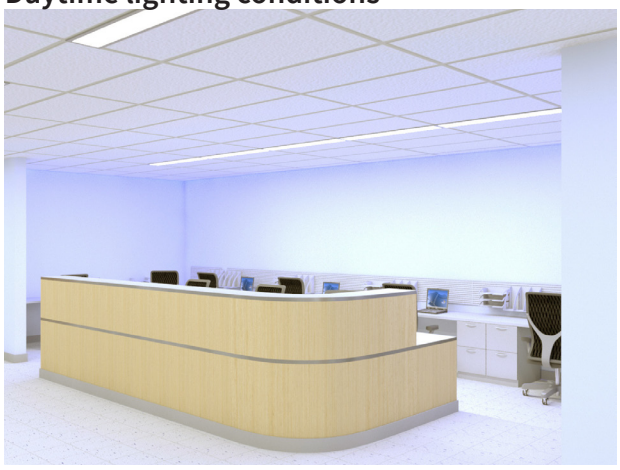
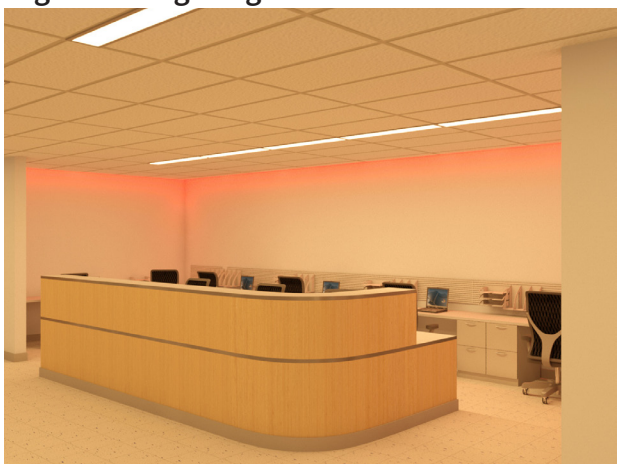
Lighting for Healthcare

Daytime lighting conditions



Night-time lighting conditions



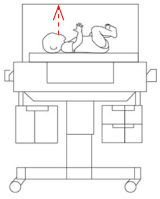
Designing lighting for hospitals can prove to have many challenges including varying needs of different user types, as well as the need for a 24-hour operation. Creating zones of light in a hospital can allow for unique circadian schedules to deliver light for dayshift and night-shift nurses, infants above 32-weeks old, and patients. Nurses that work night-shifts long term are at greater risk of certain diseases and even cancer if the circadian system is disrupted for a long period of time. Simply providing light levels appropriate for avoiding disruption of the circadian system can reduce this risk. Especially in a facility that operates 24/7, it is imperative to provide a robust lighting system that provides high light levels in the day for circadian entrainment, and low light levels are night to not disrupt the circadian system, while also not compromising alertness. Blue light is suggested during daytime hours to promote alertness, while red light at night is suggested for its ability to provide alertness without disrupting the circadian system.

Example CS schedules for general lighting for a 24-hour facility is given along with individual schedule for nurses to follow before and after his/her shift. Notably for shifts with atypical hours, assuring enough light to promote circadian entrainment is reached during the daytime, and avoidance of high circadian stimulus in the night outside of work hours is key for the greatest effect. This could be done with personal light goggles and orange filter goggles.

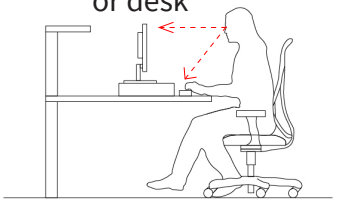
Design techniques

The direction an occupant is facing impacts greatly how much light gets to the eye. Keeping this in mind, lighting designs should be strategic to deliver light optimally for CS while avoiding glare from direct view of fixture. Nurses doing tasks at nurse's stations could be standing or sitting looking at computer screens or desk. Infants or patients laying in bed will be facing upward or possibly tilted on a patient bed.

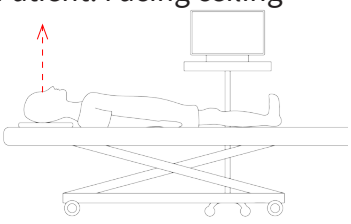
Infant: Facing ceiling



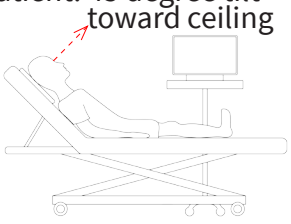
Nurse: Facing computer or desk



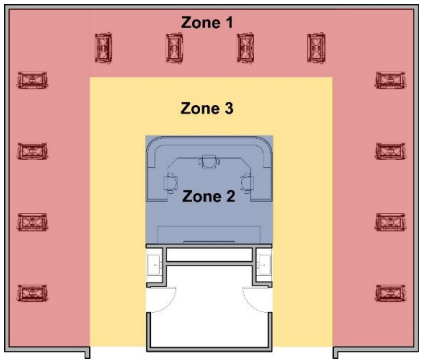
Patient: Facing ceiling



Patient: 45 degree tilt toward ceiling

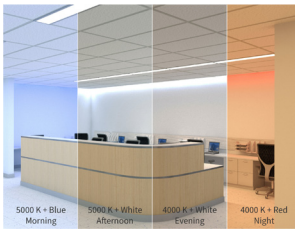


Zoning spaces within the facility is important to provide proper circadian entrainment for different user types. Supplying separate lighting controls for fixtures above the nurse's desk and the incubators can allow for dimmer light at night in the infant zone 1 without compromising visibilty and alertness for nurses in zone 2.



CS schedules

24-hour



24-hour hospital lighting: 8-hour shifts

Time of day	CS	Add-on color	Shift
7:00 AM - 1:00 PM	0.4	Blue	Shift 1
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	Shift 2
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	Shift 3
6:30 AM - 7:00 AM	0.1 → 0.4	Transition (orange glasses)	

24- hour hospital lighting: 12-hour shifts

Time of day	CS	Add-on color	Shift
7:00 AM - 1:00 PM	0.4	Blue	Shift 1
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)	
7:00 PM - 7:30 PM	→ 0.3	Transition	Shift 2
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)	

Nurse's personal schedules

7:00 AM - 3:00 PM

Time of day	CS	Add-on color	Shift
Wake - 7:00 AM	0.4		Shift 1
7:00 AM - 1:00 PM	0.4	Blue	
1:00 PM - 2:00 PM	0.4 → 0.3	Transition	
2:00 PM - 3:00 PM	0.3	White	
3:00 PM - 4:00 PM	0.3 → 0.2		
4:00 PM - 7:00 PM	0.2		
7:00 PM - 8:00 PM	0.2 → 0.1		
8:00 PM - EOD	0.1		

3:00 PM - 11:00 PM

Time of day	CS	Add-on color	Shift
Wake - 3:00 PM	0.4		Shift 2
3:00 PM - 9:00 PM	0.3	White	
9:00 PM - 10:00 PM	0.3 → 0.1	Transition	
10:00 PM - 11:00 PM	0.1	Red	
11:00 PM- EOD	0.1		

11:00 PM - 7:00 AM

Time of day	CS	Add-on color	Shift
Wake - 7:00 PM	0.4		Shift 3
7:00 PM - 8:00 PM	0.4 → 0.2		
8:00 PM - 10:00 PM	0.2		
10:00 PM - 11:00 PM	0.2 → 0.1		
11:00 PM - 7:00 AM	0.1	Red	
7:00 AM - EOD	< 0.1	Orange glasses	

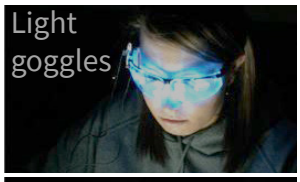
7:00 AM - 7:00 PM

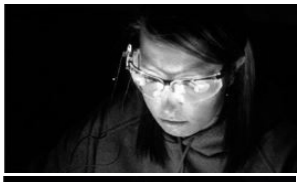
Time of day	CS	Add-on color	Shift
Wake - 7:00 AM	0.4		Shift 1
7:00 AM - 1:00 PM	0.4	Blue	
1:00 PM - 2:00 PM	0.4 → 0.3	Transition	
2:00 PM- 4:00 PM	0.3	White	
4:00 PM - 5:00 PM	0.3 → 0.2	Transition	
5:00 PM - 7:00 PM	0.2	Dimmer white	
7:00 PM - 8:00 PM	0.2 → 0.1		
8:00 PM - EOD	0.1	Orange glasses	

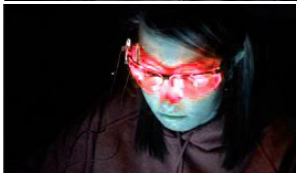
7:00 PM - 7:00 AM

Time of day	CS	Add-on color	Shift
Wake - 7:00 PM	0.4		Shift 2
7:00 PM - 11:00 PM	0.3	White	
11:00 PM - 12:00 AM	0.3 → 0.1	Transition	
12:00 AM - 7:00 AM	0.1	Red	
7:00 AM - EOD	< 0.1	Orange glasses	

Nurse's personal schedules







7:00 AM - 3:00 PM

Time of day	CS	Add-on color	Shift
Wake - 7:00 AM	0.4		Shift 1
7:00 AM - 3:00 PM	0.4	Blue	
3:00 PM - 4:00 PM	0.3 → 0.2		
4:00 PM - 7:00 PM	0.2		
7:00 PM - 8:00 PM	0.2 → 0.1		
8:00 PM - EOD	0.1		

3:00 PM - 11:00 PM

Time of day	CS	Add-on color	Shift
Wake - 3:00 PM	0.4	Blue	Shift 2
3:00 PM - 9:00 PM	0.4	Blue	
9:00 PM - 11:00 PM	0.1	Red	
11:00 PM - EOD	0.1		

11:00 PM - 7:00 AM

Time of day	CS	Add-on color	Shift
Wake - 11:00 PM	0.4	Blue	Shift 3
11:00 PM - 7:00 AM	0.1	Red	
7:00 AM- EOD	< 0.1	Orange glasses	

7:00 AM - 7:00 PM

Time of day	CS	Add-on color	Shift
Wake - 7:00 AM	0.4	Blue	Shift 1
7:00 AM - 4:00 PM	0.4	Blue	
4:00 PM - 7:00 PM	0.2	Dimmer white	
7:00 PM- EOD	0.1	Orange glasses	

7:00 PM - 7:00 AM

Time of day	CS	Add-on color	Shift
Wake - 7:00 PM	0.4	Blue	Shift 2
7:00 PM - 11:00 PM	0.3	White	
11:00 PM - 7:00 AM	0.1	Red	
7:00 AM - EOD	0.1	Orange glasses	

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

Patient

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