

# The Impact of Quality Lighting on Circadian Rhythm, Patient Care, and Costs



Oklahoma Association  
of Healthcare Engineers



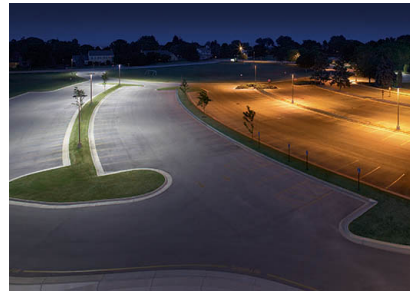
**Haley Robson** LC, LEED Green Associate  
*Lighting Designer*

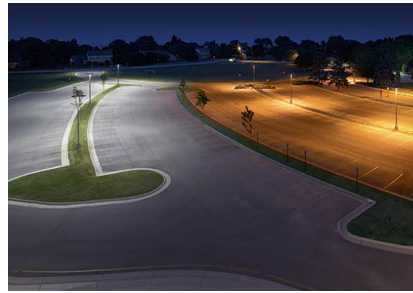
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# Agenda

- Lighting's Influence
- Circadian Rhythm
- Why is This Important to Healthcare?





# Lighting Can Influence...

- Mood
- Productivity
- Perception of Safety
- Path Taken
- Health



# Lighting's Influence on Mood

## Mood of Occupants

**Spa** – Dimming and Wall Washing Mimics Sunset

**Concerts** – Bright Flashing Lights, Uneven Lighting is Exciting



# Lighting's Influence on Mood

## Mood of Occupants

**Offices** – Even Illumination is Calming vs High Contrast Illumination which is Stressful



# Lighting's Influence on Work Productivity



- Eye Strain Limits Productivity and Causes Health Issues
- Proper Lighting Levels Allow for Maximum Work Performance
- Increased Productivity Equals Higher Profits



# Lighting's Influence on Perception of Safety



- Evenly Illuminated Paths at Night are Perceived as Safe
- High Contrast Illuminated Areas are Perceived as Unsafe
- Increase Security with Energy Efficient Upgrades





# Lighting's Influence on Occupant's Path Taken

- Movement of People Toward Lights, Taylor and Sucof (1974)
- 75% of Occupants Chose the Path with Higher Lighting Levels
- Improve Circulation

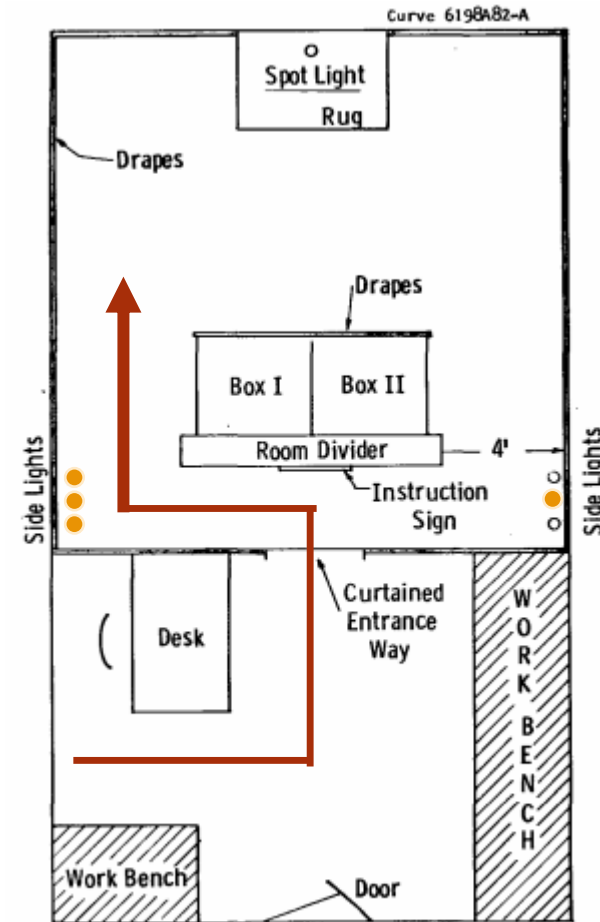


Figure 1. Experimental room floor plan.



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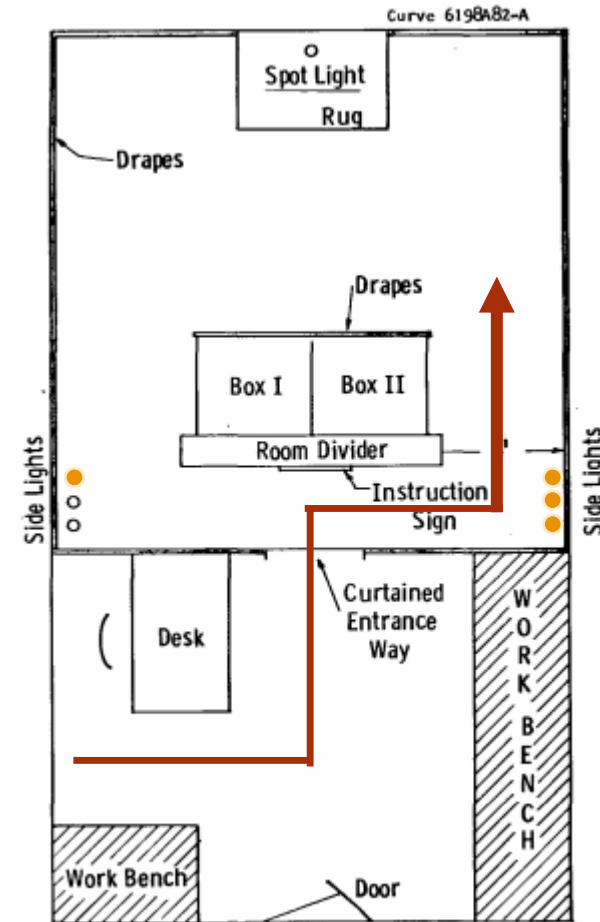


Figure 1. Experimental room floor plan.



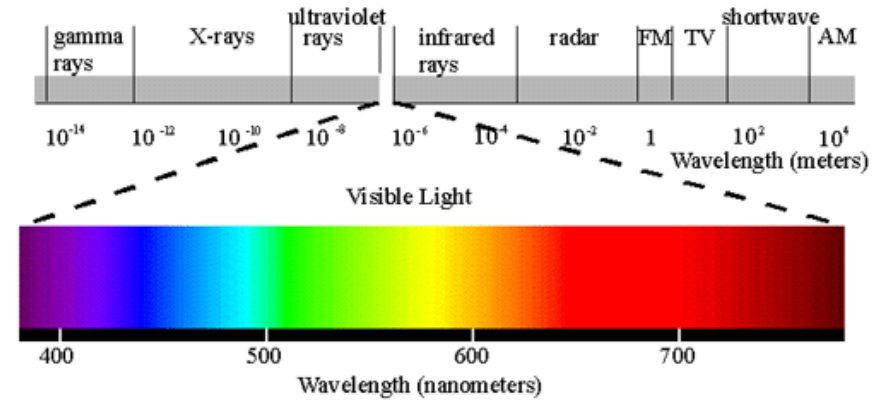
# Lighting's Influence on Health

415nm/630nm Combination  
Good Blue/Red Light  
**76% Acne Reduction**

415nm Good Blue Light  
**58% Acne Reduction**

532nm Green Light  
**35% Acne Reduction**

585-595nm Yellow Light  
**49% Acne Reduction**



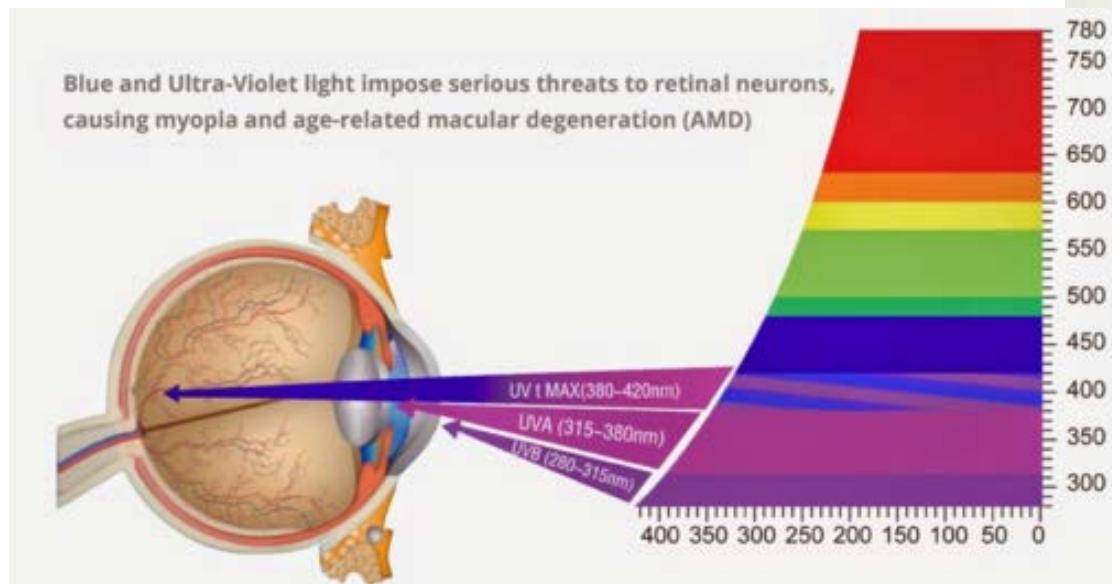
Before After  
Actual BlueMD - Light Assisted Acne Treatment Results



# Lighting's Influence on Health

- Age related Macular Degeneration has increased and there is a direct link to UV rays coming from technology causing it.

## 400-430nm Bad Blue Light for Eyes

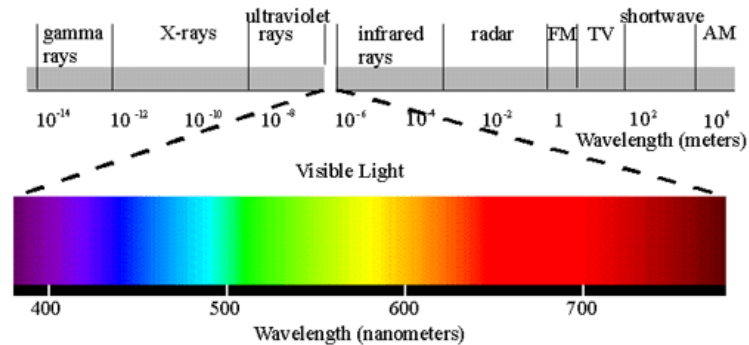


# Lighting's Influence on Health



- Seasonal Affective Disorder (SAD) Improvement

430-480nm- Improvement with blue light at 1000 lux for an hour per day

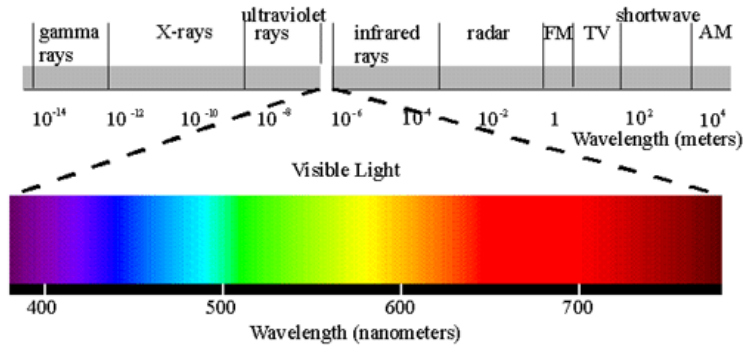


# Lighting's Influence on Health

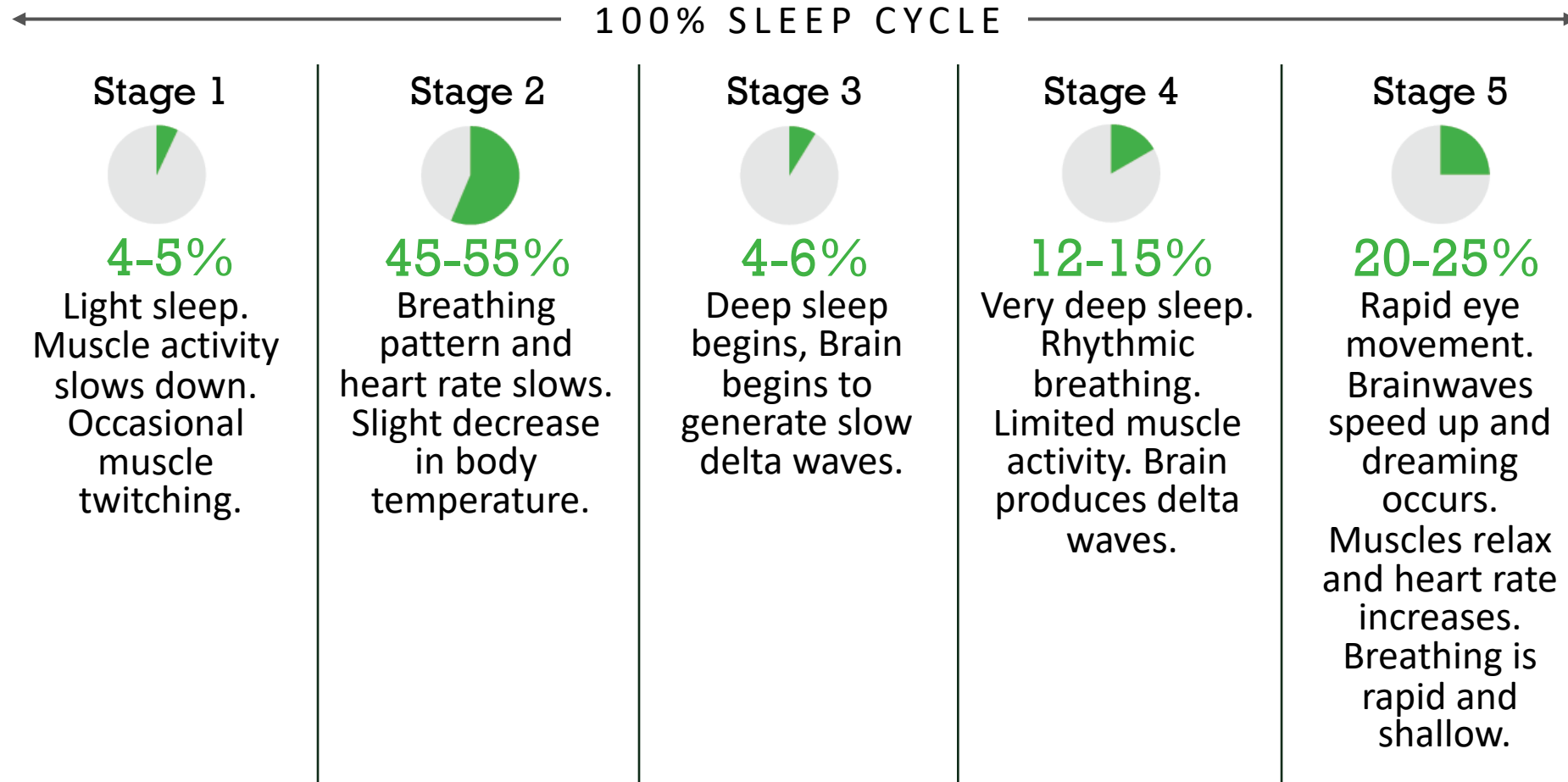
## Regulation of Circadian Rhythm

460-480nm - Triggers Awake Cycle

560-630nm – Triggers Sleep Cycle



# What is a Healthy Sleep Cycle?



# True or False

In a healthcare situation, quantity of sleep is best for the patient who needs to heal.





# False

Quality of sleep is more important than quantity. The Awake cycle is just as important as the sleep cycle in patient healing.



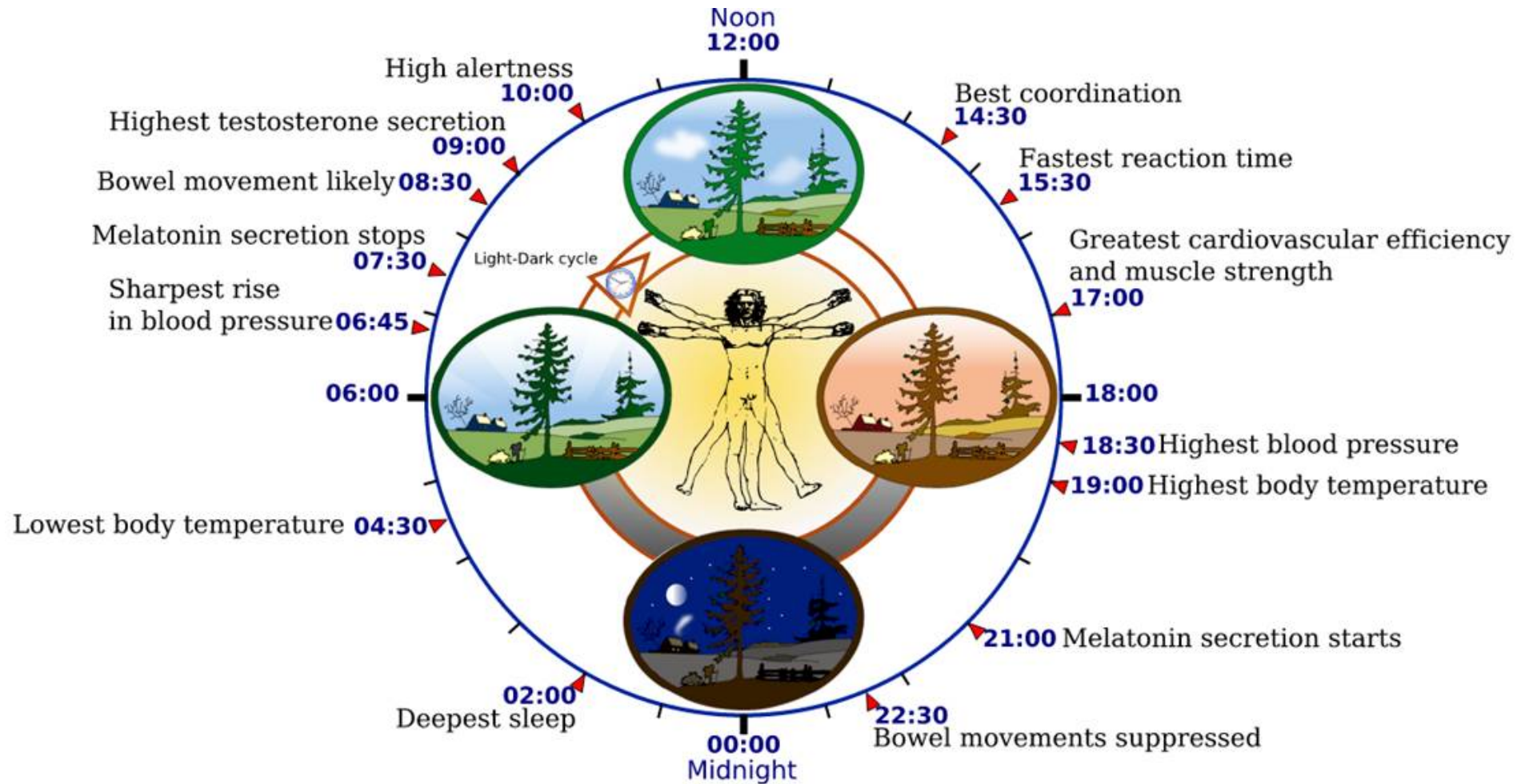
# Circadian Rhythm



**Florence Nightingale** was a nurse in the late 1800's who documented the importance of natural daylight in patient care. She was observing regulation of patient circadian rhythm.



# What is a Healthy Circadian Rhythm?



# How Do You Regulate Patient Circadian Rhythm?

- Blue wavelength within 460-480nm wakes a patient up by triggering the release of the hormone Serotonin.
- The lack of the blue wavelength in the evening triggers the release of Melatonin which causes sleep.



# Is it Possible to Regulate Circadian Rhythm with Artificial Lighting?



# Circadian Rhythm

Lighting Research Center at Rensselaer Polytechnic Institute  
by Marina G. Figuerio, PhD and Mark S. Rea, PhD



# Circadian Rhythm

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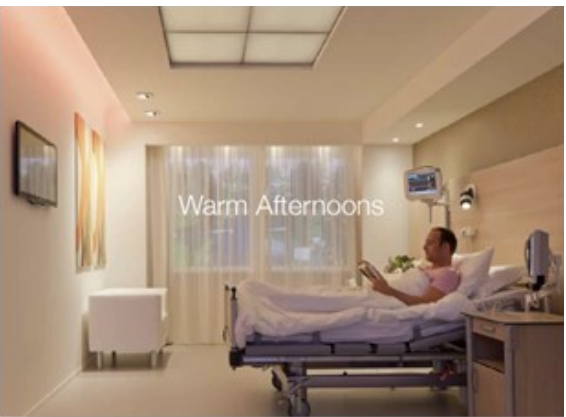


# What if We Apply This Knowledge to the Healthcare Industry?

Is it Possible to Improve Healing Times of Patients Through Quality Lighting and Regulation of Circadian Rhythm?







Color changing LED lighting with cycled lighting controls allows further regulation of patient circadian rhythm. Patients rest more soundly and heal faster.



# Circadian Rhythm



## Cool Color Temperatures in the Morning Mimics the Natural Sunrise

Exterior photocell lighting controls are used to turn on the lighting with the correct color temperature in the morning during the sunrise. The lighting slowly dims brighter with the sunrise to comfortably wake up the patient.



# Circadian Rhythm

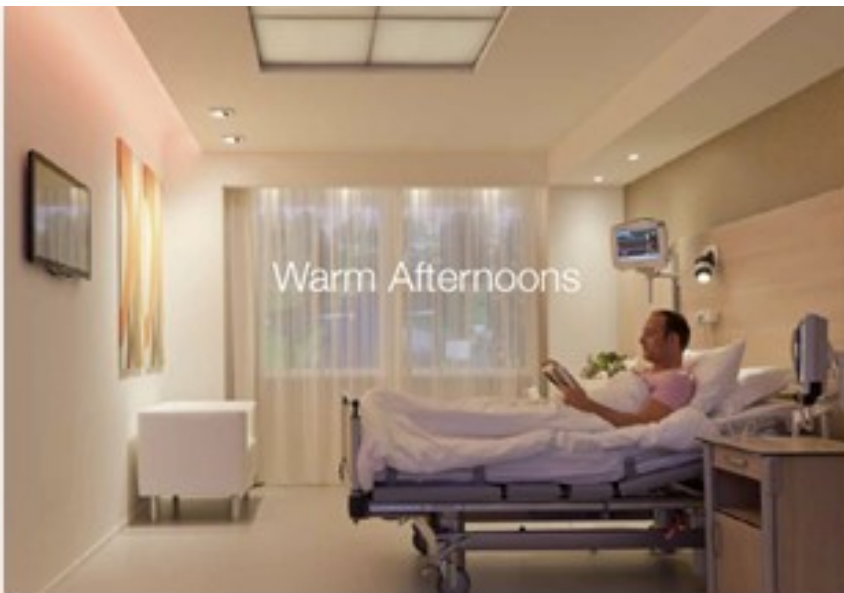


## At Noon, A Light Boost Mimics the Natural Sky

The color temperature is very blue and bright within the room to ensure the patient is awake. Serotonin is released within the patient due to the 460-480nm wavelength triggering circadian rhythm.



# Circadian Rhythm



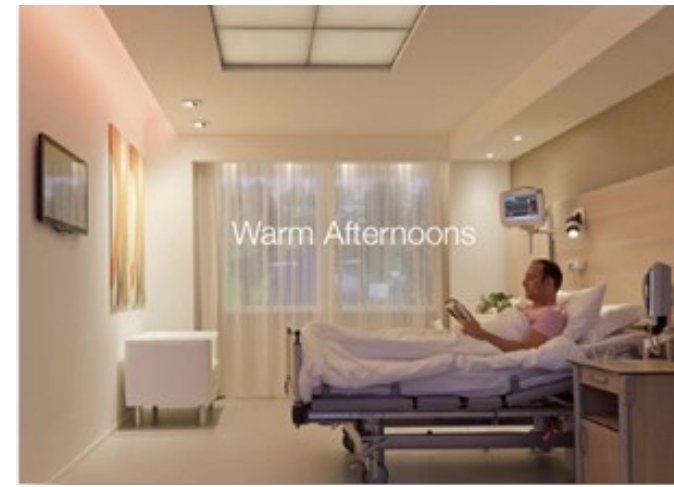
## Warm Color Temperature in the Afternoon Mimics the Natural Sunset

The lack of blue wavelengths triggers the circadian rhythm within the patient to release melatonin and helps the patient sleep soundly. The lighting slowly dims off as the sun sets for the day.



Sleep is an important part of healing. When lighting aids in improving sleep cycles for the patient, it allows us to aid in healing.

**Rested patients heal faster.**



# Why is This Important to Healthcare?

- Happy Employees = Happy Patients = Higher HCAHPS Scores
- Happy Patients = Happier Employees (easier to work when Patients aren't fighting employees)



# Why is This Important to Healthcare?

- Alert Employees = less mistakes made on the job

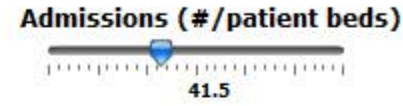
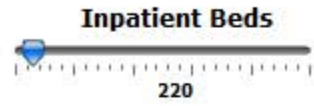


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Print

# Hospital Cost Model

- Current
- Forecast
- Target
- Sensitivity



Type of Hospital  
Typical US Hospital

## Outputs

Operating Margin (%)



Return on Equity (%)



Average Daily Census (%)



Net Cost per Admission



Average Length of Stay



Total Staffing (FTE/AOB)



Energy Cost Index (\$/SF)



Labor Cost per FTE



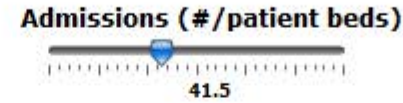
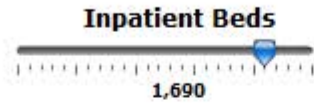


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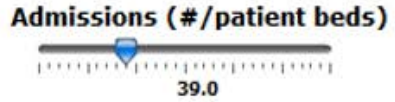
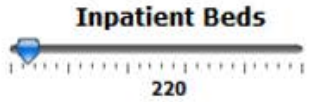


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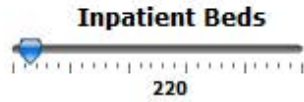


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Lighting Research Center; [www.lrc.rpi.edu](http://www.lrc.rpi.edu)

IES 10<sup>th</sup> Edition Handbook; [www.ies.org](http://www.ies.org)

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National Institutes of Health; [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)

# Questions?

THANK YOU FOR YOUR TIME



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