

Dementia-Friendly Design Considerations

Alzheimer Knowledge Exchange - Design and Dementia Community of Practice

Why is Lighting Important to Older Adults?

This document has been developed by the Murray Alzheimer Research and Education Program (MAREP) in collaboration with the Alzheimer Knowledge Exchange (AKE) Design and Dementia Community of Practice and is a supplement to the 'Alzheimer Knowledge Exchange Design and Dementia Community of Practice Dementia-Friendly Design Considerations.'

The following document highlights current research and resources available related to lighting including:

- An overview of normal age related vision changes, symptoms of eye diseases related to aging, and how this affects residents living in long-term care, including persons with dementia
- A summary of current literature on lighting and persons with dementia
- A glossary of common terms related to lighting
- A list of online resources

Why Should I be Concerned About Lighting?

Overall, lighting in long-term care is well below the required level for normal age related changes (O'Keeffe, n.d.; Lepeleire, 2007). Due to a number of age related changes in vision, eye diseases associated with aging, as well as vision changes associated with dementia, adequate lighting can improve the quality of life for all residents including persons with dementia.

Normal Age Related Changes to Vision

- *Cataracts*: generally an age related opacification of the eye (cloudiness of the lens), creating a yellow-brown change in the colour of the lens.
- Pupils decrease in size (less light is received by the eye) therefore older adults need more light (to see clearly) than healthy young adults.
- Maximum melatonin levels decrease at night and the rise in melatonin occurs 60-90 minutes earlier than in young adults (Gammack, 2008, p 140).

Eye Diseases Most Common in Older Adults

- *Macular degeneration*: At the end stage of this disease, a central scotoma (black point) occurs in the central vision at the back of the eye, which in turn, leads to the individual having to use their peripheral vision abilities only. Adapting to see only using peripheral vision requires training and education. Changes in peripheral vision reduce the person's ability to read, since the majority of reading occurs in the central vision point of the eye.
- *End Stage Glaucoma*: This disease leaves only a central island of vision; individuals have a loss of peripheral vision which may create problems with mobility (i.e., loss of ability to see floors, doorways and/or walls clearly).

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Symptoms of Eye-Related Diseases

- Decrease of contrast sensitivity (reduced ability to detect changes in contrasts).
- Decrease in visual acuity (sharpness of sight, ability to see fine detail).
- Scotoma (when vision has blacked out areas-blind spots).
- Constrictions of the visual field (loss of peripheral vision).
- Colour perception changes (decreased ability to see variations in colour).
- Misperceptions of colour (identify colours inaccurately).
- Increased sensitivity to glare (reflection of light off surfaces or caused by scatter within the eye created by cataracts).
- Increased time required to adapt to changes in light (time to adapt from light to dark and vice versa). Adaptation to low levels of light from exterior to interior lighting can take from five to thirty minutes (Brawley, 2001).

Lighting Associated Changes in Individuals Living in Long-Term Care (Including Persons with Dementia)

- Individuals living in long-term care facilities or institutions are continually challenged with low levels of lighting, insufficient for their age and disease related changes. Low lighting has also been correlated with an increased risk of falls.
- Individuals in long-term care facilities or institutions are at the highest risk of inadequate vitamin D (from sun exposure) which is correlated to a reduction in bone density and increased risk of falls.
- Disrupted circadian rhythm, leads to disrupted sleep patterns that may cause individuals living in long-term care, in particular individuals with dementia, to have an increase in late night activity.

Other Related Changes in Individuals with Dementia

- Alzheimer's disease is not known to cause vision impairment, although problems with depth perception have been shown to worsen in persons with Alzheimer's. (Noell-Waggoner, 2002).
- Misperceptions and difficulty accurately interpreting the environment may be influenced by low lighting, shadows, and glare which may lead to fear and responsive behaviours.
- Responsive behaviours often expressed by individuals with dementia include: wandering, anxiety/fidgeting, combativeness, negative verbalizations, sexual expression, pilfering, etc.
- Cognitive changes affect people with dementia's ability to problem solve, interact with people around them and/or care for themselves (personal hygiene, finances, etc).
- Individuals with dementia are often malnourished due to changes in nutrition as a result of forgetting to eat, difficulties with chewing or swallowing and may lead to under consumption or individuals may hoard or overeat leading to weight gain and related health problems.

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- Depression increases in the population with an increased length of stay in an institution (Sumaya, Rienzi, Deegan, & Moss, 2001); a large portion of individuals with dementia live in institutional settings.

Summary of Literature:

Brawley, E.C. (2001). Environmental design for Alzheimer's disease: A quality of life issue. *Aging & Mental Health*, 5(Supplement 1), S79-S83.

Several areas of design and its' impact on older adults with dementia were discussed in this article, including low level lighting and vitamin D synthesis impacts on older adult falls. The author promotes exposure to high levels of daylight for the natural circadian rhythm regulation effect it has on institutionalized older adults. Along with an increase of daylight exposure, long-term care facilities must consider glare which can be debilitating. Screens, shades, sheer draperies are suggested to control glare and maintain privacy; whereas, dark window tints are avoided due to light reductions and reflections. Gardens and natural outdoor spaces offer a higher level quality of life, therapeutic benefits and calming sensory stimulation to older adults with dementia.

Dowling, G.A., Burr, R.L., Van Someren, E.J.W., Hubbard, E.M., Luxenburg, J.S., Mastick, J., & Cooper, B.A. (2008). Melatonin and bright light treatment for rest-activity disruption in institutionalized patients with Alzheimer's disease. *Journal American Geriatrics Society*, 56, 239-246.

Results indicated that when light exposure (2,500 lux for 1 hour in the morning) and melatonin treatment (5mg in the evening) were given for 10 weeks, there was a significant improvement in daytime alertness, daytime activity and day; night sleep ratio along with a reduction in daytime sleep. Light and melatonin treatment significantly increased the regulation of the circadian or rest-activity rhythm amplitude. In summary, the researchers stated that light treatment alone did not improve night-time sleep, daytime wake, or rest-activity rhythm but light treatment plus Melatonin increased daytime wake, time and activity levels and strengthened the rest-activity rhythm.

Gammack, J.K. (2008). Light therapy for Insomnia in Older Adults. *Clinics in Geriatric Medicine*, 24(1), 139-149.

The author indicates that bright light treatment (BLT) is correlated to the regulation of the circadian rhythm and reduced melatonin production; however, mixed results were found for the impact of BLT on agitation in the elderly. The author suggested that certain subgroup of individuals with dementia may benefit from the treatment but it is not appropriate for the entire population. Further study is required.

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Garce, M.L. (2004). Daylight interventions and Alzheimer's behaviours: A twelve-month study. *Journal of Architectural and Planning Research*, 21(3), 2-13.

The method used in this research controlled the amount of direct light, moving shadows, and yellow-red waves caused by afternoon light sun angles using window glazing and increasing the lumen output of lamps to maintain a constant light level within an Alzheimer's day care program. A control and experimental group were used to determine the effect that the changes in light had on challenging behaviours (see glossary). Challenging behaviours reduced by an average of 49.5% in the experimental group during the hours of 2pm and 4pm (hours often associated with the sun downing phenomenon). The author suggests that the colour of the light may have a greater impact than afternoon shadows, white light of morning vs. the yellowish red of afternoon, a factor which can be affected by glazing of facility windows.

Hickman, S.E., Barrick, A.L., Williams, C.S., Zimmerman, S., Connell, B.R., Preisser, J.S., Mitchell, C.M., & Sloane, P.D. (2007). The effect of ambient bright light therapy on depressive symptoms in persons with dementia. *Journal of the American Geriatrics Society*, 55(11) 1817 – 1824.

There was mixed support for the high intensity, low glare Ambient Bright Light Treatment as treatment for depressive symptoms in persons with dementia, the researcher states that it might not be advisable for public areas but introduced at an individual level.

Lepeleire, J.D., Bouwen, A., Coninck, L.D., Buntinx, F. (2007). Insufficient lighting in nursing homes. *Journal of the American Medical Directors Association*, 8(5), 314-317.

The results show that lighting in nursing homes is not meeting the European Standard (ES) of light for healthy adults, let alone light levels to meet the visual requirements of older adults. Increasing the amount of light is paramount as well as considering the amount of light/colour contrasts and reflection of the lighting.

McDaniel, J.H., Hunt, A., Hackes, B., Pope, J.F. (2001). Impact of dining room environment on nutritional intake of Alzheimer's residents: A case study. *American Journal of Alzheimer's Disease and Other Dementias*, 16(5), 297-302.

This case study compared the lighting and noise levels between the extended care (EC) and Alzheimer's unit (AU) of the facility. It was shown that lighting was higher and noise levels were lower in the EC unit whereas food intake and noise were higher in the AU. Recommendations were made by the researchers to enhance levels of lighting and reduce noises in the units to further improve intake and in turn nutritional status. In particular, the AU dining room improvements in lighting were to

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i) have cove lighting installed ii) install a minimum of two frosted bulb or shaded sconces and iii) bring lighting up to the Illuminating Engineering Society's standard that dining room ambient lighting should be at least 50 foot candles during active hours.

Noell-Waggoner, E. (2002). Light: An essential intervention for Alzheimer's disease. *Alzheimer Care Quarterly*, 3(4), 343-352.

The author recommends that dimmable lighting should support activities of daily life, sheer draperies/shades will filter direct light, lighting should be indirect and energy efficient while providing adequate, cool and easily adjustable light for tasks. Daylight is an important timing cue and cost effective source of light therefore facilities should include skylights, roof monitors, or several windows into their design.

Noel-Waggoner, E. (2004). Lighting solutions for contemporary problems of older adults. *Journal of Psychosocial Nursing*, 42(7), 14-20.

The researchers recommendations are split into several areas: optimal quality of light (daylight) vs. minimal light; uniformity in lighting from room to room; balanced and diffused daylight; effective task lighting; a high colour rendition scale rating (CV >80); using cooler colour temperatures; simplicity of design; minimal dark colours in designs; dimmable light controls; as well as the use of fluorescent lighting for safety and cost effectiveness.

Pollack, R., McNair, D., McGuire, B., & Cunningham, C. (2008) Designing lighting for people with dementia.

Newly published literature by Pollack et al indicates that individuals with dementia are negatively affected by intensely polished floors which create water-like reflections on the floor, interpreting shadows as objects and objects as shadows. Individuals with dementia also need to have enough to see their surroundings and pathways, proper signage, views to the outdoors, uncluttered spaces and enough light to see people, gestures, task and locations.

Riemersma-van der Lek, R.F. (2008). Use of bright lighting may improve dementia symptoms for elderly persons. *Journal of American Medical Association*, 299(22), 2642-2655.

Over the course of three years, a randomized 2 x 2 factorial design study occurred on the impacts that light only, melatonin only, light and melatonin and a placebo group had on cognition, mood, functioning, and sleep categories of people with dementia. What the researchers concluded was that increasing the amount of light reduced adverse results in all categories. Melatonin had a significant positive impact on sleep, yet to affect mood must be used in conjunction with sleep. All day BLT had no adverse effects and was recommended for use in long-term care facilities for individuals with dementia.

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Schnelle, J.F., Alessi, C.A., Al-Samarrai, N.R., Frickler, R.D., & Ouslander, J.G. (1999). The nursing home at night: Effects of an intervention on noise light and sleep. *Journal of American Geriatrics Society*, 47(4), 430-438.

There were no significant findings or measurable improvements on day or night time sleep within the nursing home when reductions in noise and light occurred at the facility.

Shochat, T., Martin, J., Marler, M., & Ancoli-Israel, S. (2000). Illumination levels in nursing home patients: Effects on sleep and activity rhythms. *Journal of Sleep Research*, 9(4), 373-379.

Exposure to bright light but not the length of the exposure was correlated with regular sleep patterns and the timing of peaks of activity for individuals with dementia. Peak activity occurred after bright light exposure. The author recommended overall increases in lighting levels in facilities where older adults live.

Sloane, P. D., Williams, C.S., Mitchell, M., Preisser, J.S., Wood, W., Barrick, A.L., Hickman, S.E., Gill, K.S., Connell, B.R., Edinger, J., & Zimmerman, S. (2007). High intensity environmental light in dementia: Effect on sleep and activity. *Journal of the American Geriatrics Society*, 50(2), 282-289.

Using wrist actigraphy to measure the length of sleep of individuals with dementia and a control group, researchers measured the effect different BLT had on sleep patterns of individuals with various stages of dementia. Experimental groups were exposed to BLT of 2,500 lux for 2.5 to 3.0 hours per day in the morning/evening interventions, or for 8.4 hours for a full day intervention. A modest effect indicated that night time sleep increased the most after with morning and all-day light exposure. The impacts were the most prominent with individuals with severe or very severe dementia.

Sumaya, I.C., Rienzi, B.M., Deegan, J.F., & Moss, D.E. (2001). Bright light treatment decreases depression in institutionalized older adults. *The Journals of Gerontology*, 56A(6), M356-M360.

The researcher used the Geriatric Depression Scale (GDS) and compared a thirty minute 10,000 lux bright light treatment, a 300 lux BLT and a control group for five consecutive days. The results showed that 50% of the participants, in the 10,000 lux BRT group, no longer scored in the depressed range. This suggests that a nonpharmacological effect of BLT on individuals with depression.

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Torrington, J.M., & Tregenza, P.R. (2007). Lighting for people with dementia. *Lighting Research and Technology*, 39(1), 81-97.

The authors broke down their article and recommendations into three sections: 1) the impact that bright light has on individuals' diurnal (daily) cycle or circadian rhythm 2) the impact of natural views on symptoms of dementia and depression 3) and lighting to support activities. Aside from having access to outdoor spaces and daylight, four major recommendations areas were determined to have a beneficial impact on older adults. The recommendations included: minimizing direct glare, avoiding significant contrasts in dark and bright lighting, minimizing reflection by using matt finishes and avoiding line of sight luminaires, as well as increasing task specific lighting.

Glossary of Terms in the Literature:

Acrophases: the time at which the peak moment in a rhythm occurs.

Actigraphy: a recorder placed on the wrist continually assesses the level of activity

Alzheimer's disease: is a progressive, degenerative disease of the brain, which causes thinking and memory to become seriously impaired. It is the most common form of dementia. The disease was first identified by Dr. Alois Alzheimer in 1906. He described the two hallmarks of the disease: "plaques" - numerous tiny dense deposits scattered throughout the brain which become toxic to brain cells at excessive levels and "tangles" which interfere with vital processes eventually "choking" off the living cells. As well, when brain cells degenerate and die, the brain markedly shrinks in some regions. As Alzheimer's disease progresses and affects different areas of the brain, various abilities become impaired. The result is changes in abilities and/or behaviour. At present, once an ability is lost, it is not known to return. However, research is now suggesting that some relearning may be possible. Definition retrieved June 10th, 2008 from <http://www.alzheimer.ca/english/disease/whatisit-intro.htm>)

Ambient Lighting: lighting throughout an area that produces general illumination (Noell-Waggoner, 2004, p 16).

ANSI: American National Standards Institute-create standards related to lighting in senior living environments amongst other standards.

Bright Light Therapy (BLT): is the treatment that uses various levels, durations, and timing of illumination to treat various health care issues such as dementia behaviours and depression. An example of BLT used in research is 10,000 lux for 30 minutes for 1 hour daily. There is no current standard of BLT. Another example of bright light therapy is dawn stimulation. Dawn stimulation is a slowly increasing amount of light in the bedroom which begins at the end of a sleep period. The

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maximum intensity for dawn stimulation is two degrees lower than in daytime bright light therapy (e.g. 300 lux vs. 10,000 lux).

Circadian Rhythm: natural length of the rhythm is just over 24 hours and is regulated by the suprachiasmatic nuclei (SCN) in the hypothalamus. The SCN responds to light entering the retina, activating photoreceptors and production of melatonin (Gammack, 2008, p 140). Therefore, exposure to high light levels during the day provides a strong natural regulator to synchronize the wake/sleep cycle with the day/night cycle; it also regulates appetite, mood and body temperature. The amount of light required to maintain synchronization of circadian rhythms is about 10 times more than the light requirements for vision. Older adults need light levels in the range of 250 to 300 foot candles (2,500 or 3,000 lux) (Noell-Waggoner, 2002, p 344).

Colour Rendition: the degree of colour shifts objects undergo when illuminated by a light source, compared to the color of those same objects when illuminated by a reference source (daylight). The degree of colour shift is measure by a color rendering index (CRI) scale 0-100. Light sources for older people should be high on the scale, with a CRI of >80. (Noell-Waggoner, 2004, p 16).

Colour Temperature: refers to the overall appearance of a light source. Color temperature is measured in degrees Kelvin and range from warm (lower numbers) to cool (higher numbers).

Diurnal Cycle: a 24 hour cycle that occurs daily.

Dementia: dementia itself is not a disease: it is a set of symptoms. Changes in the brain cause specific symptoms and each person is affected differently. It is difficult to predict what symptoms each person will have, when the symptoms will emerge, how quickly the symptoms will progress and most importantly how the person will adapt and respond to the symptoms. Typically the individual's day to day life will be affected by changes in the following areas: memory, decision-making, performing familiar tasks, communication, and mood/behaviour. Alzheimer's disease is the most common type of dementia, approximately 64% of all individuals with dementia. Other common types of dementia include: Vascular dementia, Lewy body dementia, mixed dementia and frontotemporal lobe dementia.

Full Spectrum White Light: the term 'full spectrum lighting' that has been identified as the best type of artificial light (O'Keefe,n.d) Look for lighting that mimic natural sunlight such as incandescent or new florescent T8 lamps.

Glare: the sensation produced by luminance (light) within the visual field that is sufficiently greater than the luminance to which the eyes are adapted. It may cause annoyance, discomfort, or loss in visual performance (blindness) (Noell-Waggoner, 2004, p 16).

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IESNA: illuminating Engineering Society of North America: recognized authority for establishing lighting standards in the US, Canada, and Mexico (Noell-Waggoner, 2002, p 346).

Light Measurements: foot candles (Candelas): a measurement of light used in the lighting industry, which is equivalent to one lumen per square foot. One footcandle is approximately 10.764 lux.

Melatonin: “neuroendocrine hormone released by the pineal gland via diffusion into the bloodstream, the synthesis and release of melatonin is stimulated by darkness and inhibited by light in a dose-dependent fashion. It rises shortly after dark and peaks between 2am and 4am” (Gammack, 2008, p 140).

Task Lighting: the lighting focused on a particular task or activity should illuminate the area without being directly in the eyes of the person working on the task. I.e. A light directly above a table with a jigsaw puzzle that illuminates the table top without affecting the person’s vision.

Website Resources

Age-related Macular Degeneration (AMD) Canada: great resource on the components of vision and living with AMD.

<http://www.amdcanada.com/>

Canadian National Institute for the Blind: great resource on lighting for independent living and indoor lighting for better vision within the home.

<http://www.cnib.ca/en/your-eyes/eye-care/lighting-0607/Default.aspx>

Lighting Research Center: makes recommendations on lighting for older adults, has a wonderful glossary of light terms, and useful lighting principles.

<http://www.lrc.rpi.edu/programs/lightHealth/AARP/healthcare/lightingOlderAdults/index.asp>

The Society of Light and Lighting: lighting for people who are visually impaired

<http://www.cibse.org/index.cfm?go=page.view&item=68>

University of Waterloo-Centre for Sight Enhancement: low vision clinic providing education and rehabilitation resources.

<http://www.optometry.uwaterloo.ca/clinic/cse.html>

This document was created by the Murray Alzheimer Research and Education Program in partnership with the Alzheimer Knowledge Exchange Design and Dementia Community of Practice. For more information about MAREP please visit

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