LIGHTING: PARTNER IN QUALITY CARE ENVIRONMENTS

As people age they become more dependent on their environment to compensate for increasing frailty and sensory loss. In spite of the fact that vision loss is one of the most common and potentially disabling conditions of late life and one that can have serious effects on the quality of later life, vision problems tend to be overlooked in older adults and under-treated. Among the public and even within professional communities there is a tendency to accept vision loss as a "normal" part of the aging process. This inappropriate acceptance, however, leads to passivity in seeking basic eye care and too often, needless functional disability (Horowitz and Stuen,1996).

Keywords: visual impairment, falls, hip fractures, light quality, daylight, bright light, sleep, quality of life

Visual impairment defined as vision loss that cannot be corrected by glasses or contact lenses alone, increases with age and this can mean unnecessary loss of independence and diminished quality of life for far too many older adults. The increased prevalence of vision loss prompted the U.S. National Institutes of Health to include low vision rehabilitation in its Healthy People 2010 program (National Institutes of Health, 2000).

Dimming eyesight and sensory impairments increase vulnerability and limit the quality of life of all vision-impaired individuals. Approximately 1.8 million non-institutionalized elderly report some difficulty with basic activities such as bathing, dressing, and walking around the house due to vision impairment; and of persons identified as either moderately or severely visually impaired, one-half feel their vision problems interfere to some degree with their participation in activities of daily living, as well as their social and leisure activities (Lighthouse National Survey on Vision Loss, 1994). In other words vision impairment limits what they want to do in their daily lives – the things that provide their emotional and social well-being.

As the risk of falls and fractures increases, so does the likelihood that an older person will be admitted to a hospital or nursing home or die prematurely (Desai, Pratt, Lentzner, and Robinson, 2001); (Tinetti, Inouye, Gill, and Doucette, 1995). It is not difficult, therefore, to understand how isolation, depression and poorer social relationships often accompany sight and hearing loss (Keller, Morton, Thomas, and Potter, 1999); (Rovner and Ganguli, 1998).

Typical nursing home lighting is inadequate to meet residents' lighting needs. Normal age-related changes to the eye decrease the amount of light reaching the retina, affecting both vision and circadian rhythm. Bringing daylight into the building is essential. Too few building designs for seniors today result in lighting that meets the special vision needs of older adults.

Nursing home residents compared to age-matched community-dwelling adults have far greater visual impairment. They are, however, excluded from federally funded programs such as the Aid to the Independent Elderly Blind (Deremeik, Broman, Friedman, West, Massof, Park, Brandon-Roche, Frick, and Munox, 2007). In addition, nursing home residents also receive far less bright light exposure critical for the synchronization of their circadian rhythm which affects sleep and depression, and is also essential for stimulating the Vitamin D synthesis necessary to maintain healthy bones. As a result nursing home residents experience more falls, hip fractures (Nieves and Lindsay, 1994) and sleep problems than persons of the same age living in the community (Ancoli-Israel and Kripke, 1989).

Insufficient light has been associated with greater dependency on nursing home staff in performing activities of daily living (ADL's) including being able to feed oneself (Deremeik, Broman, Friedman, West, Massof, Park, Brandon-Roche, Frick, and Munox, 2007). Because nursing homes are often understaffed and staff are overworked, improving the lighted environment would very likely increase resident independence. As independence increases, residents' dependence on staff decreases.

It is clear that the physical environment of most nursing homes does not meet the needs of the people they are built to serve. The goal for all new construction and for the renovation of existing nursing homes must be to move beyond simply providing shelter and include providing lighting to meet both the visual and the photobiological (non-visual) needs of older people. Good lighting should be thought of as *the silent partner in caregiving* (Noell, 1995).

Daylight not only provides higher light levels during the day, it also contains the spectrum to which the circadian clock is most sensitive. Getting residents outside for exposure to sunlight can provide the necessary direct bright light exposure. Accessible gardens and outdoor areas and regularly scheduled outdoor group activities in well-designed garden areas encourage seniors to spend time outdoors and provide the additional and priceless benefit of connecting to nature that older people treasure.

To be successful both the interior and the outside environments must provide quality lighting and environmental conditions for aging eyes. These conditions are defined as (1) sufficient light to compensate for the decrease in light reaching the retina, (2) the avoidance of direct and reflected glare, and (3) providing uniform light levels.

More than ever before the physical conditions of many people living in nursing homes today make it clear why exercise, diet and life-style changes are so necessary. This

should strengthen our resolve and provide the incentives to get healthy and continue to remain as healthy as possible.

Accidents happen. Anyone can find themselves recuperating in a nursing home or face the grueling but necessary decision of moving a relative or friend to a nursing home. It is important that the criteria for selecting a nursing home include the issues that directly impact the health and quality of life of the nursing home resident. Lighting tops the list of environmental features affecting both the health and the quality of life of a nursing home resident.

Most of us experience normal changes in vision as we age, such as the need for more light or time to adjust to changing light levels. The decline in both visual acuity and visual performance is a fact of life for older adults. Normal changes in the visual system are often compounded by age-related eye diseases, which further affect their remaining visual abilities. Of persons 70 years and older, ninety-two percent wear glasses and 18 percent also use a magnifying glass for reading (Desai, Pratt, Lentzner, and Robinson, 2001).

When the pupils of aging eyes become smaller it results in less light entering the eye making it more difficult to adjust to changes in brightness. The lens thickens, becomes less flexible and more opaque, turning a yellowish-amber in color. For a sixty-five year old the combined effect of these changes reduces the amount of light that enters the eye by two-thirds (Noell,1992). The majority of older persons, including those with dementia, can be expected to have visual impairment. With increased sensitivity to glare and diminished sensitivity to contrast, these insidious changes can be overwhelming and difficult for an older person to adjust to.

Very often people deny their sight is diminished so it is important to be alert for signals that might indicate a problem. National surveys estimate, however, that as many as 48 percent of all nursing home residents have at least partial vision impairment (Horowitz, Balistreri, Stuen, and Fangmeier, 1993).

Nursing home staff today is also older and faced with the same issue of declining vision. Poor or insufficient lighting significantly impacts their visual abilities in delivering care and performing important tasks such as accurately dispensing prescription drugs. The challenge is adjusting the environment to help compensate for the vision changes.

Good lighting is key to creating successful living environments and is essential to insure safety, as well as health and quality of life for nursing home residents. Higher quality and quantities of appropriate lighting can help minimize the effects of normal aging vision and maximize the abilities of older adults. Because lighting is also an important marketing aspect, it can be a compelling reason to more quickly implement the necessary changes that insure appropriate lighting.

AGE-RELATED EYE DISEASES

Vision impairment is not a normal part of aging, but if it occurs due to age-related conditions, injury or health problems, it directly affects quality of life. Over time the ability to adapt to less than optimum conditions is greatly diminished for most aging adults**,** reducing independence, mobility and the enjoyment of seeing. The recommended lighting intervention for vision impairment and the most common age-related eye diseases is to provide high light levels, control or preferably eliminate glare and provide strong contrast to support vision. As the older population increases, the number of older adults with vision impairment resulting primarily from age-related eye diseases such as cataracts, macular degeneration, diabetes or glaucoma is expected to increase significantly.

Cataracts are the most common cause of vision problems in adults 55 and older; the cause is unknown. According to the National Eye Institute, over half of all Americans aged 65 and older have cataracts, which are more common in women than men. Cataracts cause a clouding of the lens of the eye that reduces visual acuity and produces an overall haze or blur, increasing sensitivity to glare **(**Faye, and Stappenbeck, 2000). This also results in difficulty reading small print for persons with cataracts.

A cataract is not a film on the outside of the eye, as some people think, but a clouding inside the eye's lens. The most common risk factor is aging; other contributing causes including long-term exposure to sunlight, smoking (which triples the risk), high blood pressure, high cholesterol, diabetes, obesity, a diet poor in fruits and vegetables, and eye injury (Rosenfeld, 2002); (Faye, and Stappenbeck, 2000).

Glaucoma is the second leading cause of vision loss in the elderly. Because the disease causes little pain, it is often not diagnosed in the early stages. Glaucoma is usually caused by increased intraocular fluid pressure, causing irreversible pressure damage to the optic nerve in the back of the eye, resulting in peripheral vision loss. If the condition is detected early, elevated eye pressure can be treated with eye drops, pills, laser or surgery (Faye, and Stappenbeck, 2000). Vision loss resulting from glaucoma is irreversible, and it is estimated that 12% of blindness in the US is caused by glaucoma.

Age-related macular degeneration (AMD) is the leading cause of irreversible visual impairment in the elderly. More common than glaucoma, macular degeneration affects roughly one quarter of person 70 years of age and older or approximately 3.6 million persons in this country (Desai, Pratt, Lentzner, and Robinson, 2001); (National Advisory Eye Council, 1993). Macular degeneration is the deterioration of the macula (the central part of the retina responsible for detail vision). Central vision becomes blurred and distorted, resulting in lost detail vision making it difficult to distinguish facial features and read. There is an increased need for light (without glare) and color vision is reduced (Faye, and Stappenbeck, 2000). Currently there is no proven treatment that slows or prevents the development of advanced macular degeneration.

Lighting is one of the most important design elements that will continue to support the abilities of older adults to perform the normal activities of their daily life, particularly individuals who are experiencing cognitive difficulties and diminished physical dexterity (Brawley, 1997). Well-designed lighting can decrease the level of disability associated with these impairments and contribute to maintaining an active, independent and fulfilling lifestyle - greatly improving quality of life.

For older adults living in typical long-term care settings, the lighting usually consists of a mixture of lighting fixtures that aggravate aging eyes rather than meeting the needs for higher light levels and glare free light (see Strategies for Effective Lighting). It takes careful design planning to design and execute healthy environments that will help maximize remaining abilities and preserve the health and wellness of older persons. Unless you are a lighting designer with a background in gerontology – you will need help.

LIGHT FOR VISION

While good lighting is essential in any healthcare setting, it is particularly important for nursing homes and those settings serving older residents. Every time we design or redesign housing for older adults we make decisions that impact the health, safety and welfare of hundreds of thousands of older individuals. Lighting is often not considered an integral element for achieving the goal of a healthy environment. However*, lighting can and will make a greater difference in the success of a healthcare setting than any other single feature except the healthcare itself* (Brawley, 2006).

Nursing homes in the United States serve very old people with an average resident age of 85 years. It is commonly accepted that most people in this age group experience age-related visual impairment. The message of a caring community and home environment where support and special care are normalized throughout should be conveyed beginning in the entrance/lobby of a nursing home. Unfortunately, too often when one moves beyond the lobby, the vibrant daylight and lighting systems that created the inviting, pleasant and visually comfortable environment of the lobby reverts back to the same old institutional, glare producing ceiling fixtures. This strategy is a poor substitute for good lighting or communicating the message of a caring community.

The aging eyes of a 60 year old person require up to three times more light for tasks than they did as a healthy 20 year old, and by the time they reach age 85 they may require as much as five times more light. Glare also becomes a particularly debilitating factor. Solving the problems effectively requires providing the necessary light for older eyes to see, by (1) raising light levels substantially, (2) balancing natural light and electric light to achieve even light levels and (3) eliminating glare.

ANSI/IESNA RP-28-2007:
Lighting and the Visual Environment for Senior Living

The–IESNA RP-28-98: *Lighting and the Visual Environment for Senior Living* was first developed in 1998 by the Lighting for Aging and Partially Sighted Committee of the IESNA - the Illuminating Engineering Society of North America. IESNA is the recognized authority to set light levels in the United States, Canada and Mexico. The document was adopted in 2001 by the American National Standards Institute (ANSI) making it a national building standard for buildings for older adults. The name was changed to ANSI/IESNA RP-28-2001 and it is included in the American Institute of Architects *Guidelines for Design and Construction of Healthcare Facilities 2006.* The recently updated ANSI/IESNA RP-28-2007 edition is ANSI approved. It has gained broad acceptance and is now the recommended lighting design practice for older adults.

Two studies have recently measured lighting levels in a total of 81 nursing homes across the United States and compared their findings to the recommended minimum lighting requirements found in Table 1 of ANSI/IESNA (Recommended Practice) RP-28-2001 *Lighting and the Visual Environment for Senior Living,* (ANSI/IESNA 2001) included in this report. One survey of 53 nursing homes in four states found that the facilities were often dimly lit. Illumination levels for ambient (general light) and task light (higher light levels required for reading, grooming or identifying food while dining) were compared to the minimum requirement found in the Recommended Practice-28, Table 1 (IESNA, 1998) included in this report. The illumination was rated as inadequate or barely adequate in 45 percent of hallways, 17 percent of activity areas and 51 percent of the resident rooms (Sloane, Mitchell, Calkins and Zimmerman, 2000).

The second study measured ambient (general) light levels in nursing home resident rooms. Their findings showed 15FC (footcandles) to 20FC as compared to the recommended minimum of 30FC (ANSI/IESNA, 2001). The ambient (general) lighting in these facilities ranged from 50% to 65% *lower* than the recommended minimum light levels (ANSI/IESNA, 2001). Since no additional task lighting was provided in the rooms, residents were forced to rely on low ambient light for near tasks such as reading a menu or an activity calendar. When the light levels in the rooms were compared to the minimum recommended light levels for task lighting (50 FC to 75FC), nursing homes provided only 20% - 40% of the recommended minimum light (Deremeik, Broman, Friedman, West, Massof, Park, Brandon-Roche, Frick, and Munox, 2007).

The lighting conditions reported in these studies are particularly troubling since nursing home residents experience 13 to 15 times greater visual impairment than people of the same age living in the community (Tielsch, Javitt, Coleman, Katz, and Sommer, 1995).

TABLE 1: Minimum Illuminance (Light Levels)

Measured in Footcandles*

AREAS	Ambient Light	Task Light
Exterior Entrance (Night)	10	
Interior Entry (Day)	100**	
Interior Entry (Night)	10	
Exit Stairway & Landings	30	
Elevator Interiors	30	
Parking Garage		
Exterior Walkways		
Administration (Active)	30	50
Activity Areas (Day only)	30	50
Visitor Waiting (Day)	30	
Visitor Waiting (Night)	10	
Resident Room		
Entrance	30	
Living Room	30	75
Bedroom	30	75
Wardrobe/Closet	30	
Bathroom	30	
Make-up/Shaving Area	30	60
Shower/Bathing Rooms	30	
Kitchen area	30	50
Barber/Beautician (Day)	50	
Chapel or Quiet Area (Active)	30	
Hallways (Active Hrs)	30	
Hallways (Sleeping Hrs)	10	
Dining (Active Hrs)	50	
Medicine Prep	30	100
Nurses Station (Day)	30	50
Nurses Station (Night)	10	50
Physical Therapy Area (Active Hrs)	30	50
Occupational Therapy (Active Hrs)	30	50
Examination Room (Dedicated)	30	100
Janitors Closet	30	
Laundry (Active Hrs)	30	50
Clean/Soiled Utility	30	
Commercial Kitchen	50	100
Food Storage (Non-Refrig.)	30	
Staff Toilet Area	20	

*Values are presented in footcandles (fc). Conversion to lux (1fc= 10.76 lux)

** Utilization of daylight is encouraged in entryways to provide a transition between outside and interior illumination levels.

Note: Ambient light levels are minimum averages measured at 30" above the floor in a horizontal plane. Task light levels are absolute minimums taken on the visual task. For make-up/shaving the measurement is to be taken on the face in a vertical position. It should be understood that the values listed are minimums. The optimum solution for task lighting is to give the user control over the intensity and positioning of the light source to meet their individual needs.

It is important to understand the expectations of how particular spaces will be used – the available natural light, the transitions of light within the space, how color and finishes interact with light, and the physical constraints or opportunities the space offers. While it's important to choose light sources based on efficiency, it's even more important to choose based on the needs of the individuals and the tasks being illuminated. This is where lighting design comes into play. Without the benefit of an experienced lighting practitioner, another well-meaning individual may create more problems than are solved.

On the other hand, a good lighting design can minimize or cure problems related to glare, flicker, inappropriate light levels, and lack of lighting flexibility. Healthcare communities, residents and staff alike, can derive immeasurable benefit when certified lighting designers who also understand the vision needs of older adults are part of the design process. They can insure that lighting meets vision needs and is integrated with other systems to function in the most effective and cost efficient ways.

Raise Levels of Illumination: Insufficient Light is a Common Deficient Practice although not Cited as Such

Aging eyes need more light. Insufficient lighting is one of the most obvious problems based on the two studies previously cited. Lighting should be one of the deficiencies most frequently cited by surveyors when assessing healthcare settings. This is a specific area where training would benefit surveyors. Light levels must be increased to counteract the loss of visual acuity that occurs throughout the aging process. While older adults are constantly encouraged to remain mobile and as active as possible, when there is insufficient light older individuals give up on independent activity – even walking. It's simply too risky (Brawley, 2006). This is counter to the requirements of the Centers for Medicaid and Medicare Services that facilities help each resident maintain or enhance their highest practicable level of physical, mental and psychosocial well-being.

Eliminate Glare

Glare occurs when bright light sources interfere with the viewing of objects or surfaces that are less bright. Aging eyes are more sensitive to glare and for many older adults it can be quite painful. Glare and reflection can contribute to confusion, agitation and anger, inhibit activity and compromise safety (Brawley, 1997).

Exposed bright light sources are problematic, adding up to eyestrain, headaches and a lowered ability to accomplish tasks for both residents and staff. Most glare can be controlled either by shielding the light source from direct view or balancing the light in the room. This can be accomplished by increasing the

brightness of the surroundings with evenly distributed light on walls and ceilings, decreasing the brightness of the source, or both.

Indirect lighting is the best solution for controlling glare and contributing to visual comfort. Indirect luminaries (light fixtures) conceal bright light sources and spread diffused light over a broad area, eliminating glare caused by excessive brightness. Strategies for illuminating the walls evenly include mounting light valances approximately 18" down from the ceiling. These light valances run continuously around the perimeter of the space, providing both up-light and down-light. The up-light bounces off the ceiling and becomes diffused ambient light. The down-light washes the wall surface making the walls appear light.

Indirect ceiling lighting fixtures utilize the ceiling surface as a reflector to distribute and diffuse the light. These ceiling fixtures come in a variety of configurations including pendant indirect fixtures (both round and linear) and surface mounted direct/indirect fixtures. Architectural surface finishes must be included in the design for an indirect lighting system to be successful.

Indirect lighting systems require high light reflectance values (LRV) on the ceilings and wall surfaces and medium reflectance values on the floor. The ceiling should reflect at least 80 percent of the light. The recommended LRV for a ceiling flat white paint should be 80 or above. Upper wall finishes should be light colored finishes with an LRV of 65-85 percent. Rich finishes and other surfaces of low reflectance can be used below wainscot or handrail height, with minimum negative impact. Floor surfaces should have a light reflectance value of 30-40 to keep the floor surface color in a medium color value range. Matte surface finishes rather than highly reflective surfaces are also a good strategy to control glare. Glare from windows can be controlled either by balancing the light within the room or with automated or solar controlled shades to reduce glare and minimize accidents.

Ceiling height matters! Ceiling height and the width of the space will influence the choice of luminaries (lighting fixtures). Although codes vary, the minimum distance allowed between the floor and the base of the ceiling light fixture is typically 7'0" to 7'5". *However, light fixtures suitable for an 8' ceiling that produce the quantity and quality of light necessary to meet the required needs of older adults are quite limited and expensive.*

A better, energy efficient lighting strategy calls for 9 ft or 10 ft ceiling heights, which increases flexibility and maximizes the use of indirect fixtures. The light source of choice is fluorescent which utilizes current technology – particularly the electronic ballast. I n many applications, fluorescent lighting offers the best options for color rendering and efficiency. Indirect lighting systems, working in tandem with *electronic dimming ballasts* and daylight sensors can significantly reduce energy use and cost by dimming lights when sufficient daylight is present. Lighting controls are already a large focus for energy conservation and we will

see an even greater reliance on this technology in the future. Many nursing homes may still be using fluorescent lights with magnetic ballasts. These old magnet ballasts are not only responsible for the "flicker affect" but are not energy efficient and considered obsolete technology.

Larger spaces are likely to require several types of lighting fixtures. For example, light valances around the perimeter to wash the walls with light combine with pendant indirect lighting in the center of the space. Higher quality, indirect lighting design provides better color and more comfortable and appealing distribution of light while minimizing glare.

Fluorescent lamp technology today produces color quality very close to natural light and undisputed efficiency. Any good lighting system must be maintained properly, but because fluorescent lamps (tubes) last much longer, maintenance costs are reduced. A good lighting designer can find ways to maintain lighting quality while meeting codes and also help in securing rebates and tax deductions. Utility companies often provide financial incentives for reducing the cost of energy-efficient lighting.

Combining the right quality of light with the most efficient lighting systems is essential today since about 75 percent of the floor space in the typical healthcare setting is lighted 100 percent of the time during the day. Energy efficiency and the life of the light sources greatly impact the bottom line. We can now provide better quality lighting, with better color, that uses less energy, has a longer life, and for a cost that has actually decreased over the last twenty years in comparison to other building costs (Gotti, 2003).

Daylighting

Healthcare lighting is being designed differently today, better utilizing daylight as the primary lighting system. Successful lighting interventions for older adults require careful consideration be given to the design of both the daylighting and electric lighting systems, as well as the materials used within the visual environment. The best lighting solutions use abundant natural light - daylight, daylight, and more daylight. Many facilities are taking advantage of daylighting to meet or exceed energy codes restrictions.

Intelligent daylighting means designing building with taller ceiling and window openings to help daylight penetrate spaces more deeply. The most common systems used by architects for bringing light into a building and distributing it within the interior spaces incorporate windows, light shelves, skylights, and clerestory windows (See Figure II) to prevent glare (Brawley, 2006).

It is important to balance daylight within the space. The best way to accomplish this is to use a minimum of two sources of daylight, preferably from more than one direction. Daylight can be introduced into the building from skylights above

or through windows from the sides. Both skylights and clerestory windows, located above the field of view contribute large quantities of energy-efficient natural light and control glare. Daylight also offers a strong cue as to the time of day.

Light Controls

Natural light use can be maximized in conjunction with electric lighting through light-sensitive controls. An increasing variety of controls exist to adjust for day and night light levels or automatically shut off lighting, but getting the most from these options requires a clear understanding of their benefits and the possible pitfalls. Sensors at various locations reduce the output and power consumed by lighting equipped with dimmable ballasts. Various types of skylights and automated window treatments can control incoming natural light, minimizing the need for electric lighting. Light controls may cut or dim lighting that is not immediately needed. Occupancy sensors for turning lights on and off have improved greatly, and the increased use of wireless lighting control technology is also minimizing energy costs. A word of caution - it is also important to accommodate the learning curves of the people who will be using and maintaining the controls.

LIGHT FOR HEALTH

In addition to light for vision, the photobiological (non- vision) effects of light for entrainment of circadian rhythms and vitamin D synthesis are even more important to older people**.** As people age and their mobility decreases, so does their exposure to daylight. A move to a nursing home dramatically reduces the daylight exposure older people experienced when living at home in the community.

Once in a nursing home natural light exposure diminishes significantly in intensity, duration and spectrum (color) compared to individuals living in the community. One study of institutionalized older adults found that nursing home residents age 60 – 100 years old, received an average of only 9 minutes of bright light exposure (> 1000 lux) or 100 fc a day (Ancoli-Israel, Klauber, Jones, Kripke, Martin, Mason, Horenczyk, and Fell, 1997).

The research community is providing more information about how light and dark affects humans physiologically. Without sufficient exposure to bright light during the day and darkness at night for entrainment of the body-clock, individuals living in nursing homes experience a high degree of circadian disruption. Disturbances of these cycles often result from physiological disorders, some of which are associated with aging. Circadian disturbances are also associated with cardiovascular problems, immune dysfunction, increased mortality, cognitive and

functional deterioration, increased risk of institutionalization, and depression (Chen, Sloane, and Dalton, 2003). Sleep fragmentation is a major problem in nursing homes, (Regenstein, 1987) and one of the most observable problems. A Canadian research team noted that people who reported no sleep problems when living at home developed sleep problems after they were admitted to a nursing home (Clapin-French, 1986).

Vitamin D deficiency and hip fractures are also more common among nursing home residents than elders living in the community (Nieves, and Lindsay, 1994). Osteoporosis, the most common bone disease, is characterized by a decrease in bone mass and density. Worldwide osteoporosis afflicts an estimated one-third of women aged 60 to 70 and two-thirds of women aged 80 or older (World Osteoporosis Day, October 20, 2002). Vitamin D deficiency has been linked to an increased risk of falls among people over 65. While nursing home residents make up only 4% of the population 65 years and older, they experience 20% of all osteoporosis hip fractures. While calcium and vitamin D are essential to maintaining healthy bones throughout life, these residents do not receive adequate sunlight exposure containing ultraviolet B radiation (290-320 nm) required for vitamin D synthesis, (Webb, Pilbeam, Hanafin, and Holick, 1990) and typical interior lighting does not contain the spectrum to which the circadian system is most sensitive or the spectrum necessary to treat vitamin D deficiency.

IMPROVING QUALITY OF LIFE

Light is a potent regulator. Environmental light specifically is the primary stimulus for regulating circadian rhythms, seasonal cycles, and neuroendocrine responses in humans (Brainard, G. 2002); (Klein, Moore and Reppert, ed(s). 1991). The discoveries of independent research teams beginning in 2001 have helped the understanding of which cells of the human eye receive light and transmit impulses to synchronize circadian rhythm. We also now have a better understanding of the specific wavelengths of light (460 – 480 nm - color of the blue sky) to which these cells are most sensitive **(**Brainard, Hanifin, Greeson, Byrne, Glickman, Gerner and Rollag, 2001); (Berson, Dunn, and Takao, 2002); **(**Lockley, Brainard, and Czeisler, 2003**).** The best and most affordable source of the bright light necessary for synchronization or entrainment of the circadian system is daylight. In addition, daylight also stimulates the production of serotonin, one of the body's "feel good" chemicals. One of the most pleasant side effects of serotonin is its ability to cheer people up and feel alert. It's like a miracle drug from the sun.

Maximizing healthy circadian function is especially important in any older adult living setting. Bright light and outdoor physical activity have been shown to have restorative effects on cell and rhythm functions in humans (Von Someren, E. 2000), and this recent research validates the new and thriving emphasis on creating gardens and inviting, safe and elder friendly outside environments.

Outdoor gardens add pleasure, fresh air and a chance to connect with the natural world. Depending upon the seasons and geographical location, regularly scheduled outdoor group activities provide both the bright light for circadian rhythm and exposure to sunlight for vitamin D. A study in Japan reported that with 15 minutes per day of sunlight exposure on the face and hands during clear weather (averaging 236 days per year) the individuals in the experimental group had 84 percent fewer hip fractures than a control group (Sato, Metoki, Iwamoto, and Satoh, 2003).

Bright light and high light levels are not to be confused with glare. Older eyes are more sensitive to glare and adapt much more slowly to changes in brightness. To prevent the reflected glare produced by strong sunlight from bouncing up into residents' eyes, a medium color value should be selected for surface materials for sidewalks and patios. Concrete can easily be stained to produce a medium color value rather than the bright reflective surface of new or very light concrete. A thorough and detailed description of proper lighting and environmental considerations for older adults is found in the *ANSI/IESNA (Recommended Practice) RP-28-2007 Lighting and the Visual Environment for Senior Living.*

Figure I: Nursing home residents enjoying a family visit in the garden.

LACK OF LIGHTING REGULATIONS OR STANDARDS

As a society we expect our government - federal or state to protect the health and safety of all its citizens. With the growth of the aging population it is important to insure the needs of older adults are represented. In nursing homes and institutional settings it is important that government standards and regulations address normal age-related changes, and require appropriate environments to meet their needs.

Individuals in nursing homes are unable to make environmental modifications. They are instead, dependent upon government regulation to ensure that their needs are met. Although the Centers for Medicare and Medicaid Services does include lighting in its requirements at Tag F256 (see box below) these requirements need to be clarified and strengthened to include the quality and specific quantity of light to meet the visual needs of older people in nursing homes.

Surveyors are much younger than residents. Because of the age difference it makes it literally impossible for these regulators to see the world through the eyes of the residents and judge the "adequacy and comfort" of the lighting system for them. A light meter should be used at several points within a space to measure the light levels, or on the table or reading surface for task lighting.

The last sentence of the first paragraph reads "For some residents (e.g., those with glaucoma), lower levels of lighting would be more suitable." is incorrect (Rosenbloom, 1993).

State Operations Manual
Appendix PP - Guidance to Surveyors for
Long Term Care Facilities
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(Rev. 19, 06-01-06)

F256

483.15(h)(5)

483.15(h)(5) Adequate and comfortable lighting levels in all areas;

Interpretive Guidelines§483.15(h) (5) Adequate lighting is defined as levels of illumination suitable to tasks the resident chooses to perform or the facility staff must perform. For some residents (e.g., those with glaucoma), lower levels of lighting would be more suitable.

"Comfortable" lighting is defined as lighting which minimizes glare and provides maximum resident control, where feasible, over the intensity, location, and direction of illumination so that visually impair ed residents can maintain or enhance independent functioning.

Procedures: 483.15(h)(5)

Are there adequate and comfortable lighting levels for individual resident and staff work needs? Consider the illumination available from any source, natural or artificial. For hallways,
observe the illumination that is normally present. For resident rooms or for other spaces, where residents can control the lighting, turn on the lights and make the rating under these conditions.

Because federal government standards do not quantify nursing home lighting, there is great variability in how surveyors survey this issue.

Each state is allowed to create its own regulations, and there is great variability between states. Some state regulations are vague; others require light levels far too low to enable older people to see. A few states now have lighting regulations appropriate and consistent with the quality and quantity of light recommended in the *ANSI/IESNA (Recommended Practice) RP-28-2007 Lighting and the Visual Environment for Senior Living.*

Most state regulations, however, are too general to be useful and do not provide for the special needs associated with normal age-related changes to the eyes. Virginia, for example, requires:

> A) Artificial lighting shall be by electricity, and
> B) All areas shall be well lighted for the safety and comfort of the residents according to the nature of activities (Virginia Department of Social Services, 1996).

Without specific quantified minimum target illuminance values (light levels) to guide code officials, lighting designers, inspectors, and surveyors the desired intent of regulations such as CMS' Tag 256 is not achieved. Judgments as to "safe and comfortable" made by a younger person will not be adequate for an older adult.

Figure II: An example of lighting problems a) extremely low light levels, b) uneven lighting, and c) glare from doors at the end of the corridor.

Figure III: The diffused daylight from the clerestory windows coming into this corridor creates a pleasant visual environ - ment along with the spectrum and higher light levels for circadian rhythm .

SUMMARY AND RECOMMENDATIONS

Each time we design or redesign nursing homes and housing for older adults we make decisions that impact the health, safety and welfare of hundreds of thousands of older individuals. It has been demonstrated that nursing home residents have impaired vision, including poor eyesight and blindness, which affects a third of the residents. While some would benefit from eye surgery, many also have dementia (Tielsch, Javitt, Coleman, Katz, and Sommer, 1995). The compounding of these conditions makes improving the lighting the best and possibly the only solution.

ACTION IS NEEDED NOW

Energy is a hot topic on the national agenda with implications both good and bad. The good news is that in order to conserve energy many utility companies are offering rebates and financial assistance for new energy-efficient fixtures. Check with your local utility provider to see what programs are available to you. The bad news is that energy for electric lighting is being restricted and controlled based on the lighting needs of younger people, leaving older people "in the dark."

The Department of Energy (DOE) began restricting energy usage in 1975 with the adoption of the Energy Conservation & Production Act (Energy Policy Act 2005, DOE.gov). Subsequently, these energy restrictions have increased under the Energy Policy Act of 1992 and 2005. The DOE sets stringency levels that each state must follow and has stated the energy restrictions must meet or be greater than those found in the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc/Illuminating Engineering Society of North America (ASHRAE/IESNA) Standard 90.1. There is a provision in this document that exempts facilities that serve the visually impaired from the energy restrictions (ASHREA/IESNA Standard 90.1 2004, 2004. Exemptions: 9.3.1:G).

RECOMMENDATIONS

1. Insure federal and state agencies recognize residents living in nursing homes are visually impaired. We recommend that the Centers for Medicare and Medicaid Services acknowledge nursing home residents are visually impaired and support their special needs by petitioning the United States Surgeon General to declare individuals living in nursing homes and healthcare settings serving older adults are visually impaired and further, exempt nursing homes from the ASHRAE/IESNA 2004 energy restriction. We will otherwise be trading energy-

efficiency for an increase in falls, fractures, sleep disorders and general quality of life.

2. Build coalitions with organizations who share a common vision and purpose for improving environments for living and care, for example the American Association of Homes and Services for the Aging (AAAHSA), American Health Care Association (AHCA), American Society on Aging (ASA), the Gerontological Society of America (GSA), and the Alzheimer's Association. There is strength in numbers.

3. Insure the lighting needs of nursing home residents are met for both quality and quantity of light. It is recommended that the Centers for Medicare and Medicaid Services adopt and thereby require the lighting recommendations contained in ANSI/IESNA RP-28-2007 *Lighting and the Visual Environment for Senior Living*.

4. Increase available light during the day within nursing homes by employing greater use of skylights and daylight design principles.

5. Provide increased access to safe, healthy outdoor environments and a variety of activities to encourage residents to go outdoors. Getting residents out of doors into the healing environment of nature and sunlight will provide opportunities for healthy bright light exposure and exercise and will likely prove to be one of the least costly prescriptions for better sleep quality and reduced depression. It is certainly a powerful demonstration of the best of person-centered care that optimizes quality of life. Getting people outside will require transformational thinking and a shift in priorities as to how staff is best utilized.

6. Revise, enhance and clarify Tag F256 Lighting at 483.15(h)(5) to insure clear, accurate information. Define methods of assessment to meet minimum lighting standards.

7. Provide training for surveyors in assessing lighting in nursing homes. Surveyors should be provided light meters specifically designed for measuring interior room lighting. Nursing homes can request that local utility companies measure light levels using the methodology found in ANSI/IESNA RP-28-2007. Light levels can then be compared to the recommended light levels found on Table 1 Minimum Illuminance (ANSI/IESNA RP-28-2007).

8. ANSI/IESNA RP-28-2007 defines recommendations for light for vision for environments for seniors. Light for health is defined as the impact of natural light on the health of an individual. Increased research is needed to provide evidenced-based guidelines for recommendations for light for health for older adults, equal to the recommendations for light for vision found in ANSI/IESNA RP-28-2007.

9. Design an effective system for making research and research findings relative to improving environments and safety for older adults easily accessible and available to architects, interior designers, builders, lighting designers and engineers, acoustical designers and engineers, product designers and other practitioners. Insure the latest research is in the hands of those responsible for designing better solutions.

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TABLE 1: Minimum Illuminance
Measured in Footcandles*

AREAS	Ambient Light	Task Light
Exterior Entrance (Night)	10	
Interior Entry (Day)	100**	
Interior Entry (Night)	10	
Exit Stairway & Landings	30	
Elevator Interiors	30	
Parking Garage		
Exterior Walkways		
Administration (Active)	30	50
Activity Areas (Day only)	30	50
Visitor Waiting (Day)	30	
Visitor Waiting (Night)	10	
Resident Room		
Entrance	30	
Living Room	30	75
Bedroom	30	75
Wardrobe/Closet	30	
Bathroom	30	
Make-up/Shaving Area	30	60
Shower/Bathing Rooms	30	
Kitchen area	30	50
Barber/Beautician (Day)	50	
Chapel or Quiet Area (Active)	30	
Hallways (Active Hrs)	30	
Hallways (Sleeping Hrs)	10	
Dining (Active Hrs)	50	
Medicine Prep	30	100
Nurses Station (Day)	30	50
Nurses Station (Night)	10	50
Physical Therapy Area (Active Hrs)	30	50
Occupational Therapy (Active Hrs)	30	50

Examination Room (Dedicated)	30	100
Janitors Closet	30	
Laundry (Active Hrs)	30	50
Clean/Soiled Utility	30	
Commercial Kitchen	50	100
Food Storage (Non-Refrig.)	30	
Staff Toilet Area	20	

*Values are presented in footcandles (fc). Conversion to lux (1fc= 10.76 lux)
** Utilization of daylight is encouraged in entryways to provide a transition between outside and interior illumination levels.

Note: Ambient light levels are minimum averages measured at 30" above the floor in a horizontal plane.

Task light levels are absolute minimums taken on the visual task. For make-up/shaving the measurement is to be taken on the face in a vertical position. It should be understood that the values listed are minimums. The optimum solution for task lighting is to give the user control over the intensity and positioning of the light source to meet their individual needs.