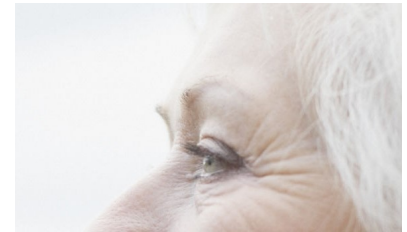


Tailored Lighting Intervention for Seniors

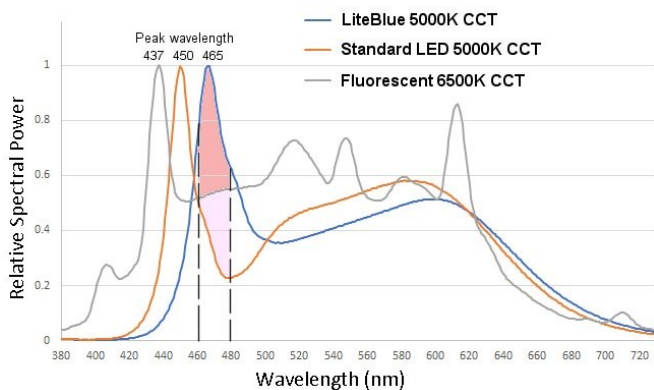
Nowadays, seniors stay indoor most of the time and rely on artificial lighting for illumination. As a result, their eyes are under-exposed to light during daytime and over-exposed in the evening before going to bed. This unhealthy pattern of light exposure leads to a disruption of the circadian rhythm, which brings adverse effects to human health, like, sleep disorders, depression, obesity, cardiovascular disease, and possibly cancer.



Tailored Lighting Intervention (TLI) is an effective tool in helping seniors with sleep, mood, and behaviour in persons especially with Alzheimer Disease and Related Dementias. TLI as a non-pharmacological therapy maximally affects the circadian system during the 24-hour life cycle.

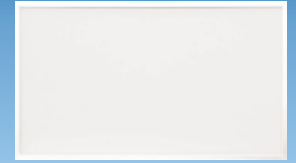
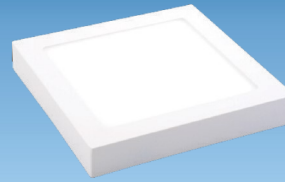
High Potency Blue Wavelengths (460 - 480 nanometers)

Numerous studies have shown that the light between 460 - 480 nm is very effective in regulating the circadian entrainment by suppressing Melatonin secretion. These wavelengths are referred as High Potency Blue Wavelengths (HPBW). As little as 24 Lux (4% of total irradiance) from a Sylvania 32-Watt fluorescent F032/850 of 5000K CCT within the HPBW suppresses 50% - 54% Melatonin secretion after 2-4 hours light exposure time [1]. By placing the peak blue wavelength at 465 nm, **LiteBlue** LED emits roughly 50% more power within the HPBW than cool-white fluorescent of 6500K CCT. Besides providing higher efficiency in regulating the circadian entrainment, more power in the HPBW can increase cognitive performance and alertness during daytime.



Bright Light Therapy for Seasonal Affective Disorder usually employs cool-white light source of 5000K - 6500K CCT. As compared with **LiteBlue** LED of 5000K CCT, the spectral power emitted by fluorescent of 6500K and standard LED of 5000K within the HPBW is only 65% and 40% of it respectively. To achieve the same biological effect of Circadian Stimulus equal to 0.41, standard LED of 5000K is required to emit 25% more illuminance than **LiteBlue** LED of 5000K.

Metrics	Circadian Stimulus				Melanopic Ratio (EML)		
	CCT	Illuminance	LiteBlue LED	Standard LED	Lux Saving	LiteBlue LED	Standard LED
5000K	400 Lux	0.41	0.36	25%	1.027	0.816	26%
	500 Lux	0.448	0.41				

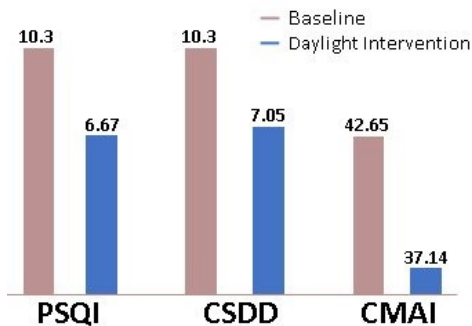


Circadian Entrainment

The all-day lighting schedule of TLI for seniors facilities should be as follows:

- 1) Daytime— High Circadian Stimulus (CS) of 0.4, or 400/600 Lux of **LiteBlue** LED 5000K/4000K respectively;
- 2) Evening/Nighttime — Low Circadian Stimulus (CS) of < 0.1, or < 60 Lux of **LiteBlue** LED 3000K;
- 3) Bedtime — Dark or dim light.

Note: CS metrics is illustrated in UL RP 24480, Design Guideline for Promoting Circadian Entrainment with Light for Day-Active People



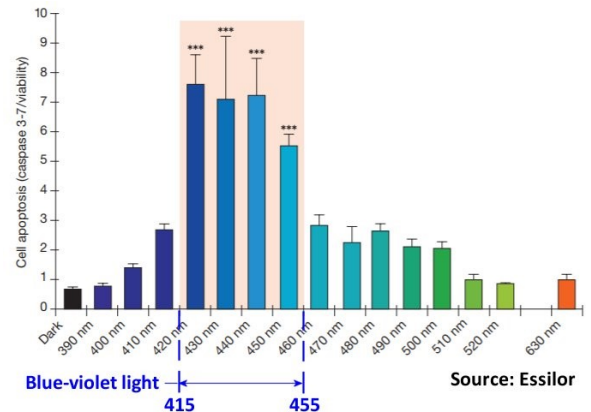
A study [2] of TLI was carried out on patients with Alzheimer's Disease in long-term care facilities. This study shows that the *Daytime Lighting schedule* of CS=0.4 improves all three scores of Pittsburgh Sleep Quality Index (PSQI), Cornell Scale for Depression in Dementia (CSDD), and Cohen-Mansfield Agitation Inventory (CMAI). Lower light intensities emitted by **LiteBlue** LED at CS=0.4 helps with less eye irritation and more visual comfort.

Ocular Health

Senior's eyes may be more susceptible to Photoretinitis and Age-related Macular Degeneration. Long time exposure of blue-violet light (415 - 455 nanometers) may have higher risk of Photoretinitis or Retinal Blue-Light Hazard (IEC/EN 62471).

Age-related Macular Degeneration may be accelerated by the blue-violet light. A study [3] shows that blue-violet light may increase the apoptosis cell death rate by about two times more than blue-turquoise light (456 - 490 nanometers).

LiteBlue LED emits about 10% of blue-violet light, so as to provide more protection on ocular health.



1. Rahman S.A. et al. Spectral modulation attenuates molecular, endocrine, and neurobehavioral disruption induced by nocturnal light exposure. *Am J Physiol Endocrinol Metab* 300: E518–E527, 2011
2. Figueiro M.G. et al. Effects of a Tailored Lighting Intervention on Sleep Quality, Rest–Activity, Mood, and Behavior in Older Adults With Alzheimer Disease and Related Dementias: A Randomized Clinical Trial
3. Arnault et al. Phototoxic action spectrum on a retinal pigment epithelium model of age-related macular degeneration exposed to sunlight normalized conditions, *PLOS one* 23 Aug 2013

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Android APP

Circadian
Light Meter

