Lighting for Senior Care

Age-related changes to the eye and central nervous system can have significant negative impacts on day-to-day functioning, general health, well-being, and the visual and non-visual systems' responses to light . As Boyce notes, "…older people tend to show reduced visual field size, increased absolute threshold luminance, reduced visual activity, reduced contrast sensitivity, increased sensitivity to glare, and poorer color discrimination." [99] An inevitable consequence of aging is the thickening of the crystalline lens, which increasingly absorbs light, preventing it from reaching the retina (and ultimately the circadian system). Lens thickening also scatters light within the lens, increasing sensitivity to glare. Aging also changes the manner in which the rod photoreceptors transmit signals to the brain, which makes older adults more sensitive to light and further exacerbates sensitivity to glare [6]. Several field studies have shown that exposure to a robust light-dark pattern enables older adults to consolidate their sleep during the night and reduce their napping during the day [106, 107].

Design techniques

Increase illuminance on task areas: Use concentrated light to increase illuminance on the task or work plane. Generally, light fixtures should be positioned or installed wherever visibility is important (e.g., above the countertop, above bathroom and kitchen sinks, in showers, closets, laundry spaces).

Reduce glare: Because older adults require more light for visual performance, avoid glare, which can hinder vision and cause discomfort. The light source itself should be hidden or covered with a diffuser.

Balance light levels: Given that older adults cannot adapt to dim lighting conditions as well as younger people do, provide ambient levels in transitional spaces (hallways and entrance foyers) that are similar to those of the adjacent spaces.

Improve contrast: Because contrast sensitivity reduces with age, improve the visibility of important architectural features (such as steps and walls) by increasing their contrast using paint or other enhancements.

Mute patterns: Avoid busy patterns on walls, floors, and furniture, which can cause visual confusion and disorientation.

Create warm environment: Create a welcoming atmosphere with warm furniture, flooring, and walls to make the occupants feel more at home.

Enhance colors: The aging eye makes it more difficult for older adults to discriminate between, for example, colors such as dark purple and maroon. Use lamps with high light output and good color characteristics.

CS schedule

Senior Care- 0.3 target	
Time	**CS**
7:00 AM - 4:00 PM	0.3
4:00 PM - 5:00 PM	0.3 → 0.2
5:00 PM - 7:00 PM	0.2
7:00 PM - 8:00 PM	0.2 → 0.1
8:00 PM - EOD	0.1

Choose 0.3 CS target if:
- Occupant location is known
- CCT preference is warm white (< 3000 K)
- Energy usage is a major concern and personal light devices can't be used

Senior Care- 0.4 target	
Time	**CS**
7:00 AM - 12:00 PM	0.4
12:00 PM - 1:00 PM	0.4 → 0.3
1:00 PM - 4:00 PM	0.3
4:00 PM - 5:00 PM	0.3 → 0.2
5:00 PM - 7:00 PM	0.2
7:00 PM - 8:00 PM	0.2 → 0.1
8:00 PM - EOD	0.1

Choose 0.4 CS target if:
- Occupant location is unknown
- Cooler CCTs are used
- Better assure light required to stimulate the circadian system reaches the back of the aging eye
- Usage of light tables/trays

Senior Care- Extended 0.4	
Time	**CS**
7:00 AM - 5:00 PM	0.4
5:00 PM - 6:00 PM	0.4 → 0.1
6:00 PM - EOD	0.1

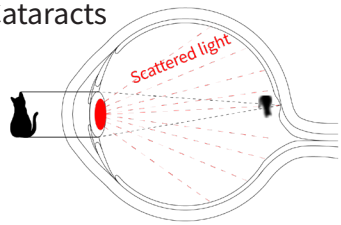
Choose extended 0.4 CS if:
- If population includes individuals with Alzheimer's disease and related dementias (ADRD)

*EOD = End of day

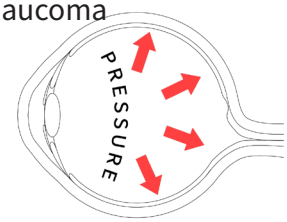
Aging eye diseases

With retinal and pre-retinal changes to the eye, older adults can undergo visibility challenges like the ones depicted below. When designing senior care facilities, be mindful of certain visibility challenges. Since some of the diseases destroy the photoreceptors, light cannot bring them back, rather, these techniques can enhance the use of the remaining photoreceptors.

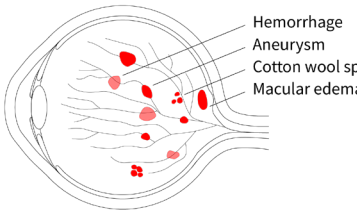
Cataracts



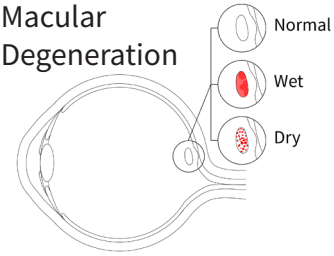
Glaucoma



Diabetic Retinopathy



Macular Degeneration



Additional lighting

Daytime solutions

Light table

Light tray

Light tables and trays are useful devices for providing light stimulus for older adults during the daytime. These lighting devices can stimulate the circadian system as well as provide cognitive stimulation. This can improve mood and cognitive functioning. These devices can be used while doing daily activities such as eating.

Night-time solutions

Falls are a major concern within the older adult community. Especially when getting up to use the bathroom at night, falling due to the inability to orient oneself is a common occurrence. Giving visual cues to promote postural control, such as a horizontal light bar can aid in stability when standing up. Lighting doorframes and handrails can also be beneficial.

References

[6] Depner CM, Stothard ER, Wright KP (2014) Metabolic Consequences of Sleep and Circadian Disorders. *Metabolic Consequences of Sleep and Circadian Disorders* **14**, 507.

[99] Boyce PR (2014) *Human Factors in Lighting*, CRC Press, Boca Raton, FL.

[106] Figueiro MG, Rea MS (2005) Improving the sleep quality of older adults In *Proceedings of the CIE Midterm Meeting and International Lighting Congress* Commission Internationale de L'Eclairage, Leon, Spain.

[107] Figueiro MG, Rea MS, Eggleston G (2003) Light therapy and Alzheimer's disease. *Sleep Review Magazine* **4**, 24.