was located near the tub or shower in 67% of master bathrooms and in 73% of second bathrooms. These items were not considered essential for half baths and not recorded. A towel bar

was located near the lavatory in 67% of master bathrooms, 48% of second bathrooms, and 67% of half baths. Towel bars installed in locations that greatly restricted accessibility, such as the wall behind a bathtub, requiring the user to step into the bathtub to access, were not counted. Figure 15 and Figure 16 are examples of inappropriate locations for towel bars.

Figure 15: *Towel Bar*

It is impossible to access the towels on this towel bar without stepping into the bathtub or reaching across the entire width of the garden tub, placing the home owner in a dangerous position.

Figure 16: *Towel Bar*

This towel bar is in a location making the towels difficult to access without an awkward reach or stepping into the garden tub. The addition of a towel bar on the wall to the right side of the sink would have appreciably increased ease of access to the hand towels.

Doors and Doorways

Master bathrooms received 44% of possible points for the supportive features in the category of Doors and Doorways. Second bathrooms received 43% of the possible points. Half baths scored slightly higher with 52% of possible points. All Doors and Doorways were considered normal and ranged from .615 to -.088. Frequency information about this category of supportive features is in Appendix B-5.

The recommended clear width for doorways is a minimum of 32". Some master bathrooms had more than one door, as in the case of a private toilet room with it's own door. If all the doors in a bathroom did not have a 32" clear doorway, that room did not receive the points. Forty-five (75%) doors in master bathrooms, 54 (90%) doors in second bathrooms, and all doors in half baths were not wide enough to be compliant with this recommendation.

Many bathrooms (37% in master bathrooms, 78% in second bathrooms, 67% in half baths) had doors that did not swing out of the room. This is a possible hazard if, in an emergency, a person falls against the door and it cannot be opened to render assistance.

Sinks and Lavatories

It was possible to earn six Sinks and Lavatories points for such things as providing a seating place in the bathroom, providing adequate clearance at the sink, and providing a large and easily manipulated faucet. Master bathrooms earned 42% of the six points. Second bathrooms earned 39% and half baths earned 30% of the possible points. Distribution of scores in master bathrooms was 1.262, in second bathrooms .556, and in half baths -1.620. Appendix F-9 contains detailed information about this group of supportive features.

Thresholds

Some thresholds were considered to be inaccessible because the threshold was higher than ½“ and the edges were not beveled. The inaccessible thresholds in bathrooms were like those in kitchens shown in Figure 5.

The master bathroom scored 56% of possible points for thresholds. Second bathrooms scored 52% of possible points. Half baths got 85% of possible points awarded for this category. Variability was low in this category since there are only two items and they are “either / or” items. The distribution of scores was skewed in master bathrooms (1.435), normal in second bathrooms (.326), and negatively skewed in half baths (-1.620). Appendix F-10 contains details about Thresholds.

Bathtubs

Master bathrooms had a bathtub in 44 cases (73%). Usually these tubs were large “garden tubs” and they often had whirlpool jets. The distribution of scores in this category was skewed (1.343). Second bathrooms had a bathtub in 50 cases (83%) and the distribution for those 50 cases was fairly normal (.443). In second bathrooms, bathtubs were smaller, 60” traditional tubs. All bathtubs in second bathrooms had a shower head included.

Sixty-three percent of bathtubs in both master bathrooms and second bathrooms did not have a grab bar. In master bathrooms, three (5%), and in second

bathrooms four (7%), bathtubs did not have a flat, non-slip tub bottom. If any of these occurrences are in the same bathtub, the combination of no grab bar and a slippery tub bottom could be hazardous to the bather.

There were 23 possible points for supportive Bathtub features. Both master bathrooms and second bathrooms received 58% of the possible bathtub points. Appendix F-11 has the results of studying Bathtubs in master bathrooms and second bathrooms.

Separate Showers

Fifty-three (88%) master bathrooms and 10 (17%) second bathrooms had a separate shower. It was possible to score 29 points in the Separate Showers. Master bathrooms earned 48% and second bathrooms earned 52% of the possible points. The distribution of scores in both master bathrooms (-.777) and in second bathrooms (.480) was fairly normal. An itemized list of supportive features in Separate Showers is included in Appendix F-12.

In 24 master bathrooms and five second bathrooms, the showers were sufficiently large, 34” x 34” or larger, to be awarded the two points. Many showers (34 in master bathrooms and 9 in second baths) also had a bench or seat. Of those showers with benches or seats, some were not the appropriate height or depth and did not reduce the amount of clear space on the floor of the shower and were not awarded additional points. This occurred in 24 master bathroom showers and in two second bathroom showers. Fourteen showers in master bathroom and four in second bathrooms had the maximum number of shower storage features.

Total Bathroom Scores and Bathroom Percentage Scores

Scores for all categories of supportive bathroom features were summed for each type of bathroom and this is considered to be the Total Bathroom Score. In order to have a comparable number to use in comparing the 60 homes, a Bathroom Percentage Score was also calculated. The Bathroom Percentage Score was calculated by dividing the Total Bathroom Score in each room by the number of possible points for each room. It was possible to earn 93 points in full bathrooms and 87 points in half baths.

The 60 individual homes have several combinations of bathrooms, half baths, showers, and bathtubs. Because it is possible to have either a bathtub, a shower, both, or neither in any bathroom, scores for these bathing fixtures were calculated separately. Appropriate percentages for both types of bathing fixtures were also calculated.

The distribution of scores for the total master bathrooms was normal (-.136); the distribution for second bathroom was positively skewed (1.850); the distribution for half baths was normal (.137). Needless to say, the distributions for the percentage scores were the same as for the total scores. Table 6 includes the summaries of the findings in the three types of bathrooms and all possible combinations of bathrooms and bathing fixtures. This table also includes the percentages of possible points for each room and combination of bathroom and fixtures.

The variable used to test the second hypothesis was a compilation of the scores of all bathroom and half bath scores for each house, plus the scores for bathing fixtures (bathtub, separate shower or both) present in each house. The resulting number was the Final Bathrooms Score. The Final Bathrooms Score was divided by the maximum number of possible points for the combination of bathrooms, half baths, and bathing fixtures in each individual home. The resulting number was the Final Bathroom Percentage Score and this number was used for hypotheses testing.

The Final Bathroom Percentage Scores ranged from 43% to 69% of the possible points earned (*M*=.5358, *SD*=.04517). The skew statistic was .618, indicating that there was a greater frequency of higher scores, but it was not significantly different from a normal distribution.

Summary of Findings in the Bathrooms

The 5’ x 7’ Bathroom

The second bathroom should be as accessible as the master bathroom, since it used so frequently. However, a large number of second bathrooms were 5’ x 7’, with a standard 60” bathtub at one end of the room, a vanity at the other end of the

Table 6: *Bathroom Supportive Features Totals*

Supportive Bathroom Design Features – Bathroom Totals

Feature	Max. Poss.	Master Bath			Second Bath			Half Bath		
		N	Mean	%	N	Mean	%	N	Mean	%
Bathroom Totals	93✶	59	52.59	57	48	46.15	50	7	38.86	48
Bathrooms with Separate Shower	122	16	64.13	61	10	66.50	55		NA	
Bathrooms with Bathtub	116	7	72.43	62	36	58.47	50		NA	
Bathrooms with Separate Shower & Bathtub	145	36	80.14	55		NA			NA	

✶ The Total Maximum Possible Points in this category is less for Half Baths

room, a toilet sandwiched in between the tub and vanity, and all the plumbing fixtures on a common plumbing wall. Even though a bathtub may be riskier for the older bather to use, showers were rarely substituted for a bathtub in the second bathroom (N=10, 17%). While very economical in its use of space in the home, this type of bathroom greatly decreases accessibility within the space. There is simply little room to spare or to accommodate necessary clearances. .

Critical dimensions include those between the bathtub and the toilet. Since all plumbing is on one wall, the showerhead and water temperature and velocity controls are on the same wall as the back of the toilet. Unless the bather gets into the tub prior to turning on the water, a bather must access the area between the toilet and the tub to adjust water temperature and velocity. This area is often just a few inches wide. The option of getting into the tub to turn on water for a shower is not satisfactory since, prior to adjusting the water temperature, the bather risks being sprayed with either too hot or too cold water from the showerhead.

Another problem with the usual configuration of the 5' x 7' bathroom is the absence of a wall near the toilet. This situation precludes the homeowner from ever having a wall mounted grab bar next to the toilet. Installing bars on the floor often presents a tripping hazard and reduces the amount of clear space in an already too-small room.

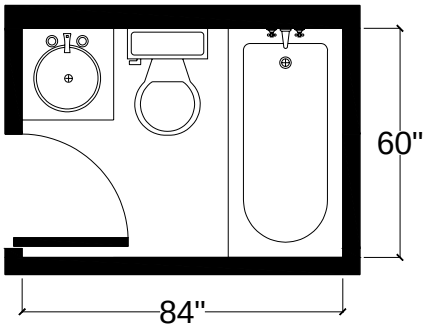
An observation made during this study was that if there was an increase in the size of this type of bathroom, the increase was frequently in the length of the room and was compensated for by a corresponding increase in the length of the vanity. The critical dimensions did not increase and a 5' x 9' bathroom did not seem to afford the homeowner increased accessibility over a 5' x 7' bathroom. Figure 17 includes a photograph of a typical 5' x 7' bathroom, a plan for a 5' x 7' bathroom, and demonstrates the manner in which most 5' x 7' bathrooms are expanded.

Narrow Doorways

Seventy-five percent of master bathrooms, 90% of second bathrooms, and 100% of half baths had at least one door that was less than 32" wide. In second bathrooms and half baths, the problem of narrow doorways was most prominent at

Figure 17: *The 5' x 7' Bathroom*

The 5' x 7' bathroom presents numerous accessibility challenges due to its small size and the configuration of fixtures on one plumbing wall.



This bathroom, while larger, has increased only the length of the room and the vanity. The critical dimensions near the toilet and bathtub remain unchanged.

the doorway that provided entrance to the room. Master bathrooms often featured a separate toilet room in order to provide privacy to the user. Unfortunately, the doors to these toilet rooms were very often too narrow to fall within the design guidelines.

Storage

Storage space was at a premium in many bathrooms studied. Eight percent of master bathrooms and second bathrooms and 100% of half baths did not have a medicine cabinet. Only 32% of master bathrooms, 20% of second bathrooms, and 100% of half baths had storage in any location besides a medicine cabinet and vanity cabinet. The majority of vanity cabinets in all types of bathrooms had no features that would increase accessibility. Thirty-two percent of master bathrooms and 62% of second bathrooms did not have more than one towel bar.

Lighting in the Bathrooms

All master bathrooms had windows but even with the addition of daylighting, ambient light was inadequate in 60% of master bathrooms. Fewer second bathrooms had windows and 72% had inadequate levels of ambient light. No half baths had adequate ambient light levels.

A commonly seen light fixture was the light bar located over the vanity sink in bathrooms. While these fixtures can contain numerous light bulbs, they do not appear to be adequate light for an entire room, as seen in the adequacy of levels of ambient light. Light bars also present a problem if un-frosted bulbs are used in the fixtures since they present a bright source of light and can be a source of glare. Additionally, the location of the light source often presents an unflattering light on the face in the mirror. Figure 18 shows some of these situations.

As was the case in kitchens the use of dark materials aggravated the low levels of ambient light. Several second bathrooms and half baths did not have windows, which created an even darker environment, as seen in Figure 18 .

The Total House Score

Even though it was not a part of the hypothesis for this study, a score for the house was also calculated. Since each house could have a different combination of bathrooms and bathroom fixtures, the total possible score ranged from 161 to 264 points and for that reason the mean score is not considered. The mean home

Figure 18: *Dark Bathrooms*

The use of dark interior materials and the absence of a window in these bathrooms creates a very dark environment. The illumination of the room with a light bar across the vanity was a frequent finding. Bright points of light in a dark environment can create problems with glare.

percentage score is a reflection of the percentage of possible points for each individual home and ranges from 48% to 70% of all possible points with the mean home percentage score being 57% (*SD*=.04087) of the possible points. Table 7 contains detailed information about all the types of rooms studied, and the possible combinations of bathrooms and bathing fixtures. Total scores and percentage scores for all rooms are also included in Table 7.

Table 7: *Rooms, Fixtures, and House Totals and Percentages*

Rooms, Bathroom Fixtures and House - Total and Percentage Scores

			Final Score – Total Points				Percentage of Possible Points			
	N	Max. Poss.	Min.	Max.	Mean	Standard Deviation	Min.	Max.	Mean	Standard Deviation
Kitchen	60	99	46	76	65.367	6.322	.46	.77	.6603	.0639
Master Bathroom	60	93	45	63	54.604	4.344	.48	.68	.5871	.0467
Master Bathroom-Shower only	52	29	7	20	14.192	3.652	.24	.69	.4897	.1259
Master Bathroom-Bathtub only	44	23	10	19	13.419	1.768	.43	.83	.5834	.0769
Second Bathroom	60	93	36	68	45.478	5.387	.39	.73	.4890	.0579
Second Bathroom-Shower only	10	29	12	19	15.000	2.404	.41	.66	.5172	.0829
Second Bathroom-Bathtub only	51	23	0	19	12.980	3.165	.00	.83	.5644	.1376
Half Bath	9	81	34	41	37.172	2.448	.42	.51	.4589	.0302
House	60	varies	161	264	✶	✶	.48	.70	.5694	.0409

Examination of the Hypothesis

The First Hypothesis

The first hypothesis stated that the Kitchen Percentage Score of homes designed for senior citizens will be related to characteristics of the location, characteristics of the community in which the house is built, and characteristics of the home.

The hypothesis to be tested was:

H_1 The percentage score for supportive features included in kitchens of homes built in age-restricted retirement communities will be related to:

A. characteristics of the location of the community:
   i. state in which the community is located
   ii. size of the nearest large urban area
   iii. closeness to the nearest large urban area

B. characteristics of the community in which the house is built including:
   i. the age of the community
   ii. the number of homes in the community
   iii. the mean price of homes in the community
   iv. the mean size of homes in the community
   v. the type of development
   vi. the type of community ownership
   vii. the type of homeownership
   viii. the number of same type communities owned by this community
   ix. developer

C. characteristics of the home, including:
   i. the age of the home
   ii. the size of the home
   iii. the price of the home

Kitchen Percentage Score and Characteristics of Location

The first part of the hypothesis, location of the community, included 1) the State in which the community is located, 2) Size of the Nearest Large Urban Area, and 3) Distance to the Nearest Large Urban Area. A one-way analysis of variance conducted to detect differences in the mean Kitchen Percentage Scores in homes in different states revealed no significant differences, between the four states. Table 8 contains some of the ANOVAs used to examine the first hypothesis.

Table 8: *Kitchen Scores and State*

Kitchen Percentage Scores and Characteristics of the Location

	Homes N	Mean Kitchen % Score	*F*	*p*
Characteristics of the Location				
The States			*F* (3, 56) = .081	.970
Florida	18	.6588		
North Carolina	4	.6591		
Texas	23	.6570		
Virginia	15	.6603		

Pearson product moment correlations were computed to determine if there were significant relationships between the mean Kitchen Percentage Score and the Size of the Nearest Large Urban Area and the Distance to the Nearest Large Urban Area. There were no significant relationships between the Size of the Nearest Large Urban Area (*r*=.089, *p*=.500) and the Distance to the Nearest Large Urban Area (*r*=.136, *p*=.300) and the number of supportive kitchen features.

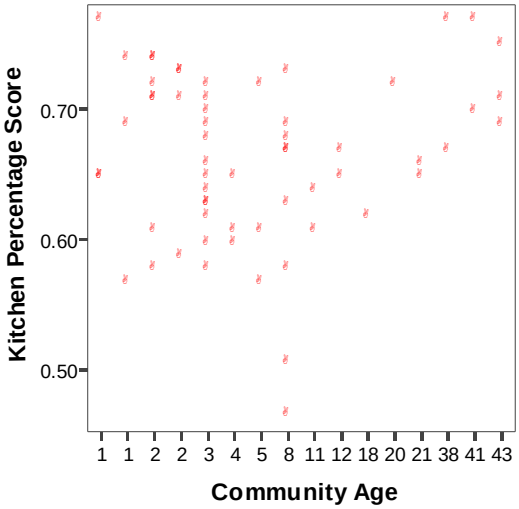
Kitchen Percentage Score and Characteristics of Community

The second portion of the hypothesis included characteristics of the community in which the house is built such as 1) Age of the Community, 2) Number of Homes in the Community, 3) mean Price of Homes in the Community, 4) mean Size of Homes in the Community, 5) Type of Homeownership, 6) Type of Development, 7) Type of Community Ownership, 8) number of Same Type Communities and 9) Developer. Each of the nine individual characteristics were tested to determine if they had any effect on the Kitchen Percentage Score.

Pearson product moment correlations were completed between the Age of the Community, the Number of Homes in the Community, the mean Price of Homes in the Community, the mean Size of Homes in the Community and the Kitchen Percentage Scores at the .05 confidence level. A tentative positive relationship (r=.266, p=.040) exists between the mean Age of the Community and the mean Kitchen Percentage Scores. The linearity of this relationship could have been influenced by the presence of several extreme scores, as indicated in the scatter plot in Figure 19. The three not-for-profit communities were older communities and when they are removed from the scores in the variable, Age of the Community, there is no correlation (r=.212, p=.113).

Figure 19: *Scatterplot: Kitchen and Age of Community*

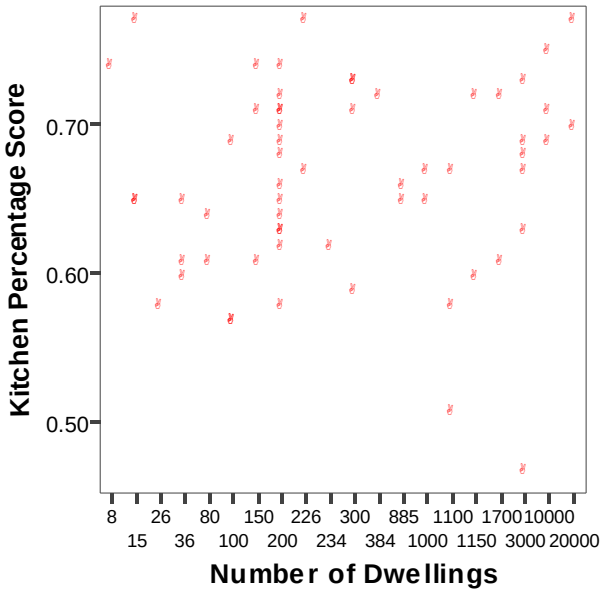
Scatterplot Displaying Relationships Between Kitchen Percentage Scores and Age of the Community



Significant relationships also exist between the Kitchen Percentage Score and the Number of Dwellings in the Community (r=.256, p=.048) – communities with more homes have kitchens with higher Kitchen Percentage Scores. Extreme scores could have influenced the findings of a linear relationship in this case as well, as indicated in the scatterplot in Figure 20. The relationship persists when the not-for-profit communities are removed from the pool of communities (r=.284, p=.032). The Kitchen Percentage Scores are higher in larger communities.

Figure 20: *Scatterplot: Kitchen and Number of Dwellings*

Scatterplot Displaying Relationships Between Kitchen Percentage Scores and Number of Dwellings in the Community



The mean Price of the Home (r=.185, p=.156) and the mean Size of the Home size (r=.211, p=.106) within a community had no relationship with the Kitchen Percentage Scores in the community.

All of the retirement communities studied were either Continuing Care Retirement Communities or Active Adult only communities. The CCRCs had somewhat higher mean Kitchen Percentage Scores than did the Active Adult communities, but testing using a one way analysis of variance indicated the difference was not statistically significant. Table 9 contains the analysis of variance results for Kitchen Percentage Scores and characteristics of the community.

There were two types of community ownership in the retirement communities studied, for-profit and not-for-profit. Faith based communities are not-for-profit communities. Not-for-profit communities had higher mean Kitchen Percentage Scores (M=.7172, SD=.0634) than did for-profit communities (M=.6573, SD=.0505). In order to determine if the differences in the percentage kitchen scores for the

different types of community ownership were significant, one-way ANOVAs were conducted and revealed no significant differences F (1, 58) = 2.574, p=.114. Homeownership in this study consisted of fee simple ownership and life-time leaseholds as well as the situation in manufactured homes studied where the individual owned the home but leased the land. Since the two manufactured homes were purchased outright by the homeowner, they were included in the category of fee simple ownership. Since the life-time leaseholds were the same homes as the homes in the not-for-profit communities tested previously, no further testing was necessary to determine that the mean Kitchen Percentage Scores were higher for this group, but not significantly so.

Table 9: *Kitchen and Community*

Kitchen Percentage Scores and Characteristics of the Community

	Homes N	Mean Kitchen % Score	*F*	*p*
Characteristics of the Community				
Type of Homeownership			*F* (1, 58) = 2.574	.114
Fee simple	57	.6573		
Life-time leasehold	3	.7172		
Type of Development			*F* (1,58) = 1.054	.309
CCRC	4	.6919		
Active Adult	56	.6580		
Type of Community Ownership			*F* (1, 58) = 2.574	.114
For-profit	57	.6573		
Not-for-profit	3	.7172		
Developer			*F* (1, 58) = .199	.657
Nationwide	30	.6566		
Local / regional	30	.6640		

Developers who built homes included in this study had varied amounts of experience building other retirement communities of the same type that was studied. The numbers of other Same Type Communities built by the same developer ranged from zero to 130 other communities. Pearson product moment correlations were computed and revealed that there were no significant correlations between the mean Kitchen Percentage Scores and the number of other communities built by the developer.

In order to preserve the anonymity of the 17 developers that participated in the study and to facilitate comparisons, the developers in this study were placed in categories: nationwide and local / regional Developers. One-way ANOVAs were conducted to determine if differences existed in the mean Kitchen Percentage Scores and the Developer of the home. No significant differences were found.

Kitchen Percentage Score and Characteristics of Home

The third part of the first hypothesis stipulates that the Age of the Home, the Size of the Home, and the Price of the Home will be related to the Kitchen Percentage Scores. Pearson product moment correlations were used to analyze the possible relationships between the four variables and no significant relationship was found between the Age of the Homes and the Kitchen Percentage Score (r=.068, p=.05). A significant relationship does exist between the Size of the Home (expressed in square footage) and the Kitchen Percentage Score (r=.414, p≤.001) (see Figure 21) and the Price of the Home and the Kitchen Percentage Score (r=.329, p=.01) (see Figure 22). The Size of the Home and the Price of the Home are highly correlated (r=.633, p≤.000).

Figure 21: *Scatterplot: Kitchen and Size of Homes*

Scatterplot Displaying Relationships Between Kitchen Percentage Scores and Size of the Individual Homes

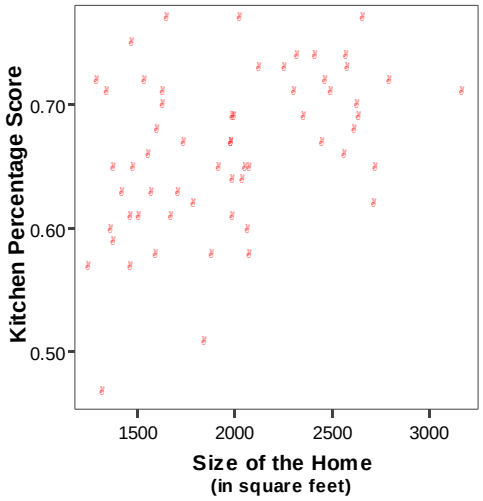
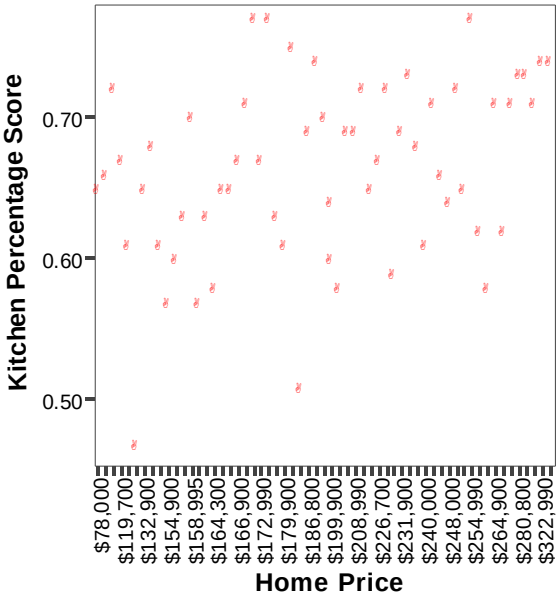


Figure 22: *Scatterplot: Kitchen and Price of Homes*

Scatterplot Displaying Relationships Between Kitchen Percentage Scores and Price of Individual Homes



Summary

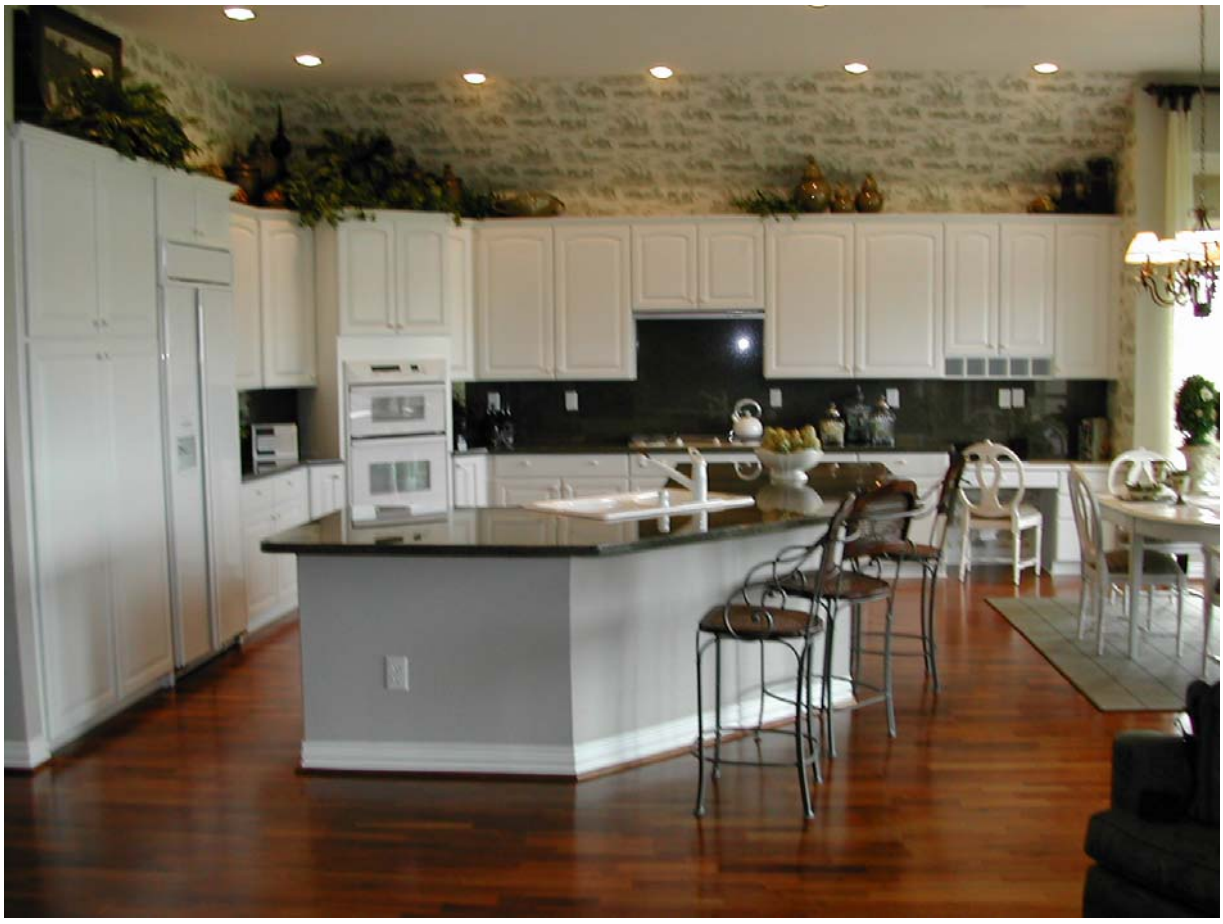
To summarize, statistical comparisons used to examine the first hypothesis revealed that significant relationships exist between the Kitchen Percentage Scores and the Age of the Community, the Number of Dwellings in the community, the Size of the Home, and the Price of the Home. The relationships that exist between the Kitchen Percentage Scores and the Age of the Community and the Number of Dwellings in the community are much weaker than the relationship between Kitchen Percentage Score and the Size and Price of the Home. Consumers should not think that if they purchase a home in an older retirement community or a larger retirement community, they will have a more supportive kitchen.

While most kitchens were large, kitchen size is probably proportional to home size. Large, more expensive homes may be the homes that had built-in ovens and microwave ovens, rather than ranges with a microwave also serving as a ventilation unit installed over the cooktop. These conditions would result in higher Kitchen

Percentage Scores. Larger kitchens may generally be more accessible simply because there is more room to move around in the kitchen and not necessarily designed to be more supportive kitchens. It is not possible to know this since overall kitchen dimensions were not recorded. Figure 23 shows a large kitchen with a configuration of appliances and large floor space that would probably result in a higher kitchen score than many of the other kitchens studied.

Figure 23: ***A Large Kitchen***

The size of the floor space and the placement of appliances in this kitchen make it more accessible than many other kitchens.



The Second Hypothesis

The second hypothesis considers the same characteristics of the location, community, and the individual home that the first considers but relates the relationship to the final percentage score for the bathrooms.

The hypothesis to be tested was:

H_2 The percentage score for supportive features included in bathrooms of homes built in age-restricted retirement communities will be related to:

A. characteristics of the location of the community:
    i. state in which the community is located
    ii. size of the nearest large urban area
    iii. closeness to the nearest large urban area
B. characteristics of the community in which the house is built including:
    i. the age of the community
    ii. the number of homes in the community
    iii. the mean price of homes in the community
    iv. the mean price of homes in the community
    v. the type of development
    vi. the type of community ownership
    vii. the type of homeownership
    viii. the number of same type communities owned by this community
    ix. developer
C. characteristics of the home, including:
    i. the age of the home
    ii. the size of the home
    iii. the price of the home

Bathroom Percentage Score and Characteristics of Location

Retirement communities in the state of North Carolina had the highest mean Bathroom Percentage Scores and Florida had the lowest. To determine if these and other scores were significantly different, an analysis of variance test was conducted. No significant difference between the states was observed. Table 10 compiles all the Bathroom Percentage Scores and the location of the state with the results of ANOVAs used to test the second hypothesis.

Table 10: *Bathroom and State*

Bathroom Percentage Scores and Location of the State

	Homes N	Mean Bathroom % Score	*F*	*p*
Location of the State				
The States			*F* (2, 57) = 2.406	.077
Florida	18	.5240		
North Carolina	4	.5888		
Texas	23	.5362		
Virginia	15	.5358		

Pearson product moment correlations revealed there was no significant relationship between the mean Bathroom Percentage Score, the Size of the Nearest Large Urban Area (*r*=-.010, *p*=.939), or the Distance to the Nearest Large Urban Area (*r*=.132, *p*=.316).

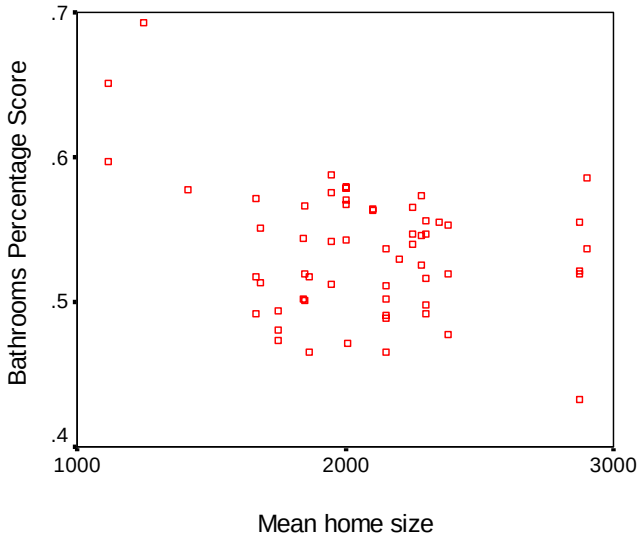
Bathroom Percentage Score and Characteristics of Community

The second portion of the second hypothesis contains the same nine variables to be tested that the first hypothesis contained. In order to determine if correlations between Age of the Community, Number of Homes in the Community, and mean Size and Price of Homes in the communities and Bathroom Percentage Scores exist, Pearson product moment correlations were completed. Differences in the Age of the Communities did not have a significant correlation with the Bathroom Percentage Scores (*r*=.170, *p*=.195). The Number of Homes within the communities also did not have a significant correlation with the bathroom scores (*r*=-.003, *p*=.983). While the mean Size of Homes within the community did have a significant

correlation with the mean Bathroom Percentage Score (*r*=-.310, *p*=.016) (see Figure 24), the mean Price of Homes did not (*r*=-.218, *p*=.094). As seen in previous correlations, extreme scores may influence the overall findings and the correlation between Size of Homes within the community and mean Bathroom Percentage Score disappears when the smaller homes in the not-for-profit communities are removed from the pool of homes (*r*=-.019, *p*=.887).

Figure 24: *Scatterplot: Bathrooms and Size of Homes*

Scatterplot Displaying Relationships Between Bathroom Percentage Scores and Mean Size of Homes in the Community



As in the first hypothesis, there were two different types of homeownership in the communities studied: fee simple and life-time leasehold. To determine if there was a difference in the homeownership types and the Bathroom Percentage Scores, one-way ANOVAs were conducted on the data. Levine's Test for Equality of Variances was not significant and equal variances were assumed. The tests for between groups effects was significant F (1, 58) = 27.892, $p \leq .000$. Post hoc tests were not performed since there were only two groups being tested. The observed power for this test was high (α=.999). The Type of Homeownership had a significant effect on the Bathroom Percentage Scores and homes purchased with a life-time leasehold had significantly higher Bathroom Percentage Scores.

The types of community ownership were divided into two categories, for-profit and not-for-profit, just as was done in the testing the first hypothesis. Homes in not-for-profit communities were the same homes as were purchased with a life-time leasehold and results of statistical testing for Type of Development were the same as for Type of Homeownership. Homes in not-for-profit communities had significantly higher Bathroom Percentage Scores than did homes in for-profit retirement communities.

Active adult retirement communities and CCRCs were compared to determine if there was a difference in Bathroom Percentage Scores in the two types of developments. CCRCs had higher mean Bathroom Percentage Scores and a one-way ANOVA revealed that the differences were statistically significant. Post hoc tests were not performed since there were only two groups to compare. Observed power was high (α=.987). Bathrooms in CCRCs had significantly higher percentage scores than did bathrooms in active adult communities. Table 11 shows the ANOVAs used to demonstrate the relationships between the Bathroom Percentage Scores and characteristics of the community.

Table 11: *Bathroom and Community*

Bathroom Percentage Scores and Characteristics of the Community

	Homes N	Mean Bathroom % Score	*F*	*p*
Characteristics of the Community				
Type of Homeownership			*F* (1, 58) = 27.892	.000
Fee simple	57	.5299		
Life-time leasehold	3	.6471		
Type of Community Ownership			*F* (1, 58) = 27.892	.000
For-profit	57	.5299		
Not-for-profit	3	.6471		
Type of Development			*F* (1, 58) = 18.165	.000
CCRC	4	.6176		
Active Adult	56	.5300		
Developer			*F* (1, 58) = .033	.587
Nationwide	30	.5347		
Local / regional	30	.5369		

Some developers had past experience building other retirement community developments of the same type. Developers in this study had developed between zero and 130 other retirement communities. There was not a significant correlation between builders who had experience building other retirement communities and those who did not and the Bathroom Percentage Scores (r=-.082, p=.531). Developers with more experience did not produce homes with higher Bathroom Percentage Scores than developers with less experience.

The same Developer categories were used to test Bathroom Percentage Scores as were used to test the Kitchen Percentage Scores in the first hypothesis. A one-way ANOVA revealed no significant differences in the local and nationwide Developers.

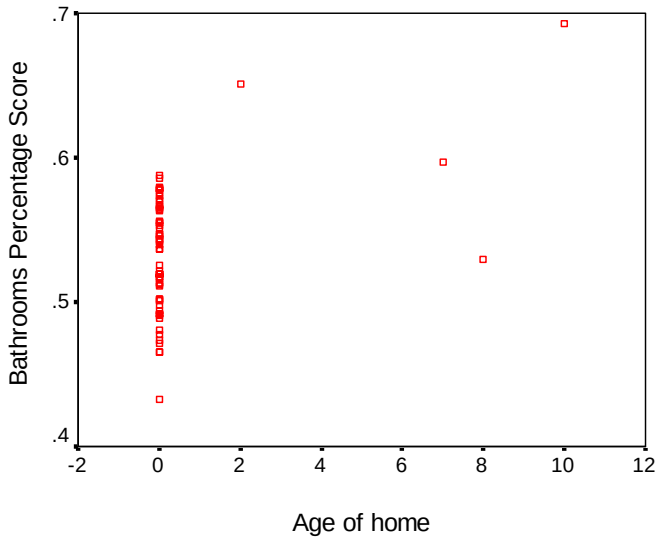
Bathroom Percentage Score and Characteristics of Home

When Pearson product moment correlations were used to compare the mean Bathroom Percentage Scores with the Age of the Home, the Price of the Home and the Size of the Home only one significant characteristic was revealed. There was a significant positive correlation with the Age of the Home and the Bathroom Percentage Scores (r=.439, p≤.000). Once again, when the not-for-profit homes were removed from the pool of homes, the correlation between the mean Bathroom Percentage Score and the Age of the Homes disappears. The scatterplot in Figure 25 demonstrates the large percentage of new homes in the study and the higher Bathroom Percentage Scores in some of the older homes.

To test the relationship between the Bathroom Percentage Scores and the Size of the Homes, Pearson product moment correlations were calculated and no significant relationship was identified (r=.023, p=.863). Correlations were also computed for the Price of the Homes and the Bathroom Percentage Scores and revealed no significant relationship (r=-.193, p=.140). Larger, more expensive homes do not have more supportive features in their bathrooms.

Figure 25: *Scatterplot: Bathrooms and Age of Home*

Scatterplot Displaying Relationship Between Bathroom Percentage Scores and Age of the Home

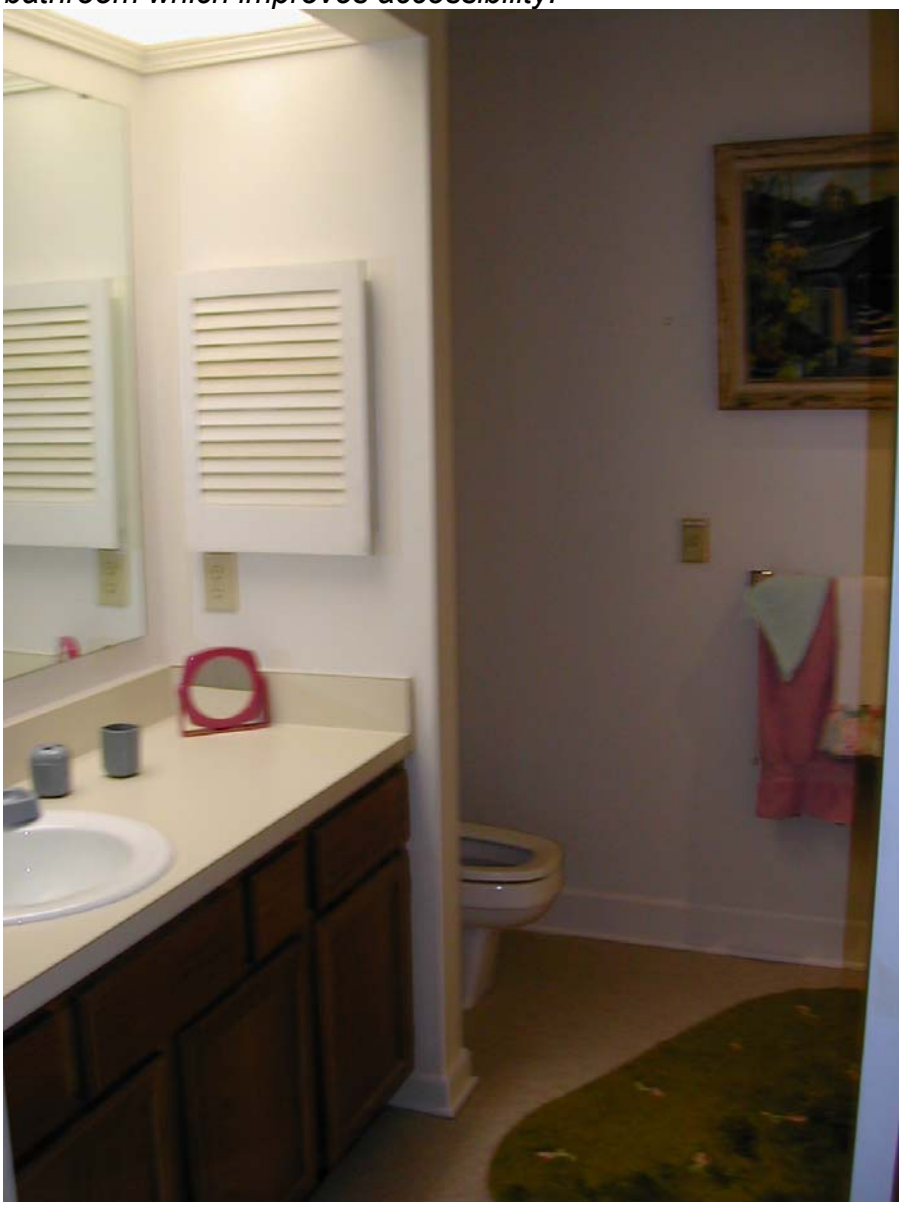


Summary

There are significant relationships between the Type of Homeownership, Type of Development, and Type of Community Ownership and the Bathroom Percentage Scores. While the homes in the not-for-profit communities are older and not professionally decorated they often have more supportive features, as are seen in Figure 26. Homes in not-for-profit communities are the same homes as are in communities where residents have a life-time leasehold. These homes and homes in CCRCs have higher mean Bathroom Percentage Scores than homes in other communities in this study. The types of community and ownership (life-time leasehold, CCRCs, and not-for-profit communities) that are associated with higher percentage scores have features common to each other. Tables 2 and 3 demonstrate the associations between the Type of Homeownership, Type of Development, and Type of Community Ownership; in most cases they are the same communities.

Figure 26: ***Bathroom in Not-For Profit Community Home***

This second bathroom in a not-for-profit community home is more spacious than the 5' x 7' often found in second bathrooms. This bathroom has a wall near the toilet which can hold a grab bar. There is a relatively large area in the center of the bathroom which improves accessibility.



The shower in this second bathroom in a not-for-profit community home has a grab bar, no shower door, recessed storage, a hand-held showerhead, and a light, all of which are supportive features and increase bathroom percentage scores.

CHAPTER 6 : DISCUSSION

This chapter summarizes the problem addressed by the study, a brief summary of the study itself, including the procedures used to conduct the study, as well as the findings of the study. Conclusions and implications of the findings are also discussed, as well as recommendations for additional research.

Statement of the Problem

The number of older persons is increasing, both in actual numbers and in percentage of the population. Older persons experience numerous physical and physiological changes as aging takes place. Many of the changes will eventually place burdens on the individual as they interact with their environment. An environment that is more supportive of the individual as they age will allow the senior to compensate for the changes and remain in their home as long as possible. It is very important for most people to be able to stay in their homes as they get older. Being required to move to a nursing home because they can no longer live independently is dreaded by the majority of older persons.

In anticipation of the large numbers of older persons retiring, builders and developers are building increasing numbers of retirement communities and homes for seniors. There are indications that existing senior housing research and design recommendations are not being applied to the homes being built for seniors (Belser & Weber, 1995). If the existing recommendations were followed in the design and construction of senior housing, the homes would allow the homeowner to live independently in their home for a longer period of time and utilize the space more fully.

If any individual is to be able to live independently in their home, it is essential that they be able to use their kitchens and bathrooms fully. Kitchens and bathrooms often present the greatest challenges to the older person, in addition to being the location of some of the greatest safety hazards. Therefore, the purpose of this study was to determine what supportive features are being included in the kitchens and bathrooms of homes being built for independent living retired persons and to

examine any relationships that exist between the supportive features included in seniors' houses and characteristics of the facilities and the builders.

Summary of the Study

This study included the review of literature related to the design of housing for senior citizens and the development of checklists with which to survey the kitchens and bathrooms of homes designed for seniors. One tool, *Community and Home Information,* collected data from retirement communities and identified characteristics of the individual communities. Two tools, one for data collection in kitchens, the *Supportive Kitchen Features Checklist,* and one for data collection in bathrooms, the *Supportive Bathroom Features Checklist* were created to survey individual homes. The tools identify the extent to which kitchen and bathrooms in the homes designed for senior citizens contained supportive features identified in the literature as being important for older persons to live independently in their homes. Hypotheses were developed relating characteristics of the locations of the retirement communities, characteristics of the retirement communities, and characteristics of the individual homes to the percentage of possible points earned in kitchens and bathrooms of homes studied.

Community and Home Information

The Community and Home Information data collection tool identified characteristics of the location of the retirement community, the size and age of the community, and information about ownership of the community and the homes within it. A brief description of the developers and amenities was also included. Information about the homes surveyed, such as size, price, age, and available upgrades, was also included.

Information on The Community and Home Information sheet and permission to study and photograph the homes was obtained before any home was studied or photographed. Usually the same community representative that granted permission to study homes within the community also provided the information.

The Supportive Kitchen Features Checklist

The *Supportive Kitchen Features Checklist (SKFC)* was created for this study and based on existing research recommendations made for kitchens in homes

designed for older persons. The *SKFC* contained 15 categories of supportive features and contained 99 possible points.

The Supportive Bathroom Features Checklist

The basis for including individual items in the *Supportive Bathroom Features Checklist (SBFC)* was existing research and design recommendations for bathrooms designed for older persons. The checklist for bathrooms contained ten categories of supportive features with a total of 93 possible points for full bathrooms and 81 possible points for half baths. A separate checklist was developed for Separate Showers and for the Bathtubs and was filled out in each bathroom, depending on the type of bathing fixtures, or combination of fixtures in each bathroom.

The Separate Shower category contained 14 individual items and it was possible to accumulate 29 points for any separate shower.

The Bathtub category contained 12 individual items and a total of 23 points were possible for this bathing fixtures.

Pilot Study

A pilot test was conducted to identify problems with the instruments and to assure clarity and consistency in their use. Several minor changes and additions were made to the *SKFC* after the pilot study was completed.

Statement of the Procedures

Age-restricted retirement communities were identified through advertising and Chambers of Commerce and contacted by telephone to determine if they met the criteria for inclusion in the study. Communities were required to: 1) be designated as an age-restricted retirement or senior living community for homeowners 55 years or older, 2) have homes that were purchased outright or obtained through a life-time leasehold, 3) have individual homes that were designed for seniors who are able to live independently, 4) be free of services, such as housekeeping or meal programs that are provided to residents as part of an agreement to purchase the dwelling, 5) have homes that were less than 10 years old, and 6) dwellings that were single family homes. Permission to visit the community and study the homes was obtained at the time of the initial telephone contact.

Using three data collection tools as a guide, information was collected from 60 homes in 23 retirement communities. The retirement communities were located in four different states. At the time of the visit to the community a representative of the community was interviewed and *Community and Home Information* was obtained from this individual. This individual also granted permission to study and photograph the homes in the community.

All available information from the three tools was collected in each home included in the study. Photographs of kitchens and bathrooms in the homes were also taken for later use in verifying information collected as examples of design conditions in the homes. Data were compiled in a statistical program (SPSS® 11.0 for Windows). Hypotheses were then examined using Pearson product moment correlations, one-way analysis of variance, and t-tests.

Limitations

This study was a convenience sample and therefore has the limitations of a convenience sample. The study population of retirement homes may lack essential characteristics of the larger population of retirement homes in the country and findings of this study may not be applicable to other retirement communities.

This study also has an uneven distribution of homes within groups which limits the statistical options and power. There were nearly twice as many communities and homes studied in Florida as in North Carolina . Telephone calls to new home communities in North Carolina that were advertised as retirement communities often revealed that the communities were not age restricted. Also North Carolina had more CCRCs that provided amenities to residents at the entry, or independent living, level of care. Both of these conditions excluded many North Carolina retirement communities from inclusion in the study.

Fewer CCRCs were included in the study than were Active Adult communities. The nature of the CCRCs caused them to provide services that excluded them from the sample. Also, few older homes were included in the study because they were usually occupied and community representatives did not want to intrude on the privacy of the homeowners by asking them to participate in the study.

Since the community representative who was interviewed was often involved in marketing of the homes, they, on occasion, did not have information that was not directly related to promoting the community or marketing the home, such as who designed the homes. In more than half (53%) of homes, it was not possible to determine the source of the plan for the home.

The Research Hypotheses

Examination of the two research hypotheses revealed several positive relationships, some of which could have been influenced by extreme scores within the data. The first strong impression created by the statistical analysis was that kitchens with higher percentage scores were probably larger kitchens in more expensive homes. This is probably the result of larger size kitchens providing greater accessibility. More expensive kitchens may have fewer ranges and more customized features, such as wall ovens and microwave ovens, which may increase the number of supportive features in those kitchens.

In bathrooms, a strong association between higher Bathroom Percentage Scores and homes in not-for-profit communities (the same communities in which residents have a life-time leasehold on their homes) and CCRCs exists. These homes have fewer 5' x 7' bathrooms and greater accessibility as a result of larger bathrooms.

All but one of the CCRCs were also the not-for-profit / life-time leashold communities. Several communities were also faith-based communities. These communities contained the homes with the highest Bathroom Percentage Scores and the greatest numbers of supportive features.

Conclusions

The purpose of this study was to determine what supportive features are being included in the kitchens and bathrooms of homes being built for independent living retired persons and to determine if there is a relationship between the supportive features included in seniors' houses and characteristics of the facilities and the developers.

Few homes had high percentage scores in either kitchens or bathrooms. Results of the study revealed that kitchen had only 46% - 76% of the recommended

features for seniors to have in their kitchen to allow them to age in place. Bathrooms had only 48% - 52% of the possible numbers of supportive features; separate showers had 48% -52% of the possible numbers of supportive features; bathtubs had approximately 58% of the possible number of supportive features recommended in the existing literature. The results indicate that supportive features do exist in homes for seniors, but they are not extensive.

This study concludes that some relationships probably do exist between the supportive features included and some characteristics of the homes and communities. More expensive, larger homes have higher Kitchen Percentage Scores and homes in not-for-profit communities have higher Bathroom Percentage Scores. While these findings seem paradoxical, they can be intuitively explained.

In kitchens, one reason for these findings could be the efficiency provided by inclusion of things like the range in smaller, more economical homes. The presence of the range resulted in lower kitchens scores because of the low height of the oven and the frequent inclusion of a microwave oven above the cooktop. Larger, more expensive homes probably have larger kitchens. A larger kitchen almost certainly provides greater access simply by being larger. A more expensive kitchen may have a wider variety of appliances, ovens and microwave ovens installed at more convenient locations, and fewer ranges, all of which would result in higher scores.

This study revealed the presence of a large number of 5’ x 7’ bathrooms in the retirement community homes. This type of bathroom is financially economical and an efficient use of space. Unfortunately, this type of bathroom also resulted in low scores due to low accessibility in this very small room. There were more of this type of bathroom in homes built in for-profit communities. Developers in communities built for-profit are obviously motivated to reduce the cost of construction, which the inclusion of a 5’ x 7’ bathroom will do. However, their involvement with the homes ends shortly after the home is sold.

Conversely, the involvement of the CCRC / not-for-profit community only begins when the new resident moves into the community. The CCRC is contractually obligated to provide care to the residents for as long as it is needed in the future. Therefore, they have a vested interest in providing a more supportive

bathroom to residents with the hope that they can remain independent for longer periods. Fortunately, this is also the wish of most individuals. Time spent living independently is more desirable for both resident and community, less financially costly to both, and utilizes fewer expensive days in assisted living or skilled nursing home care. Additionally, many CCRCs have altruistic motives for providing a supportive environment for residents.

Implications

Designers, architects, builders, and developers should have more clearly defined research and design recommendations for use in their practice. Today the parameters of problems faced by seniors in their homes are more clearly defined and can more easily be addressed by this group of home building professionals. This study compiles almost 40 years of research and design recommendations for the design of senior housing and is the first attempt to compare recommendations for supportive senior housing to the homes actually being designed and built for seniors.

The tools developed for this study recognize that one house is not the same as another and provides a means of comparing supportive features within different homes. Kitchens of different sizes and configurations can be compared using overall scores or by the percentage score method. The tools can be used to compare bathrooms with different fixtures against one another by using the Bathroom Percentage Scores. A score for the whole house can be obtained by combining kitchen scores with scores for different bathroom configurations. Kitchens, bathrooms, or whole houses can be compared without consideration for style, size, or opulence of the homes. The tools developed for this study can be refined for use by consumers, designers, and architects and by members of the building trades.

It is possible that the inclusion of greater numbers of supportive features in senior homes will not occur until seniors begin to demand these features. Without adequate education about their own changing housing needs, older Americans may be buying retirement homes with the assumption that the new home is more appropriate for their changing needs than their current home. Younger seniors may

not yet be aware of their changing housing needs and the effect a supportive environment may have on them. Additionally, the maladroit application of supportive features may result in a stigmatizing appearance that is rejected by the home buying senior population.

The abundance of large, garden tubs in master bathrooms raises the question of the appropriateness of this type of bathing fixture for the senior housing market. Use of an ordinary bathtub presents seniors with numerous safety and accessibility dilemmas that are not reduced by making the tub larger, and, in many cases, impossible to step into. What are the implications of including this fixture in the bathrooms of seniors?

The range is not a good cooking system for seniors. The oven is too low and its location presents several accessibility challenges that are easily avoided by having a location at a more appropriate height. The cooktops do not offer advantages that offset the disadvantages of the oven. Additionally, the microwave oven is installed over the cooktop in very many cases, thereby increasing the safety and accessibility problems. Do builders and developers include this appliance for any reasons other than economic?

In a capitalist , market-driven society, such as ours in the United States, the consumer frequently gets what he or she wants. Older Americans should be educated in the supportive design features that can be available to them so that they will know to request, or demand, them in their retirement housing. Builders and developers will respond to an expressed desire of their target population of consumers.

Recommendations for Improving the Housing Assessment Tools

The physical structure of all checklists should be improved to make their use more clear and simple. A standardized approach to the design of the data collection tools is suggested.

Many observations for the study involved counting numbers of features, rather than recording specific information about features and their locations. All items should be reviewed to determine if more information is needed about the individual item. In the case of the *Community and Home Information* items, all

should be reviewed in light of who will be providing the information to the researcher and whether they are likely to be in possession of the information being requested.

Low variability in some items may be due to an element being present in almost all homes because of code requirements or because the builder duplicates the same features for his convenience, efficiency, or because of it's perceived desirability. For example, the height of electrical controls is covered by national and local building codes. In such a case simply recording the height of electrical controls in one location is probably sufficient, if this item is retained at all. In another instance, builders appear to install the same type of door handles in all interior doors in a home. Simply recording the type of door handle once is probably sufficient.

Detailed drawings of the rooms may have revealed useful information, especially with regard to accessibility problems in small bathrooms. Recordings and drawings of overall room size may have added perspective and insight to accessibility problems. The possibility of including specific room dimension, if not more detailed drawings, should be considered.

In measuring the light levels in kitchens and in bathrooms, it was not possible to determine how much of the light came from non-electrical sources and how much came from light fixtures. Observations about types and locations of light fixtures would have revealed more information and possibly helped determine if lighting plans were inefficient or inept. Additionally, a system for judging the color value of materials used on interiors should be incorporated into both checklists.

The Supportive Kitchen Features Checklist

Not all communities provided all of the appliances included on the *SKFC*. Small changes in scoring had to be made to accommodate the omission of some appliances in a number of communities. The omission of some appliances should be planned for in future use of the *SKFC*.

Most cooking (75%) in the homes studied would have to be done using a range. The propensity of developers to provide ranges resulted in low variability for more than one kitchen variable.

The Supportive Bathroom Features Checklist

The large number of 5’ x 7’ bathrooms seen in second bathrooms and their “sameness” resulted in limited variability among several items. There was vary little variety observed in this type of bathroom. However, many of the duplicated items on the checklist should probably be retained. The same type of bathtub results in low variability, but bathtubs should still be studied. These items should be subjected to further testing to determine which should be retained and which should be eliminated to produce a more reliable checklist.

Both the *SKFC* and the *SBFC* should include the overall dimensions of those rooms. The *SBFC* should include measurements of the heights of vanities and pedestal sinks. The *SBFC* should include measurements of all doors, including the shower doors, sliding doors to bathtub enclosures, and doors to toilet rooms.

Consideration should be given to including the height of the side walls of bathtubs and the lips of garden tubs. Garden tubs should be more fully described, possibly including the height and size of the decking in which they are frequently installed and the height of the tub above the deck. Measuring the distance a bather must move from the floor, to the tub deck, and across the deck before being able to enter the tub should also be considered.

The *SBFC* did not have space to record measurements of more than one doorway and therefore, if a single door was found to be less than 32” wide no points were awarded. As a result, exact measurements of all doors and doorways in bathrooms were not made

Recommendation for Seniors in Search of Retirement Housing

Senior consumers should be aware that developers and builders are making some changes in the way they build homes in order to accommodate seniors. Most of the homes in this study were one-storey homes and all had the master bedroom and at least one full bathroom on the ground floor. Some builders are adding features such as grab bars, shower benches, and elevated toilet seats to bathrooms, as well as elevated dishwashers and conveniently located ovens to kitchens. The homes and communities were attractive and most had numerous amenities for the

use of their residents. There was a variety of retirement communities from relatively small and compact to a huge community that has it's own zip code.

Senior consumers should also be aware that while some features that the homeowner may need in the future are being provided in retirement community homes, many are not. Seniors must be aware that change in the housing industry comes slowly and that they need to advocate for themselves and their future housing needs.

Prior to shopping for a retirement home, seniors should familiarize themselves with the basics of kitchen and bathroom design. The design of kitchens and bathrooms is important for the full and safe use of any home. The National Kitchen and Bath Association maintains a website to provide information to consumers about the basic requirements for good kitchen and bathroom design. This service is free and available to the public at http://www.nkba.org/ .

Seniors should educate themselves about their changing physical needs and their needs for supportive housing. Most people want to age in place. There are supportive features which can be included in the homes of seniors enabling them to remain independent and self sufficient in their homes for as long as feasible. Seniors should look for the supportive features included in the *SKFC* and the *SBFC* when buying a home for themselves. Seniors should also be aware that lighting levels in the homes included in this study were, on average, below the recommended minimum level and look for homes that could have light levels augmented during the construction process.

Suggested Further Research

The data collection tools should be refined and clarified. Perhaps more specific populations, such as those in assisted living situations, could be served by isolation of particular supportive features most appropriate for their use. The research tools could be refined and applied to family housing as well, since the features identified in the data collection tools will increase safety and utilization in kitchens and bathrooms for all members of the society.

Since there is a disparity in ages of individuals entering CCRCs and active adult retirement communities, the possibility of limiting the study to either one or the

other type of community would result in a more even distribution of cases. The inclusion of communities which provide housekeeping and meal programs would also result in a more even distribution of homes within the types of communities.

Garden tubs were seen frequently in this study. There is little available research about how bathers, especially older bathers, use this type of tub. Research into how bathers access large garden tubs, how homeowners clean these large tubs, and how frequently they are used should be pursued. Additionally, homeowners should be asked if they really want these large tubs in their bathrooms.

Since garden tubs take up a large amount of space in bathrooms, usually the master bathroom, and there is little research to support their use in senior housing, homeowners should be given a choice about their inclusion in a master bathroom. It is possible that inclusion of a sit-down vanity, larger shower with an integral seat, or a larger toilet room would be more appropriate use of this space in the senior home.

Designers should be encouraged to design a replacement for the 5' x 7' bathroom that is size and cost efficient, but more accessible. Developers are probably highly motivated to use the 5' x 7' bathroom because of it's size and cost efficiency and may be willing to substitute a more supportive bathroom design if it meets their needs for efficiency.

The kitchen range is probably popular with developers for size and cost economy reasons. Kitchen designers should encourage appliance manufacturers to design a more supportive range or an alternative for the range that is cost-effective.

Kitchen designers and builders of senior housing should review the newer types of appliances available to homeowners today. The innovative combination microwave and convection oven should be considered as a possible replacement for the separate microwave oven and traditional oven seen frequently in this study. Research could determine if this type of appliance is acceptable to older cooks.

Post-occupancy research should be conducted to determine how different groups of seniors use their homes and how those uses change over time. Senior housing design could then better anticipate the housing needs and desires of older persons. Longitudinal kitchen and bathroom use studies might also provide valuable information for designers.

Appliance and fixture designers could better design for the changing needs of older persons. Inclusion of more accessible appliances and fixtures in lines that are not marketed as “handicapped” and have a non-stigmatizing, attractive, and residential appearance would increase their acceptance and use by all segments of the market. Additionally, research should be carried out to determine how seniors utilize appliances and bathroom fixtures, and the availability, location and types of supportive features for those appliances and bathroom fixtures.

Some supportive features are probably more appropriate for use in different age ranges of older persons. Perhaps the development of lists of supportive kitchen and bathroom features for varying age ranges, or levels of agility, of older persons could be developed. A more supportive list of features for individuals in assisted living could also be developed.

An educational program to share information about supportive design features should be developed for builders and developers of senior housing. This group has been slow to change from traditional building designs to homes that include more appropriate design features. Designs marketed to builders and developers must include evidence that the designs are cost efficient and acceptable to seniors. Designers are the most appropriate professionals to collect this evidence.

The use of dark materials in the interiors of the homes studied was a problem that accentuated the low light levels observed in many homes. A maximum color value could be established through research with seniors. A system that designers, architects, and builders could then use to judge the color value of materials intended for use in homes for seniors could be developed.

Research to determine how developers and builders make decisions about what to include in the homes they construct for Americans would be beneficial to those attempting to affect the process.

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APPENDIX A: The Supportive Kitchen Features Checklist

The Supportive Kitchen Features Checklist

HID - Home identification information:		
Lighting		
Types of lighting in kitchen: ☐ **A.** Incandescent ☐ **B.** Fluorescent ☐ **C.** Halogen	**L-1.**	
Ambient lighting is_____ foot candles	**L-2.**	
Ambient lighting is in 60-400 foot candles range.	**L-3.**	☐ YES (3) ☐ NO (0)
Light fixtures have shades / diffusers.	**L-4.**	☐ YES (1) ☐ NO (0)
Exposed light bulbs are frosted /have diffusers.	**L-5.**	☐ YES (1) ☐ NO (0) ☐ NA (0)
Task lighting is provided: ☐ **A.** Under-cabinet (1) ☐ **B.** Over cooktop (1) ☐ **C.** Over sink (1)	**L-6.**	Total number of features: _____
Total Lighting Score (8 possible points)	**L-7.**	
Electrical Controls		
Light switches are within Universal reach range (15" – 48" AFF).	**EC-1.**	☐ YES (3) ☐ NO (0)
Electrical outlets are within Universal reach range (15" – 48" AFF).	**EC-2.**	☐ YES (3) ☐ NO (0)
Total Electrical Controls Score (6 possible points)	**EC-3.**	

Floors		
Flooring material is: _____	**F-1.**	
Flooring material is vinyl composition tile, sheet vinyl, vinyl tile, linoleum tile, sheet linoleum, sheet rubber, or rubber tile.	**F-2.**	☐ YES (2) ☐ NO (0)
Floors are fairly smooth and regular.	**F-3.**	☐ YES (3) ☐ NO (0)
Flooring has a matte finish.	**F-4.**	☐ YES (3) ☐ NO (0)
Flooring color contrasts with wall color /not a monochromatic, repetitive value color scheme.	**F-5.**	☐ YES (1) ☐ NO (0)
Total Floor Score (9 possible points)	**F-6.**	
Thresholds		
Thresholds are smooth. OR	**T-1.**	☐ YES (3) ☐ NO (0)
Thresholds are accessible: • Edges are beveled, *and* • Edges are less than ½" high	**T-2.**	☐ YES (1) ☐ NO (0) ☐ NA (0)
Total Thresholds Score (3 possible points)	**T-3.**	
Doors, Doorways, Locks and Handles		
Clear width of entry into kitchen is 32", or greater.	**D-1.**	☐ YES (3) ☐ NO (0)
Doors have lever handles.	**D-2.**	☐ YES (3) ☐ NO (0) ☐ Nodoor (0)
Total Doors, Doorways, Locks and Handles Score (6 possible points)	**D-3.**	

Cabinetry and Storage

Height of bottom shelf in base cabinet: _____"	**CAB-1.**	"AFF
Height of top shelf in wall cabinet: _____"	**CAB-2.**	"AFF
Distance between bottom of wall cabinets and counter top is 18" or less.	**CAB-3.**	☐ YES (2) ☐ NO (0) ☐ NA (0)
Storage under counters is in the form of: ☐ **A.** Drawers (1) ☐ **B**. Roll-outs (1) ☐ **C.** Adjustable shelves. (1) ☐ **D.** Corner carousel / lazy-susan (1) ☐ **E.** Fixed shelves (0)	**CAB-4.**	Total number of features
Height of bottom shelf in base cabinet is higher than 5" AFF.	**CAB-5.**	☐ YES (2) ☐ NO (0)
Total Cabinetry Score (8 possible points)	**CAB-6.**	

Counters and Countertops

There is an opening under the countertop to allow one to work while seated	**CO-1.**	☐ YES (2) ☐ NO (0)
There are heat resistant surfaces on both sides of the cooktop.	**CO-2.**	☐ YES (2) ☐ NO (0)
Counter tops: ☐ **A.** At more than one height ☐ **B.** Contrasting countertop edges. ☐ **C.** Raised countertop edges. ☐ **D.** Clipped countertop corners ☐ **E.** Rounded countertop corners	**CO-3.**	Total number of features
Total Counters and Countertops Score (9 possible points)	**CO-4.**	

The Work Triangle		
Work area between refrigerator and sink: ☐ **A.** Has continuous countertop (1) ☐ **B.** Leg of work triangle is 4' or greater and less than 9' in length (1)	**WT-1.**	Total number of features
Work area between sink and stove: ☐ **A.** Has continuous countertop (1) ☐ **B.** Leg of work triangle is 4' or greater and less than 9' in length (1)	**WT-2.**	Total number of features
Work area between refrigerator and stove: ☐ **A**. Has continuous countertop (1) ☐ **B.** Leg of work triangle is 4' or greater and less than 9' in length (1)	**WT-3.**	Total number of features
Work triangle is less than 26':	**WT-4.**	☐ YES (2) ☐ NO (0)
Total Work Triangle Score (8 possible points)	**WT-5.**	
Sink and Faucets		
Faucet and water diverter control: ☐ Is large, ☐ Is easily manipulated ☐ Do not require pinching, grasping or twisting to operate ☐ Is operable with one hand	**SINK-1.**	Total number of features 1-2 = 1 3-4 = 2
Total Sink and Faucets Score (2 possible points)	**SINK-2.**	

Cooktop		
Cooktop controls are located: ☐ **A.** On the side (3) ☐ **B.** In the front (3) ☐ **C**. Neither (0)	**COK-1.**	
Burners are staggered.	**COK-2.**	☐ YES (2) ☐ NO (0)
Cooktop is electric.	**COK-3.**	☐ YES (1) ☐ NO (0)
Total Cooktop Score (6 possible points)	**COK-4.**	
Oven		
Height of the bottom of the oven: _____"	**OVN-1.**	"AFF
Oven is installed so that: ☐ **A.** The bottom of oven is 26" – 28" AFF (1) ☐ **B**. One rack is close in height to adjacent transfer surface (1) ☐ **C.** None of the above (0)	**OVN-2.**	
Oven: ☐ **A.** has a landing zone with heat resistant surface within 3' of the oven (2) ☐ **B**. has a heat resistant pull out shelf under the oven (2) ☐ **C**. neither A or B (0)	**OVN-3.**	
Oven hinges on the side.	**OVN-4.**	☐ YES (2) ☐ NO (0)
Total Oven Score (8 possible points)	**OVN-5.**	

Refrigerator		
Refrigerator is provided	**REF-1.**	☐ Yes (0) ☐ No (0)
Refrigerator has ice-maker	**REF-2.**	☐ YES (1) ☐ NO (0)
Refrigerator provides access to an ice-maker within the Universal reach range.	**REF-3.**	☐ YES (1) ☐ NO (0) ☐ NA (0)
Refrigerator door swings at least 180°.	**REF-4.**	☐ YES (2) ☐ NO (0)
Refrigerator with freezer compartment located: ☐ **A.** On bottom (2) ☐ **B.** Side-by-side (2) ☐ **C.** Neither of the above (0)	**REF-5.**	
Total Refrigerator Score (6 possible points)	**REF-6.**	
Clear Space		
There is a 30” x 48” clear space in front of **sink**.	**CS-1.**	☐ YES (2) ☐ NO (0)
There is a 30” x 48” clear space in front of **cooktop**.	**CS-2.**	☐ YES (2) ☐ NO (0)
There is a 30” x 48” clear space in front of **refrigerator**	**CS-3.**	☐ YES (2) ☐ NO (0)
There is a 30” x 48” clear space in front of **oven**.	**CS-4.**	☐ YES (2) ☐ NO (0)
Kitchen has a 5’ turning radius	**CS-5.**	☐ YES (2) ☐ NO (0)
Total Clear Space Score (8 possible points)	**CS-6.**	

Microwave Oven		
Microwave oven is present	**MIC-1.**	☐ YES (2) ☐ NO (0)
Height of the bottom of the microwave oven less than 48” AFF.	**MIC-2.**	☐ YES (2) ☐ NO (0)
There is a 30” x 48” clear space in front of **microwave oven**.	**MIC-3.**	☐ YES (2) ☐ NO (0)
Total Microwave Score (6 possible points)	**MIC-4.**	
Dishwasher		
Dishwasher is present.	**DW-1.**	☐ YES (2) ☐ NO (0)
Dishwasher is elevated.	**DW-2.**	☐ YES (2) ☐ NO (0)
There is a 30” x 48” clear space in front of **dishwasher**.	**DW-3.**	☐ YES (2) ☐ NO (0)
Total Dishwasher Score (6 possible points)	**DW-4.**	
Total Score for Kitchen (99 possible points)		

The Supportive Bathroom Features Checklist

HID - Home identification information:		
Bathroom description: ☐ **A.** Full bath – off master bedroom ☐ **B.** Full bath – off bedroom ☐ **C.** Full bath – ☐ **D.** Half bath – off bedroom ☐ **E.** Half bath		
LIGHTING		
Types of lighting in bathroom: ☐ **A.** Incandescent ☐ **B.** Fluorescent ☐ **C.** Halogen	**BL-1.**	
Ambient lighting is:_____foot candles.	**BL-2.**	
Ambient lighting is in 60-400 foot candles range.	**BL-3.**	☐ YES (3) ☐ NO (0)
Light fixtures have shades / diffusers.	**BL-4.**	☐ Yes (1) ☐ No (0)
Exposed light bulbs are frosted.	**BL-5.**	☐ Yes (1) ☐ No (0) ☐ NA (0)
Task lighting is provided. ☐ **A.** Under-cabinet (1) ☐ **B.** Over sink (1) ☐ **C.** Other location (1) _____ ☐ **D.** No task lighting	**BL-6.**	Total number of features
There is a lighting fixture next to / above the mirror.	**BL-7.**	☐ Yes (2) ☐ No (0)
There is a lighting fixture in the center of the room.	**BL-8.**	☐ Yes (2) ☐ No (0)

There is a lighting fixture over the shower / bathtub enclosure.	**BL-9.**	☐ Yes (2) ☐ No (0)
Total Lighting Score (14 possible points)	**BL-10.**	
Electrical Controls		
Light switches are within Universal reach range (15" – 48" AFF).	**BEC-1.**	☐ Yes (3) ☐ No (0)
Electrical outlets are within Universal reach range (15" – 48" AFF).	**BEC-2.**	☐ Yes (3) ☐ No (0)
Heat lamp: ☐ There is a heat lamp in the bathroom (1) ☐ Heat lamp is on a timer (1) ☐ No heat lamp	**BEC-3.**	Total number of features
There is an outlet for a nightlight between the bed and the bathroom.	**BEC-4.**	☐ Yes (1) ☐ No (0)
There is an outlet adjacent to sink / mirror.	**BEC-5.**	☐ Yes (1) ☐ No (0)
Bathroom has an emergency call system.	**BEC-6.**	☐ Yes (1) ☐ No (0)
Total Electrical Controls Score (11 possible points)	**BEC-7.**	
Floors		
Flooring material is:_____	**BF-1.**	
Flooring material is vinyl composition tile, sheet vinyl, vinyl tile, linoleum tile, sheet linoleum, sheet rubber, or rubber tile	**BF-2.**	☐ Yes (2) ☐ No (0)
Floors are fairly smooth and regular.	**BF-3.**	☐ Yes (3) ☐ No (0)
Flooring has a matte finish.	**BF-4.**	☐ Yes (3) ☐ No (0)
Flooring color contrasts with wall color /not a monochromatic, repetitive value color scheme.	**BF-5.**	☐ Yes (1) ☐ No (0)

Floor color contrasts with color of bathroom fixtures /not a monochromatic, repetitive value color scheme	**BF-6.**	☐ Yes (1) ☐ No (0)
Total Floor Score (10 possible points)	**BF-7.**	
Thresholds		
Thresholds are smooth. OR	**BT-1.**	☐ Yes (3) ☐ No (0)
Thresholds are accessible: ✶ Edges are beveled, *and* ✶ Edges are less than ½" high	**BT-2.**	☐ Yes (1) ☐ No (0) ☐ NA (0)
Total Thresholds Score (3 possiblepoints)	**BT-3.**	
Doors, Doorways, Locks and Handles		
Clear width of entry is 32", or greater.	**BD-1.**	☐ Yes (3) ☐ No (0)
Doors have lever handles.	**BD-2.**	☐ Yes (3) ☐ No (0)
Bathroom door swings out.	**BD-3.**	☐ Yes (2) ☐ No (0)
Doors are un-lockable from both sides.	**BD-4.**	☐ Yes (2) ☐ No (0) ☐ NA (0)
Door lock is easily manipulated: ✸ no pinching, twisting required ✸ *not* the screw-tab in the handle type ✸ *not* a keyed lock	**BD-5.**	☐ Yes (1) ☐ No (0) ☐ NA (0)
Total Doors, Doorways, Locks and Handles Score (11 possible points)	**BD-6.**	
Cabinetry & Storage		
Height of bottom shelf in base cabinet: _____"	**BCA-1.**	" AFF
Height of top shelf in wall cabinet: _____"	**BCA-2.**	"AFF

Storage under counters is in the form of: ☐ **A** – Drawers (1) ☐ **B** Roll-outs (1) ☐ **C** Adjustable shelves (1) ☐ **D.** Fixed shelves (0) ☐ **E.** There is no storage under counters (0)	**BCA-3.**	Total number of features
Locations of bathroom storage: ☐ **A.** linen closet (1) ☐ **B.** wall cabinets (1) ☐ **C.** base cabinets (1) ☐ **D.** medicine cabinets (1) ☐ **E.** open shelving (1)	**BCA-4.**	Total number of features:
There are at least two towel bars in each full bath.	**BCA-5.**	☐ Yes(2) ☐ No (0)
There is a towel bar located near bathtub / shower.	**BCA-6.**	☐ Yes (2) ☐ No (0)
There is a towel bar located near lavatory.	**BCA-7.**	☐ Yes (1) ☐ No (0)
Total Cabinetry & Storage Score (13 possible points)	**BCA-8.**	
Medicine Cabinet & Mirror		
Bathroom mirror: ☐ There is a mirror behind the sink (1) ☐ The bottom of the mirror is at the height of the vanity back splash. (1) ☐ There is an adjustable mirror (1)	**BMC-1.**	Total number of features
Medicine cabinet is: ☐ **A.** Adjacent to the sink (1) ☐ **B.** Behind the sink (0) ☐ **C.** There is no medicine cabinet. (0)	**BMC-2.**	
Total Medicine Cabinet & Mirror Score (4 possible points)	**BMC-3.**	

Sink & Lavatory		
There is a seating space: ☐ **A.** At a vanity (1) ☐ **B.** At or near the sink. (1) ☐ **C.** Other seating area (1)_____ ☐ **D.** No seating area	**BSNK-1.**	Total number of features
Clearance from sink centerline to any side wall is 15”, or greater.	**BSNK-2.**	☐ Yes (1) ☐ No (0)
Faucet and water diverter control: ☐ Is large, ☐ Is easily manipulated ☐ Do not require pinching, grasping or twisting to operate ☐ Is operable with one hand	**BSNK-3.**	Total number of features 1-2 = 1 3-4 = 2
Total Sink & Lavatory Score (6 possible points)	**BSNK-4.**	
Toilet		
Toilet seat is 17” – 19” high.	**BToi-1.**	☐ Yes (2) ☐ No (0)
The toilet has a long oval shape seat.	**BToi-2.**	☐ Yes (2) ☐ No (0)
Toilet space has a side wall.	**BToi-3.**	☐ Yes (3) ☐ No (0)
Toilet space is 32” wide or wider.	**BToi-4.**	☐ Yes (2) ☐ No (0)
Toilet tissue holder is located: ☐ **A.** On a side wall (1) ☐ **B.** In front of the toilet seat (1)	**BToi-5.**	Total number of features
Toilet has a grab bar.	**BToi-6.**	☐ Yes (2) ☐ No (0)

The grab bar has a residential, non-stigmatizing appearance.	**BToi-7.**	☐ Yes (2) ☐ No (0) ☐ No bar
Total Toilet Score (15 possible points)	**BToi-8.**	
Clear Space		
There is a 30" x 48" minimum clear space in front of the **toilet.**	**BCS-1.**	☐ Yes (2) ☐ No (0)
There is a 30" x 48" clear space in front of the **lavatory.**	**BCS-2.**	☐ Yes (2) ☐ No (0)
Bathroom has a 5' turning radius.	**BCS-3.**	☐ Yes (2) ☐ No (0)
Total Clear Space Score (6 possible points)	**BCS-4.**	
Total Score for Bathroom ☐ **Main bathroom features** (93 possible points) ☐ **Half Bath features** (81 possible points)		_____ _____ _____

Home identification information:		
<u>Bathtub</u>		
Bathroom has a bathtub	**BTUB-1.**	☐ YES (0) ☐ NO (0)
Tub bottom: ☐ Is flat. (1) ☐ Is ribbed / pebbled, or has other non-slip base (1) ☐ Has safety tread strips (1) ☐ None of the above (0)	**BTUB-2.**	Total number of features
There are no steps at the bathtub.	**BTUB-3.**	☐ Yes (3) ☐ No (0)
There is no glass bathtub enclosure.	**BTUB-4.**	☐ Yes (2) ☐ No (0)
Water temperature and velocity controls are off-set to allow adjustment before entering the tub	**BTUB-5.**	☐ Yes (1) ☐ No (0)
Shower head is included in bathtub, if tub is the only bathing fixture.	**BTUB-6.**	☐ Yes (1) ☐ No (0)
Bathtub has a handheld shower.	**BTUB-7.**	☐ Yes (1) ☐ No (0)
Storage in the bathtub: ☐ Storage is recessed (1) ☐ Storage is on interior ledge at least 3” wide (1) ☐ Storage is within the universal reach range – 15” - 48”AFF (1) ☐ None of the above (0)	**BTUB-8.**	Total number of features

Bathtub has a grab bar.	**BTUB-9.**	☐ Yes (3) ☐ No (0)
The grab bar has a residential, non-stigmatizing appearance.	**BTUB-10.**	☐ Yes (2) ☐ No (0) ☐ Nobar (0)
Faucet and water diverter control: ☐ Is large, ☐ Is easily manipulated ☐ Do not require pinching, grasping or twisting to operate ☐ Is operable with one hand	**BTUB-11.**	Total number of features 1-2 = 1 3-4 = 2
There is a 30” x 48” clear space in front of the **tub.**	**BTUB-12.**	☐ Yes (2) ☐ No (0)
Total Bathtub Score (23 possible points)	**BTUB-13.**	

Home identification information:		
<u>Shower</u>		
Bathroom has a separate shower	**BSHO-1.**	☐ YES (0) ☐ NO (0)
Shower does not have a curb.	**BSHO-2.**	☐ Yes (2) ☐ No (0)
Floor of shower is made of non-slip materials.	**BSHO-3.**	☐ Yes (3) ☐ No (0)
Interior dimensions of shower are 34” x 34” or larger.	**BSHO-4.**	☐ Yes (2) ☐ No (0)
Shower has a bench or seat.	**BSHO-5.**	☐ Yes (2) ☐ No (0)
Shower does not have a door.	**BSHO-6.**	☐ Yes (2) ☐ No (0)
Shower door swings into the bathroom.	**BSHO-7.**	☐ Yes (2) ☐ No (0) ☐ NA (0)
Shower bench / seat: ☐ **A.** is 17” – 19” high (1) ☐ **B.** at least 15” deep (1) ☐ **C.** does not reduce the amount of clear space on the shower floor below 34” x 34” (1) ☐ NA	**BSHO-8.**	Total number of features
Faucet and water diverter control: ☐ Is large, ☐ Is easily manipulated ☐ Do not require pinching, grasping or twisting to operate ☐ Is operable with one hand	**BSHO-9.**	Total number of features 1-2 = 1 3-4 = 2

Shower has a grab bar.	**BSHO-10.**	☐ Yes (3) ☐ No (0)
The grab bar has a residential, non-stigmatizing appearance.	**BSHO-11.**	☐ Yes (2) ☐ No (0 ☐ Nobar (0)
Storage in the shower: ☐ **A.** Storage is recessed (1) ☐ **B.** Storage is on interior ledge at least 3" wide (1) ☐ **C.** Storage is within the universal reach range – 15" – 48" AFF (1) ☐ None of the above (0)	**BSHO-12.**	Total number of features
Shower has a hand held showerhead.	**BSHO-13.**	☐ Yes (1) ☐ No (0)
There is a 30" x 48" clear space in front of the **shower.**	**BSHO-14.**	☐ Yes (2) ☐ No (0)
Total Shower Score (29 possible points)	**BSHO-15.**	

Community and Home Information

HID - Home identification information:

Nearest Urban Area

M-1.	Name of nearest urban area:
M-2.	Size of nearest urban area:
M-3.	Distance to nearest urban area:

Facility Information

F-1.	Community name
F-2.	Age of community
F-3.	Number of homes in community
F-4.	How many homes are planned for this community?
F-5.	Price range of homes in this community:
F-6.	Size range of homes in this community (square footage):
F-7.	Type of home ownership ☐ A. Fee simple ownership ☐ B. Life-time leasehold
F-8.	Type of development ☐ A. CCRC ☐ B. Active adult (only independent living) ☐ C. Other: _____

F-9. Community – type of ownership:

- ☐ A. For-profit
- ☐ B. Not-for-profit
  - o Faith based
  - o Fraternal
  - o Independent

F-10. Amenities available within the community:

- ☐ A. Gym / fitness center with equipment
- ☐ B. Work out room with classes but no equipment
- ☐ C. Swimming pool
- ☐ D. Golf and sports
- ☐ E. Out – patient health care facility
- ☐ F. Drug store
- ☐ G. Shopping – convenience / grocery
- ☐ H. Shopping – other _____
- ☐ I. Dining
- ☐ J. Community center / recreation facility
- ☐ K. Walking trails
- ☐ L. Activities and programs
- ☐ M. Other: _____

F-11. How many other developments of this type does this company own?

Home Information

H-1.	Home description / name:
H-2.	Age of the home:
H-3.	Size of the home (square footage):
H-4.	Price of the home:
H-5.	What was the source of the home plan? / Who designed the building?
H-6.	Are there available upgrades? ☐ Yes ☐ No
H-7.	What are the available upgrades? ☐ A. Materials and finishes ☐ B. Modify home plan ☐ C. Upgrades to plan ☐ D. Upgrade appliances / fixtures ☐ E. Substitute appliances / fixtures ☐ F. _____
H-8.	Are the designers employed: ☐ A. In-house ☐ B. On commission ☐ C. Other : _____

APPENDIX D: Data Collected Using The Community And Home Information Tool

Appendix D - 1
Nearest Municipality

	Minimum	Maximum	Mean	Standard Deviation
Local municipality population	2,644	88,769	26,590	26,623
Distance to local municipality	0	10	1.92	3.485
Large urban area population	94,911	3,047,460	734,295	879,063
Distance to large urban area	11	106	38.37	22.123

Appendix D - 2
Facility Information

	Minimum	Maximum	Mean	Standard Deviation
Community age	1	43	9.57	12.6
Number of dwellings	8	20,000	1782.28	4076.4
Number of homes planned	54	30,000	3361.10	5836.8
Price range – low	$32,000	$275,000	$137,679	$49,020
Price range - high	$135,000	$700,000	$300,322	$100,669
Mean home price	$95,000	$375,001	$$219,001	$58,503
Size range – low	486	1888	1272	253.95
Size range – high	1680	5000	2877	757.72
Mean square footage	1115	2900	2074	398.05
Other communities of this type	0	130	12.6	26.56

Appendix D - 3
Ownership and Development Types

	Frequency	Percent
Home Ownership:		
▪ Fee simple	47	78.3
▪ Life-time leasehold	3	5.0
▪ Own home / lease land	10	16.7
Development Type:		
▪ CCRC	4	6.7
▪ Active Adult	56	93.3
Community Ownership:		
▪ For-profit	57	95.0
▪ Not-for-profit	3	5.0

Table D - 4
Amenities Offered by Retirement Communities

		Frequency	Percent
Gym / Fitness Center	Yes	56	93.3
	No	4	6.7
Work-out Room	Yes	29	48.3
	No	31	51.7
Swimming Pool	Yes	53	88.3
	No	7	11.7
Golf & Sports	Yes	41	68.3
	No	19	31.7
Out-patient Health Care	Yes	10	16.7
	No	50	83.3
Drug Store	Yes	5	8.3
	No	55	91.7
Shopping - Convenience Store	Yes	14	23.3
	No	46	76.7
Shopping - Other	Yes	6	10.0
	No	54	90.0
Dining	Yes	39	65.0
	No	21	35.0
Community / Recreation Center	Yes	58	96.7
	No	2	3.3
Walking Trails	Yes	51	85.0
	No	9	15.0
Activities & Programs	Yes	58	96.7
	No	2	3.3

Appendix D - 5
Home Information

	Minimum	Maximum	Mean	Standard Deviation
Age of home	0	10	.450	1.8633
Square footage	1259	3177	1985	475.907
Home price	$78,000	$357,900	$202,448.20	$57,908.76

Appendix D - 6
Home Information 2

	Frequency	Percent
Source of the plan:		
Architect	22	36.7
Book plan	4	6.7
Modified another plan	2	3.3
Unknown	32	53.3
Are there available upgrades to the plan:		
Yes	60	100
No	0	0
What are the available upgrades:		
Materials and finishes		
Yes	60	100
No	0	0
Modify home plan		
Yes	49	81.7
No	11	18.3
Upgrade to home plan		
Yes	43	71.7
No	17	28.3
Upgrade appliances or fixtures		
Yes	60	100
No	0	0
Substitute appliances or fixtures		
Yes	23	38.3
No	37	61.7
Designers are employed		
In-house	41	68.3
On commission	14	23.3
Other	5	8.3

APPENDIX E: Data Collected Using The Supportive Kitchen Features Checklist

Appendix E-1

Supportive Kitchen Features - Results for Individual Items - Faucets

Item Description	Possible Score	Frequency	Percent
Total number of faucet and water control features	1	2	3.3
	2	58	96.7

Appendix E - 2

Supportive Kitchen Features - Results for Individual Items – Electrical Controls

Item Description	Possible Score	Frequency	Percent
Light switches within universal reach range	0	5	8.3
	3	55	91.7
Electrical outlets within universal reach range	3	60	100
Total Electrical Controls Score	3	5	8.3

Appendix E - 3

Supportive Kitchen Features - Results for Individual Items – Clear Space

Item Description	Possible Score	Frequency	Percent
There is a 30” x 48” clear space in front of sink	0	2	3.3
	2	58	96.7
There is a 30” x 48” clear space in front of cooktop	0	1	1.7
	2	59	98.3
There is a 30” x 48” clear space in front of refrigerator	0	2	3.3
	2	58	96.7
There is a 30” x 48” clear space in front of oven	0	1	1.7
	2	59	98.3
Kitchen has a 5” turning radius	0	23	38.3
	2	37	61.7
Total Clear Space Score	0	1	1.7
	6	2	3.3
	8	20	33.3
	10	37	61.7

Appendix E - 4

Supportive Kitchen Features - Results for Individual Items – Doors and Doorways

Item Description	Possible Score	Frequency	Percent
Clear width is 32” or greater	0	13	21.7
	3	47	78.3
Doors have lever handles	0	7	11.7
	3	53	88.3
Total Doors and Doorways Score	0	2	3.3

Appendix E - 5

Supportive Kitchen Features - Results for Individual Items - Floors

Item Description	Possible Score	Frequency	Percent
Flooring material	Ceramic tile	34	56.7
	Sheet vinyl	10	16.7
	Wood	16	26.7
Flooring material is resilient	0	50	83.3
	2	10	16.7
Floors are smooth and regular	0	1	1.7
	3	59	98.3
Floors have a matte finish	0	1	1.7
	3	59	98.3
Floor color contrasts with wall color	0	4	6.7
	1	56	93.3
Total Floor Score	4	2	3.3
	6	3	5
	7	45	75
	8	1	1.7
	9	9	15

Appendix E - 6

Supportive Kitchen Features - Results for Individual Items – Thresholds

Item Description	Possible Score	Frequency	Percent
Thresholds are smooth	0	23	38.3
	3	37	61.7
Thresholds are accessible	0	39	65
	1	21	35
Total Thresholds Score	0	2	3.3
	1	21	35
	3	37	61.7

Appendix E - 7

Supportive Kitchen Features - Results for Individual Items – Work Triangle

Item Description	Possible Score	Frequency	Percent
Total number of features in area between refrigerator and sink	0	13	21.7
	1	28	46.7
	2	19	31.7
Total number of features in area between sink and stove	0	6	10
	1	21	35
	2	33	55
Total number of features in area between refrigerator and stove	0	5	8.3
	1	26	43.3
	2	29	18.3
Work triangle is less than 26’	0	7	11.7
	2	53	88.3
Total Work Triangle Score	1	2	3.3
	2	4	6.7
	4	3	5
	5	11	18.3
	6	22	36.7
	7	10	16.7
	8	8	13.3

Appendix E - 8

Supportive Kitchen Features - Results for Individual Items - Dishwasher

Item Description	Possible Score	Frequency	Percent
Dishwasher is present	Yes	60	100
	No	0	0
Dishwasher is elevated	0	52	86.7
	2	8	13.3
There is a 30” x 48” clear space in front of dishwasher	0	2	3.3
	2	58	96.7
Total Dishwasher Score	2	2	3.3
	4	50	83.3
	6	8	13.3

Appendix E - 9

Supportive Kitchen Features - Results for Individual Items - Refrigerator

Item Description	Possible Score	Frequency	Percent
Refrigerator is provided	Yes	51	85
	No	9	15
Refrigerator has ice maker	0	2	3.3
	1	49	81.7
Refrigerator provides access to ice maker within Universal reach range	0	11	18.3
	1	40	66.7
Refrigerator door swings at least 180°	0	31	51.7
	2	20	33.3
Refrigerator has freezer located on the bottom or on the side	0	12	20
	2	39	65
Total Refrigerator Score	1	7	11.7
	2	2	3.3
	3	1	1.7
	4	26	43.3
	5	1	1.7
	6	14	23.3

Appendix E - 10

Supportive Kitchen Features - Results for Individual Items – Microwave Oven

Item Description	Possible Score	Frequency	Percent
Microwave oven is present	Yes	51	85
	No	9	15
Height of bottom of microwave is less than 48” AFF	0	47	78.3
	2	4	6.7
There is a 30” x 48” clear space in front of microwave oven	0	1	1.7
	2	50	83.3
Total Microwave Score	0	1	1.7
	2	1	1.7
	4	45	75
	6	4	6.7

Appendix E - 11

Supportive Kitchen Features - Results for Individual Items - Cabinetry

Item Description	Possible Score	Frequency	Percent
Distance between base and wall cabinet is 18” or less	0	6	10
	2	54	90
Total number of under counter storage features	0	9	15
	1	9	15
	2	23	38.3
	3	17	28.3
	4	2	3.3
Height of bottom shelf in base cabinet is 5” or greater	0	13	21.7
	2	47	78.3
Total Cabinetry Score	0	2	3.3
	2	4	6.7
	3	3	5
	4	9	15
	5	6	10
	6	19	31.7
	7	17	28.3

Appendix E - 12

Supportive Kitchen Features - Results for Individual Items - Lighting

Item Description	Possible Score	Frequency	Percent
Types of lighting	Incandescent	57	95
	Fluorescent	20	33.3
	Halogen	5	8.3
Lighting within 60-400 footcandle range	0	35	58.3
	3	25	41.7
Light fixtures have shades / diffusers	0	3	5.0
	1	57	95
Exposed bulbs are frosted	0	13	21.7
	1	47	78.3
Locations of task lighting	0	2	3.2
	1	7	11.7
	2	38	63.3
	3	13	21.7
Total Kitchen Lighting Score	2	2	3.3
	3	5	8.3
	4	22	36.7
	5	10	16.7
	6	5	8.3
	7	14	23.3
	8	2	3.3

Appendix E - 13

Supportive Kitchen Features - Results for Individual Items - Cooktop

Item Description	Possible Score	Frequency	Percent
Location of cooktop controls	On the side OR In the front	38	63.3
	Neither	22	36.7
Burners are staggered	0	58	96.7
	2	2	3.3
Cooktop is electric	0	21	35
	1	39	65
Total Cooktop Score	0	1	1.7
	1	20	33.3
	3	21	35
	4	17	28.3
	6	1	1.7

Appendix E - 14
Supportive Kitchen Features - Results for Individual Items – Counters and Countertops

Item Description	Possible Score	Frequency	Percent
There is an opening under the countertop to allow one to work while seated	0	52	86.7
	2	8	13.3
There are heat resistant surfaces on both sides of the cooktop	0	26	43.3
	2	34	56.7
Total number of countertop features	0	10	16.7
	1	37	61.7
	2	13	21.7
Total Counters and Countertops Score	0	10	16.7
	1	14	23.3
	2	1	1.7
	3	19	31.7
	4	9	15
	5	4	6.7
	6	3	5

Appendix E - 15
Supportive Kitchen Features - Results for Individual Items - Oven

Item Description	Possible Score	Frequency	Percent
Oven installation location	0	50	83.3
	1	10	16.7
Landing zone near oven	1	4	6.7
	2	56	93.3
Oven hinges on the side	0	59	98.3
	2	1	1.7
Total Oven Score	1	4	6.7
	2	45	75
	3	10	16.7
	4	1	1.7

APPENDIX F: Data Collected Using The Supportive Bathroom Features Checklist

Appendix F - 1

Supportive Bathroom Features – Results for Individual Items - Floors

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Flooring material	Carpet	4	6.7	1	1.7	0	0
	Carpet & sheet vinyl	1	1.7	1	1.7	0	0
	Ceramic tile	46	76.7	45	75.0	5	55.6
	Ceramic tile & polished stone	1	1.7	0	0	0	0
	Sheet vinyl	7	11.7	10	16.7	0	0
	Wood	1	1.7	3	5.0	4	44.4
Flooring material is resilient	0	52	86.7	49	81.7	9	100
	2	8	13.3	11	18.3	0	0
Floors are smooth and regular	3	60	100	60	100	9	100
Floors have a matte finish	0	2	3.3	1	1.7	0	0
	3	58	96.7	59	98.3	9	100
Floor color contrasts with wall color	0	10	16.7	10	16.7	0	0
	1	50	83.3	50	83.3	9	100
Floor color contrasts with color of bathroom fixtures	0	9	15.0	13	21.7	0	0
	1	51	85.0	47	78.3	9	100
Total Floor Score	4	0	0	1	1.7	0	0
	5	2	3.3	0	0	0	0
	6	5	8.3	5	8.3	0	0
	7	6	10.0	6	10.0	0	0
	8	40	66.7	39	65.0	9	100
	9	1	1.7	2	3.3	0	0
	10	6	10.0	7	11.7	0	0

Appendix F - 2
Supportive Bathroom Features – Results for Individual Items - Clear Space

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Minimum clear space in front of toilet	0	27	45.0	30	50.0	8	88.9
	2	33	55.0	30	50.0	1	11.1
Minimum clear space in front of lavatory	0	3	5.0	19	31.7	8	88.9
	2	57	95.0	41	68.3	1	11.1
Clear turning radius	0	20	33.3	56	93.3	9	100
	2	40	66.7	4	6.7	0	0
Total Clear Space Score	0	3	5.0	18	30.0	8	88.9
	2	6	10.0	12	20.0	0	0
	4	29	48.3	27	45.0	1	11.1
	6	22	36.7	3	5.0	0	0

Appendix F - 3
Supportive Bathroom Features – Results for Individual Items- Electrical Controls

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Light switches within Universal Reach Range	0	5	8.3	5	8.3	2	22.2
	3	55	91.7	55	91.7	7	77.8
Electrical outlets within Universal Reach Range	3	60	100	60	100	9	100
Total number of heat lamp features	0	55	91.7	53	88.3	NA	NA
	1	4	6.7	6	10.0		
	2	1	1.7	1	1.7		
Outlet for a nightlight between bedroom and bathroom	0	11	18.3	20	33.3	NA	NA
	1	49	81.7	40	66.7		
Outlet adjacent to sink / mirror	0	2	3.3	0	0	1	11.1
	1	58	96.7	60	100.0	8	88.9
Emergency call system	0	58	96.7	58	96.7	9	100
	1	2	3.3	2	3.3	0	0
Total Electrical Controls Score	3	0	0	0	0	1	11.1
	4	0	0	2	3.3	1	11.1
	5	5	8.3	3	5.0	0	0
	7	11	18.3	16	26.7	7	77.8
	8	39	65.0	33	55.0	0	0
	9	4	6.7	5	8.3	NA	NA
	10	1	1.7	0	0		
	11	0	0	1	1.7		

Appendix F - 4
Supportive Bathroom Features – Results for Individual Items - Medicine and Mirror

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Total number of bathroom mirror features	0	0	0	0	0	8	88.9
	1	6	10.0	5	8.3	0	0
	2	54	90.0	55	91.7	0	0
	Missing	0	0	0	0	1	11.1
Total number of medicine cabinet features	0	10	16.7	17	28.3	0	0
	1	45	75.0	38	63.3	0	0
	No medicine cabinet	5	8.3	5	8.3	9	100
Total Medicine Cabinet & Mirror Score	1	3	5.0	3	5.0	0	0
	2	10	16.7	21	35.0	0	0
	3	42	70.0	36	60.0	0	0
	No medicine cabinet	5	8.3	5	8.3	9	100

Appendix F - 5

Supportive Bathroom Features – Results for Individual Items - Toilet

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Toilet seat is 17”-19” high	0	55	91.7	56	93.3	8	88.9
	2	5	8.3	4	6.7	1	11.1
Long oval toilet seat shape	0	4	6.7	5	8.3	0	0
	2	56	93.3	55	91.7	9	100
Side wall in toilet space	0	3	5.0	47	78.3	1	11.1
	3	57	95.0	13	21.7	8	88.9
Toilet space is 32” or wider	0	6	10.0	7	11.7	2	22.2
	2	54	90.0	53	88.3	7	77.8
Total number of toilet tissue holder features	0	3	5.0	5	8.3	0	0
	1	25	41.7	49	81.7	2	22.2
	2	31	51.7	3	5.0	6	66.7
	Missing	1	1.7	3	5.0	1	11.1
Toilet has a grab bar	0	59	98.3	59	98.3	8	88.9
	2	0	0	0	0	0	0
	Missing	1	1.7	1	1.7	1	11.1
Grab bar has residential appearance	No bar	60	100	59	98.3	8	88.9
	Missing	0	0	1	1.7	1	11.1
Total Toilet Score	3	0	0	7	11.7	0	0
	4	0	0	4	6.7	0	0
	5	3	5.0	31	51.7	0	0
	6	5	8.3	3	5.0	1	11.1
	7	6	10.0	4	6.7	0	0
	8	16	26.7	5	8.3	1	11.1
	9	24	40.0	3	5.0	6	66.7
	10	1	1.7	0	0	0	0
	11	3	5.0	0	0	0	0
	Missing	1	1.7	1	1.7	1	11.1

Appendix F - 6
Supportive Bathroom Features – Results for Individual Items - Lighting

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Types of lighting	Incandescent	60	100	60	100	9	100
	Fluorescent	1	1.7	3	5.0	0	0
	Halogen	0	0	0	0	0	0
Lighting within 60-400 footcandle range	0	36	60	43	71.7	9	100
	3	24	40	17	28.3	0	0
Light fixtures have shades / diffusers	0	21	35	29	48.3	2	22.2
	1	39	65	31	51.7	7	77.8
Exposed bulbs are frosted	0	35	58.3	39	65.0	7	77.8
	1	25	41.7	21	35.0	2	22.2
Locations of task lighting	1	60	100	60	100	9	100
Light fixture next to / above the mirror	0	2	3.3	0	0	0	0
	2	58	96.7	60	100	9	100
Light fixture in the center of the room	0	40	66.7	36	60.0	8	88.9
	2	20	33.3	24	40.0	1	11.1
Light fixture over shower / bathtub enclosure	0	11	18.3	47	78.3	NA	NA
	2	49	81.9	13	21.7		
Total Bathroom Lighting Score	3	1	1.7	14	23.3	2	22.2
	4	1	1.7	3	5.0	4	44.4
	5	12	20	11	18.3	2	3.3
	6	8	13.3	10	16.7	1	1.7
	7	10	16.7	6	10.0	0	0
	8	9	15.0	8	13.3	0	0
	9	8	13.3	2	3.3	0	0
	10	4	6.7	4	6.7	0	0
	11	3	5.0	0	0	0	0
	12	4	6.7	2	3.3	0	0

Appendix F - 7

Supportive Bathroom Features – Results for Individual Items - Cabinetry and Storage

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Total number of under counter storage features	0	33	55.0	45	75.0	2	22.2
	1	25	41.7	14	23.3	0	0
	2	2	3.3	1	1.7	0	0
	Pedestal sink	0	0	0	0	7	77.8
Total number of bathroom storage feature locations	0	0	0	0	0	7	77.8
	1	8	13.3	16	26.7	2	22.2
	2	33	55.0	32	53.3	0	0
	3	17	28.3	12	20.0	0	0
	4	2	3.3	0	0	0	0
Two towel bars for each full bath	0	19	31.7	37	61.7	NA	NA
	2	40	66.7	22	36.7		
	Missing	1	1.7	1	1.7		
Towel bar located near bathtub / shower	0	19	31.7	15	25.0	NA	NA
	2	40	66.7	44	73.3		
	Missing	1	1.7	1	1.7		
Towel bar located near lavatory	0	19	31.7	30	50.0	2	22.2
	1	40	66.7	29	48.3	6	66.7
	Missing	1	1.7	1	1.7	1	11.1
Total Bathroom Cabinetry and Storage Score	0	0	0	0	0	1	11.1
	1	0	0	1	1.7	6	66.7
	2	4	6.7	4	6.7	1	11.1
	3	5	8.3	8	13.3	0	0
	4	5	8.3	14	23.3	0	0
	5	10	16.7	8	13.3	0	0
	6	5	8.3	12	20.0	0	0
	7	12	20.0	8	13.3	0	0
	8	11	18.3	2	3.3	0	0
	9	6	10.0	2	3.3	0	0
	10	1	1.7	0	0	NA	NA
	Missing	1	1.7	1	1.7	1	11.1

Appendix F - 8

Supportive Bathroom Features – Results for Individual Items - Doors and Doorways

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Clear width is 32” or greater	0	45	75.0	54	90.0	9	100
	3	15	25.0	6	10.0	0	0
Doors have lever handles	0	9	15.0	10	16.7	0	0
	3	38	63.3	37	61.7	8	88.9
	Door removed	13	21.7	12	20.0	1	11.1
Bathroom door swings out	0	22	36.7	47	78.3	6	66.7
	2	21	35.0	0	0	2	22.2
	Folding door	1	1.7	0	0	0	0
	Pocket door	3	5.0	1	1.7	0	0
	Door removed	13	21.7	12	20.0	1	11.1
Doors are unlockable from both sides	0	2	3.3	1	1.7	0	0
	2	42	70.0	47	78.3	8	88.9
	Missing	16	26.7	12	20.0	1	11.1
Door lock is easily manipulated	0	32	53.3	37	61.7	6	66.7
	1	12	20.0	11	18.3	2	22.2
	Missing	16	26.7	12	20.0	1	11.1
Total Doors and Doorways Score	2	3	5.0	8	13.3	0	0
	3	2	3.3	2	3.3	0	0
	4	0	0	1	1.7	0	0
	5	8	13.3	26	43.3	4	44.4
	6	2	3.3	7	11.7	2	22.4
	7	14	23.3	0	0	2	22.2
	8	5	8.3	2	3.3	0	0
	9	4	6.7	1	1.7	0	0
	10	5	8.3	0	0	0	0
	Missing	16	26.7	13	21.7	1	11.1

Appendix F - 9
Supportive Bathroom Features – Results for Individual Items - Sink and Lavatory

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Total number of seating features	0	41	68.3	58	96.7	9	100
	1	15	25.0	2	3.3	0	0
	2	4	6.7	0	0	0	0
Adequate sink center line clearance	0	10	16.7	4	6.7	2	22.2
	1	50	83.3	56	93.3	7	77.8
Total number of faucet and water diverter control features	0	0	0	0	0	0	0
	1	42	70.0	36	60.0	9	100
	2	18	30.0	24	40.0	0	0
Total Sink and Lavatory Score	0	0	0	0	0	0	0
	1	5	8.3	1	1.7	2	22.2
	2	24	40.0	37	61.7	7	77.8
	3	27	45.0	21	35.0	0	0
	4	3	5.0	1	1.7	0	0
	5	1	1.7	0	0	0	0

Appendix F - 10
Supportive Bathroom Features – Results for Individual Items - Thresholds

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Thresholds are smooth	0	52	86.7	39	65.0	2	22.2
	3	8	13.3	21	35.0	7	77.8
Thresholds are accessible	0	14	23.3	29	48.3	7	77.8
	1	46	76.7	31	51.7	2	22.2
Total Thresholds Score	0	6	10.0	8	13.3	0	0
	1	46	76.7	31	51.7	2	22.2
	3	8	13.3	21	35.0	7	77.8

Appendix F - 11

Supportive Bathroom Features – Results for Individual Items - Bathtub

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Bathtub present	Yes	44	73	50	83		
	No	16	27	10	17	NA	
Total tub bottom features	1	3	5.0	4	6.7		
	2	41	68.3	46	76.7	NA	
	No bathtub	16	26.7	10	16.7		
No steps at tub	0	1	1.7	2	3.3		
	3	43	71.7	48	80.0	NA	
	No bathtub	16	26.7	10	16.7		
No tub enclosure	0	3	5.0	3	5.0		
	2	41	68.3	47	78.3	NA	
	No bathtub	16	26.7	10	16.7		
Off-set water temperature and velocity controls	0	9	15.0	47	78.3		
	1	35	58.3	3	5.0	NA	
	No bathtub	16	26.7	10	16.7		
Shower head	0	38	63.3	2	3.3		
	1	6	10.0	48	80.0	NA	
	No bathtub	16	26.7	10	16.7		
Hand-held shower	0	42	70.0	48	80.0		
	1	2	3.3	2	3.3	NA	
	No bathtub	16	26.7	10	16.7		
Total bathtub storage features	0			1	1.7		
	1	1	1.7	14	23.3		
	2	26	43.3	28	46.7	NA	
	3	17	28.3	7	11.7		
	No bathtub	16	26.7	10	16.7		

Tub has grab bar	**0**	**38**	**63.3**	**38**	**63.3**	
	3	5	8.3	12	20.0	
	No bathtub	16	26.7	10	16.7	**NA**
	Missing	1	1.7	0	0	
Grab bar has non-stigmatizing appearance	0	3	5.0	7	11.7	
	2	2	3.3	8	13.3	
	No grab bar	38	63.3	35	58.3	
	No bathtub	16	26.7	10	16.7	NA
	Missing	1	1.7	0	0	
Total number of faucet and water diverter control features	1	2	3.3	38	63.3	
	2	48	80.0	6	10.0	NA
	No bathtub	16	26.7	10	16.7	
Clear space in front of tub	0	0	6.7	33	55.0	
	2	40	66.7	17	28.3	NA
	No bathtub	16	26.7	10	16.7	

Appendix F - 12

Supportive Bathroom Features – Results for Individual Items – Separate Shower

Item Description	Possible Score	Master Bath		Second Bath		Half Bath	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Separate shower present	Yes	53	88.3	10	16.7	NA	
	No	7	11.7	50	83.3		
No curb at shower	0	50	83.3	10	16.7	NA	
	2	3	5.0	0	0		
	No shower	7	11.7	50	83.3		
Non-slip shower floor	0	4	6.7	3	5.0	NA	
	3	49	81.7	7	11.7		
	No shower	7	11.7	50	83.3		
Adequate interior shower dimensions	0	29	48.3	5	8.3	NA	
	2	24	40.0	5	8.3		
	No shower	7	11.7	50	83.3		
Shower has seat / bench	0	19	31.7	1	1.7	NA	
	2	34	56.7	9	15.0		
	No shower	7	11.7	50	83.3		
Shower does not have a door	0	49	81.7	9	15.0	NA	
	2	4	6.7	1	1.7		
	No shower	7	11.7	50	83.3		
Shower door swings into bathroom	0	5	8.3	3	5.0	NA	
	2	45	75.0	6	10.0		
	No door	3	5.0	1	1.7		
	No shower	7	11.7	50	83.3		
Total shower seat / bench features	0	24	40.0	2	3.3	NA	
	1	12	20.0	0	0		
	2	9	15.0	6	10.0		
	3	8	13.3	2	3.3		
	No shower	7	11.7	50	83.3		

Total number of faucet and water diverter control features	0	1	1.7	0	0	NA
	1	3	5.0	0	0	
	2	49	81.7	10	16.7	
	No shower	7	11.7	50	83.3	
Shower has a grab bar	0	40	66.7	7	11.7	NA
	3	12	20.0	3	5.0	
	No shower	7	11.7	50	83.3	
	Missing	1	1.7	0	0	
Grab bar has non-stigmatizing appearance	0	7	11.7	3	5.0	NA
	2	5	8.3	0	0	
	No grab bar	40	66.7	7	11.7	
	No shower	7	11.7	50	83.3	
	Missing	1	1.7	0	0	
Total shower storage features	0	6	10.0	0	0	NA
	1	17	28.3	2	3.3	
	2	16	26.7	4	6.7	
	3	14	23.3	4	6.7	
	No shower	7	11.7	50	83.3	
Hand-held shower	0	53	88.3	3	5.0	NA
	1	0	0	7	11.7	
	No shower	7	11.7	50	83.3	
Clear space in front of shower	0	4	6.7	3	5.0	NA
	2	49	81.7	7	11.7	
	No shower	7	11.7	50	83.3	

Vita

Glenda Marie Gilmore, daughter of John Lloyd Gilmore and Dorothy Dalferes Gilmore, was born in Panama City, Panama and lived in numerous locations in the United States and abroad during her childhood. In 1970 she received a Bachelor of Science degree in Nursing from the Louisiana State University Medical Center in New Orleans and was licensed to practice as a Registered Nurse. She subsequently received a Master of Science in Nursing degree, with a major in Pediatric Nursing and a minor in Nursing Administration and Supervision from the medical center at the University of Alabama in Birmingham. She has practiced nursing as a pediatric Staff Registered Nurse, A Pediatric Unit Supervisor, the Director of Inservice Education in a children's hospital, and taught pediatric nursing in a baccalaureate nursing program in a private college.

In 1986 she began her interior design career as a decorator, and after receiving a Bachelor of Science degree in Housing and Interior Design, as an interior designer in residential interior design firms. In 2000 she received a Master of Science degree in Housing, Interior Design and Resource Management from Virginia Tech.

While in graduate school, the author worked as a Graduate Assistant as Editorial Associate for *Housing and Society*, the official journal of the American Association of Housing Educators and as a Research Assistant for the research project Best Practices in Management and Design of Assisted Living Communities. She was the recipient of the Savannah Day Scholarship in Housing for two years and was inducted into the Kappa Omicron Nu and the Phi Upsilon Omicron honor societies. She was a delegate from the departmental Graduate Student Association to the Graduate Student Assembly and later the Graduate Student Assembly representative to the Task Force on Graduate Housing. She subsequently served as President of the departmental Graduate Student Association. She was a member of the Graduate Honor Court for four years.

Glenda has been married to Dr. Abe Andes since 1972 and they are the parents of two daughters, Cecily and Melanie.