

# LED LIGHTING IN HOSPITALS



**PAHO**



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## 1.0 Introduction

Lighting applications in hospitals are wide and varied since different areas with their own specific purpose has different requirements: Ward areas, Treatment areas, observation areas examination rooms, waiting and circulation spaces and operating theatres each have different lighting requirements and require specific design criteria. In addition to functionality, hospital lighting also aids in improving patient care and comfort. There are three (3) main parameters to be considered in hospital lighting design

1. Lighting Level
2. Colour Rendering Index
3. Colour Temperature

### 1.1 Lighting Level

Lighting level or illuminance is the amount of light measured on a plane surface or the total luminous flux incident on a surface per unit area. Lighting level is measured in Lux (Lumens /sq. metre) or Footcandle (Lumens /sq. ft.). Lighting levels have been standardized for various occupancies and applications and published by various standards agencies around the world. The IESNA (Illuminations Engineers Society of North America) and the British and European Standard BS-EN12464

### 1.2. Colour Rendering Index

Colour Rendering Index is the ability of the light source to show object colours realistically or naturally. The colour rendering Index (cri) is a scale from 0 to 100 percent. The higher the CRI the better the colour rendering ability. Light sources with a CRI of above 90 percent is considered excellent.

### 1.3 Colour Temperature

Colour Temperature is measured in the units Kelvin and is the standards method for measuring the colour of the light emitted from a lamp. The reason why the colour measurement uses a temperature unit Kelvin is because it is correlated to the colour of a piece of steel heated to the prescribed temperature 2700 K which is yellow warm white colour increases to 5500 K which is similar to the light outside on a sunny day.

## 2.0 Energy Efficiency and LED Lightning

Hospitals require lighting 24 hours per day 365 days per year. It is therefore prudent that the lighting solution provided for the hospital is efficient and meets the requirements for CRI and Colour

Temperature. Over the years the technology of LED Lighting has improved to provide required CRI and Colour Temperatures suitable for all hospital environments. It is therefore important when specifying LED lighting for hospital areas attention is paid to the CRI and Colour Temperature

The CRI range for LED lights is 70 – 98 (Montes de Oca, 2017) making it the closest to natural light compared to other light types. LED lights are therefore suitable for use in healthcare facilities and very effective in improving medical diagnosis of patients.

In addition to CRI and Colour Temperature the design should also follow the standards for lighting levels as specified by the IESNA or THE British/ European Standards

The IEC standard 60601-2-41 “Particular Requirements for Surgical Luminaires and Luminaires for Diagnosis “specifies that the Colour Temperature for lighting for Diagnosis should be between 3000k and 6500 K and Colour rendering Index should be between 90-100 Percent

The general Rule of thumb for most active areas within a hospital building is to maintain a color temperature of 4000K or more (Thorn Lighting, 2017). For Areas such as treatment areas and, operating rooms where colour representation is important, lamps with a CRI of 90 percent or greater and Colour temperature of 5000 K is required. In ward areas where patient comfort is required lamps with warmer colours 3000K and CRI of 85 to 100 is desired.

With the developments in LED lighting, most manufacturers of Surgical lighting fixtures have standardized on the use of LED Lighting in their surgical lighting fixtures.

## 2.1 Energy Efficiency of LED Lighting

LED lamps are amongst the most efficient lighting source suitable for Residential, Commercial, Industrial and Institutional Applications. Luminous Efficacy of a light source is measured in terms of Lumens/Watt. This essentially means how much visible light is produced for each watt of electricity used. The higher the value the more efficient will be the light source. In addition to the efficiency of the light source the lamp life also plays an important role in lighting economics since the frequency of lamp replacement also impacts on cost. In this regard LED lamps can last up to 50,000 hours. This value increases daily as the technology improves. It is however important to note that the efficiency of the LED lamp decreases with time.

The following is a tabulation of typical Lumens/Watt values for different light sources:

Lamp Type	Lumens /Watt	Avg. Lumens/Watt	CRI	Life (Hrs)
Incandescent	8-18	14	100	1000
T12Fluorescent	40-70	55	92	8000
T8 Fluorescent	60-80	70	85	6000

Lamp Type	Lumens /Watt	Avg. Lumens/Watt	CRI	Life (Hrs)
T5 Fluorescent	100-105	102.5	85	9000
Mercury	44-57	50	50	24000
HPS (High Pressure Sodium)	66-121	90	21	50000+
LPS (Low Pressure Sodium)	101-175	150	10	60000+
LED	75-200	137.5	98	50000+

From the above tabulation it can be seen that the only light source which satisfies all the criteria in terms on Efficiency, CRI and Lamp Life is the LED light source.

### 3.0 IES Lighting Levels for Hospital Areas

Table 1 below list lighting levels for some areas in a Hospital:

Location	Lighting Level
Lobby Area	50 lx (5 fc)
Waiting Area (General)	100 lx (10 fc)
Patient Ward Rooms (Observation)	300 lx (30 fc)
Medical Laboratory	500 lx (50 fc)
Operating Room table)	3000 - 10000 lx (300 - 1000 fc)
Critical Care Areas (Examination)	500 lx (50 fc)

Lighting levels have a direct impact on Patient health and mood. Studies show that proper lighting within hospitals through controlling the bodies Circadian system, help to reduce depression amongst patients, decrease length of stay in hospitals and ease pain (Joseph, 2006). It is also important to note that meeting the lighting requirements of hospitals whilst also limiting energy consumption is one of the major challenges faced in hospital lighting design.

## 4.0 Color Temperature/ Correlated Color Temperature (CCT)

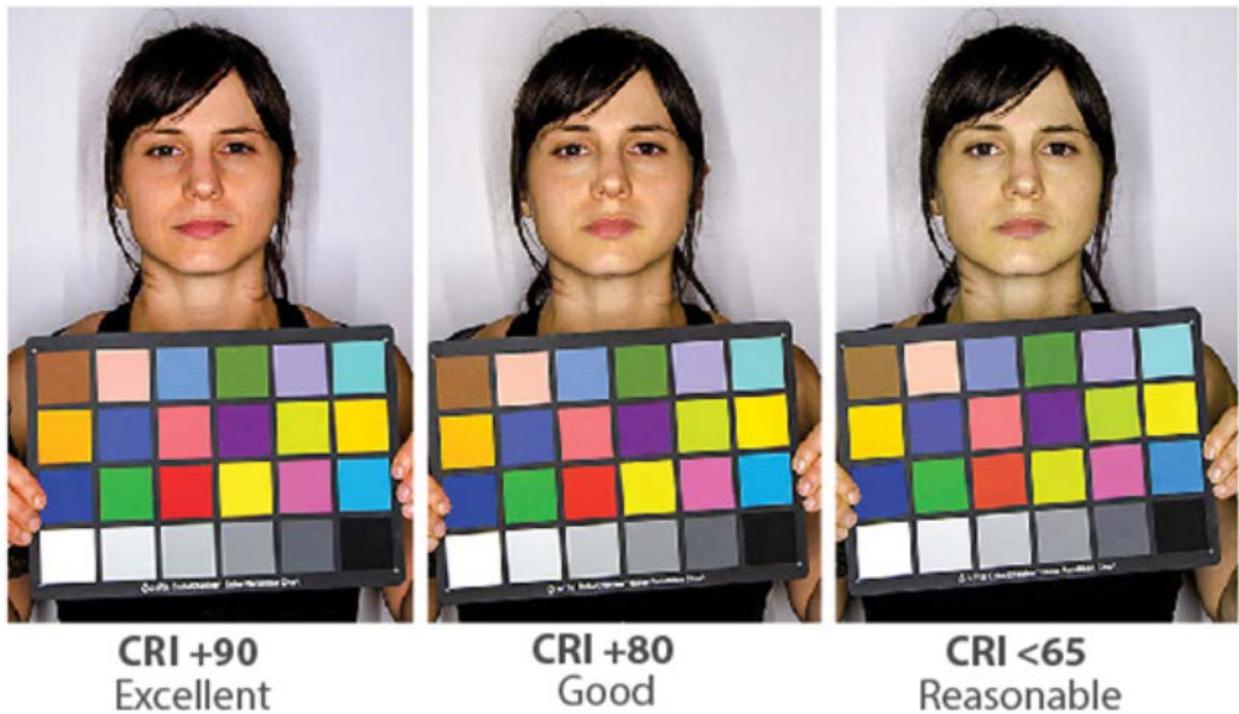
Table 2 below illustrates the different ranges of Color Temperature:

Temperature (K)	Color	Description
2000 – 3500	Orange/Yellow	Ultra Warm or Warm White
3500 – 5000	Paper White	Natural/ Neutral White
5100 – 6500	Bluish White	Cool White

(Montes de Oca, 2017)

## 5.0 Color Rendering Index (CRI) Representation

Figure 1 below illustrates the effect of CRI on skin tone:



(Montes de Oca, 2017)

Figure 1 : Effect of CRI on Skin Tone

As seen in the figure above, a low CRI can lead to a misrepresentation of body features which may lead to misdiagnosis and improper treatment. Areas where diagnosis, treatment or laboratory analysis is being done a CRI of 90 or greater is recommended. For all other areas within the hospital, a CRI is 80 is sufficient, however, under no circumstances should lamps with two (2) different CRI values be used in the same place (Thorn Lighting, 2017).

## References

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