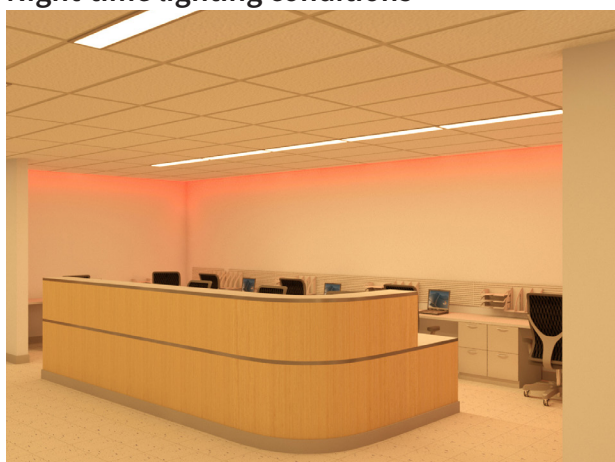


# Lighting for Healthcare

## Daytime lighting conditions



## Night-time lighting conditions

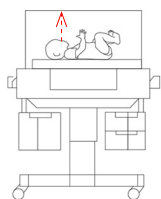


Lighting for healthcare presents unique challenges for accommodating the diverse patient populations, as well as the need for 24-hour operation. Creating zones of light in a hospital can allow for unique circadian-effective lighting schedules to deliver optimum light for day-shift and night-shift nurses, infants, other patients, and visitors. Shift work, especially rotating and overnight shifts, has been associated with increased risks for developing serious, chronic health problems [19, 78-83]. To reduce this risk, provide light levels appropriate for avoiding disruption of the circadian system. In a facility that operates 24/7, it is imperative to provide high light levels in the day for circadian entrainment, and low light levels at night to avoid disrupting the circadian system. High light levels or saturated blue light during daytime hours promotes entrainment and alertness, while red light at night promotes alertness without disrupting the circadian system. The tables on the subsequent page show examples of CS schedules for general lighting for a 24-hour facility. Also shown is an individual schedule for nurses to follow outside of work hours. For shifts with atypical hours, assure high CS values during the daytime to promote circadian entrainment, and avoid high CS at night outside of work hours; this could be done with personal light goggles and orange filter goggles, as shown on the subsequent page. In that case, use red light for maintaining alertness during the night shift.

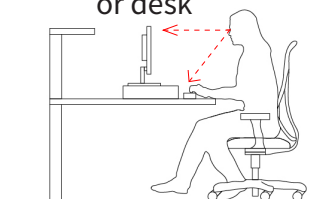
## Design techniques

The direction of gaze impacts how much light reaches the eye. Lighting designs should be optimized to deliver light for CS while avoiding glare from direct view of fixture. Infants or patients lying in bed will be facing upward or possibly tilted on a patient bed. Nurses look horizontally or downward when working at computer screens or their desk.

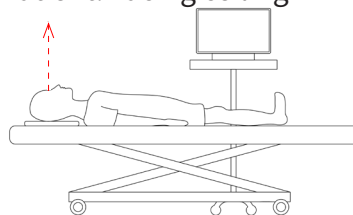
Infant: Facing ceiling



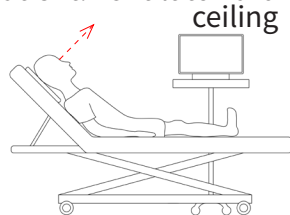
Nurse: Facing computer or desk



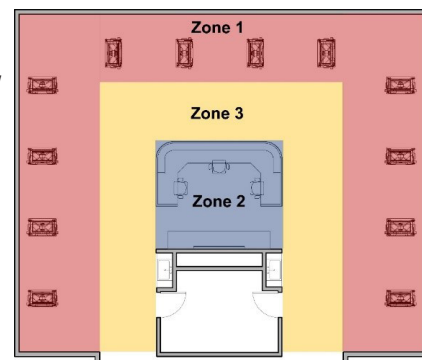
Patient: Facing ceiling



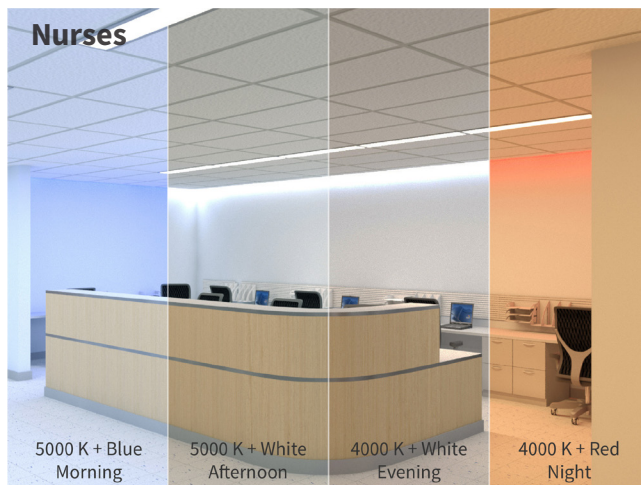
Patient: 45° tilt toward ceiling



Establish zones within the facility to provide proper circadian entrainment for different user needs. In this example from a neonatal intensive care unit, use separate lighting controls for fixtures above the incubators (zone 1) to allow for dimmer light at night without compromising visibility and alertness for nurses (zone 2).



## CS schedules



If the existing overhead lighting can meet CS targets, lighting schedules should accommodate all shift workers. The accompanying schedules are the recommended 24-hour lighting schemes for hospital that operate on 8-hour shifts: (1) days (7:00 AM - 3:00 PM), (2) afternoons/swings (3:00 PM - 11:00 PM), and (3) nights (11:00 PM - 7:00 AM) or 12-hour shifts: (1) days (7:00 AM - 7:00 PM), and (2) nights (7:00 PM - 7:00 AM).

For lighting systems that are limited to a single color, or CCT, additional layers of light are recommended to deliver short -wavelength (blue) or long- wavelength (red) light at workers' eye level. Blue or white light can be used to promote circadian entrainment and alertness during the day, while red light can provide alertness at night without circadian disruption.



Desk luminaire



If the existing overhead lighting cannot meet CS targets, nurses can use personal desktop luminaires or light goggles. These solutions are advantageous in delivering an individualized light treatment, which permits workers to personalize their circadian-effective lighting to suit their own needs and color preference.



Light goggles



Orange-tinted glasses are particularly helpful for night-shift workers to avoid undesired light exposures by filtering out the wavelengths of light that stimulate the circadian system.



Infants in NICU

Lighting for incubator zone	
Time of day	CS
7:00 AM - 9:00 AM	0.3
9:00 AM - 10:00 AM	0.3 → 0.2
10:00 AM - 5:00 PM	0.2
5:00 PM - 6:00 PM	0.2 → 0.1
6:00 PM - EOD	0.1



Patients

Lighting for patient rooms	
Time of day	CS
7:00 AM - 10:00 AM	0.3
10:00 AM - 11:00 AM	0.3 → 0.2
11:00 AM - 4:00 PM	0.2
4:00 PM - 5:00 PM	0.2 → 0.1
5:00 PM - EOD	0.1

### 24-hour schedule for 8-hour shifts

Time of day	CS	Add-on color	Shift
7:00 AM - 1:00 PM	0.4	Blue	Daytime
1:00 AM - 2:00 PM	0.4 → 0.3	Transition	
2:00 AM - 3:00 PM	0.3	White	
3:00 PM - 9:00 PM	0.3	White	Evening
9:00 PM - 10:00 PM	0.3 → 0.1	Transition	
10:00 PM - 11:00 PM	0.1	Red	
11:00 PM - 6:30 AM	0.1	Red	Nighttime
6:30 AM - 7:00 AM	0.1 → 0.4	Transition (orange glasses)	

### 24-hour schedule for 12-hour shifts

Time of day	CS	Add-on color	Shift
7:00 AM - 1:00 PM	0.4	Blue	Daytime
1:00 PM - 2:00 PM	0.4 → 0.3	Transition	
2:00 PM - 4:00 PM	0.3	White	
4:00 PM - 5:00 PM	0.3 → 0.2	Transition	
5:00 PM - 6:30 PM	0.2	Dimmer white	
6:30 PM - 7:00 PM	0.2 →	Transition (orange glasses)	Nighttime
7:00 PM - 7:30 PM	→ 0.3	Transition	
7:30 PM - 11:00 PM	0.3	White	
11:00 PM - 12:00 AM	0.3 → 0.1	Transition	
12:00 AM - 6:30 AM	0.1	Red	
6:30 AM - 7:00 AM	0.1 → 0.4	Transition (orange glasses)	

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