PHILIPS

HealWell

White paper

Backgrounds on **Light & Health** and description of the **HealWell System**

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Glossary

Dynamic Lighting	Gradually changing light during the day
Day-rhythm light	Light that is following a pre-programmed pattern (rhythm) throughout the day
Dynamic-natural light	Light during the main day part in the rhythm, mimicking the sunlight outside during the day
Light boost	High-intensity light
Wake-up	Sequence in the day rhythm of the light that mimics the sunrise by slowly enhancing the light intensity
Go-to-sleep	Sequence in the day rhythm of the light that mimics the sunset by slowly decreasing the light intensity
Ambience light	Accent lights on the wall, creating a pleasant atmosphere in the room
Orientation light	Low light level enabling medical staff to move around in patient rooms safely and enabling patients to find their way at night without disturbing others in the room
Simple Examination light	Light setting that can be used by the medical staff when performing simple examination tasks, offering non-glary, diffuse bright light
Emergency light	Light setting that can be used by the medical staff in case of emergencies, offering simple examination light above all beds in the patient room
User interface	Element of the lighting system with which one can control the light in the room, like e.g. buttons

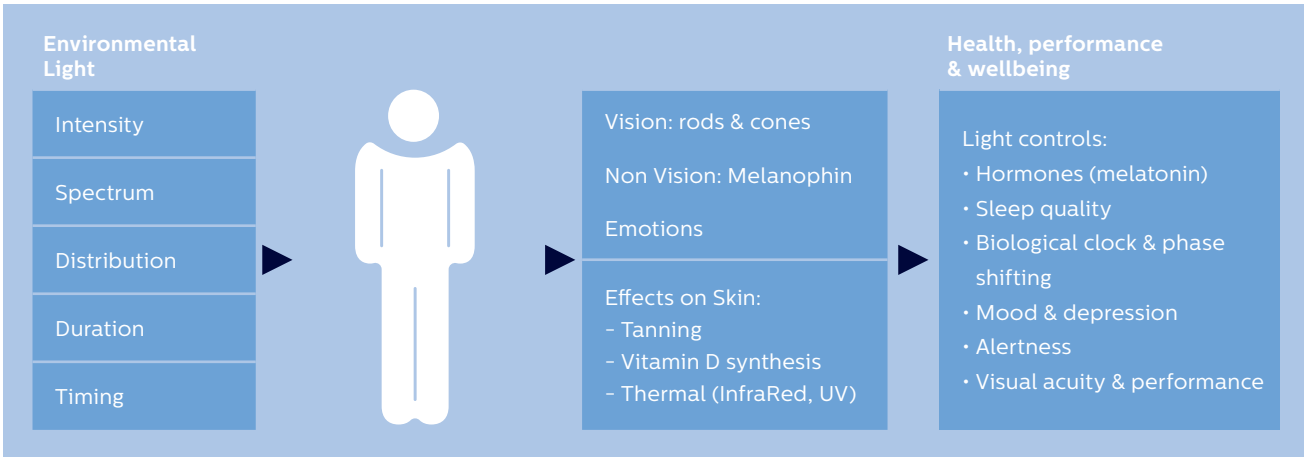
1. Introduction on Light & Health

Light affects human beings in a variety of ways: visually, psychologically and (photo-)biologically.

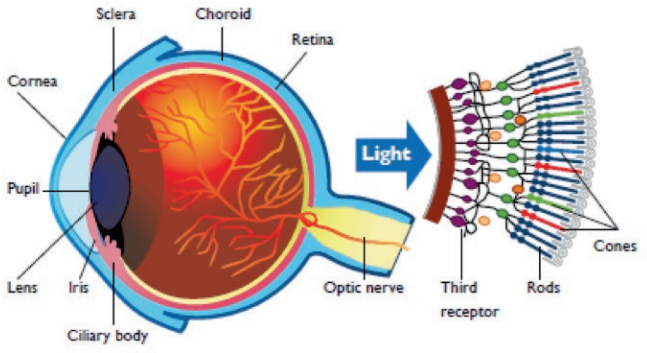
Light's most obvious effect on humans is in enabling vision and the performance of visual tasks.

The psychological effects of light are related to the attractiveness, atmosphere and ambience of the environment (light intensity, intensity distribution, dynamic aspects, light color and color distribution within the field of vision) and they affect our mood, alertness, feelings and motivation.

In recent decades we have learned a lot about the non-visual, biological or non-image-forming (NIF) effects of light; some of these NIF effects are indicated in below figure. These effects are, at least partially, mediated by a recently-discovered photoreceptor that resides within a cell type in the retina of the eye (Berson et al 2002). It is referred to as melanopsin ("third receptor") and it regulates the biological effects of light. It is most sensitive to blue light (peak sensitivity at 480 nm (Hankins et al 2008)).



When ocular light (light perceived with the eyes) reaches these melanopsin-containing photoreceptor cells, a complex chemical reaction occurs, producing electrical impulses which are sent via separate nerve pathways to our biological clock, which in turn strongly mediates most circadian (daily) and circannual (seasonal) rhythms of a large variety of bodily processes, including the production of some important hormones essential for a healthy sleep/waking pattern.



Locations of the various kinds of photo-receptors in our retina.

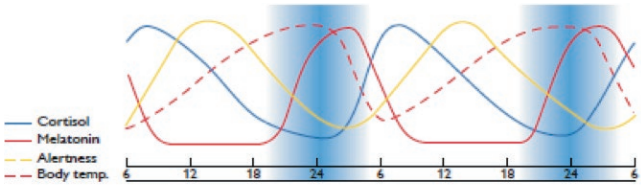
The hormones cortisol (often referred to as the "stress hormone") and melatonin (the "sleep-promoting hormone" that is produced during nocturnal darkness) play an important role in regulating activity and rest.

Cortisol, amongst others, increases blood sugar to give the body-energy and suppresses the immune system (N.B. This action is not favorable: in the long term stress reduces our resistance). Cortisol levels increase in the morning, the natural morning cortisol peak preparing the body for the coming day's activity. In addition, the level of the sleep-promoting hormone melatonin drops in the morning. Both signals act to reduce sleepiness.

Melatonin levels normally rise again in the evening when it becomes dark (DJ Dijk et. al. 1997), enabling healthy and consolidated sleep. Disruption of the circadian rhythm of melatonin or cortisol production has negative effects on the quality of sleep and consequently the ability to perform as well as on our overall sense of well-being.

This diagram illustrates some typical circadian (i.e, 24-hour) rhythms in human beings. The figure shows only a few examples: core body temperature, alertness, and the hormones cortisol and melatonin.

Our biological clock controls our biorhythm, and under natural conditions light synchronizes our internal body clock to the earth's 24-hour light-dark rotational cycle. Without the regular 24-hour light-dark cycle, our endogenous circadian rhythm – our internal body clock – would be autonomously running, with its own period. The period of the internal clock is precise and intrinsic personal property that varies from person to person.



The average period in humans is about 24.2 hours (Czeisler et al 1999), slightly slower than the natural light-dark cycle. Without resetting by light, even this small discrepancy would produce recurrent periods during which our body physiology (melatonin/cortisol/core body temperature) would tell our body that it was time to sleep during the day and to be awake at night. This situation can be compared with jetlag during trans-meridianal travel and is associated with negative effects like fatigue, headache and reduced performance and well-being. Some blind people are known to report these phenomena periodically (Lockley et al 1999, Skene et al 1999).

The biological effects of light extend much further than visual effects only and mean that good lighting has a positive influence on health (Riemersma-van der Lek et al 2008), well-being (Partonen & Lonnqvist 2000, Miller et al 1995), alertness (Campbell et al 1995, Phipps-Nelson et al 2003), and on sleep (Campbell et al 1993, Viola et al 2008, Mishima et al 2001, Nanthi et al 2011).

2. Healwell: System description & light effects

2.1 Introduction

HealWell is a new lighting solution for the patient room that aims to combine the positive, regulating biological effects of light with the creation of a pleasant atmosphere for patients and staff.

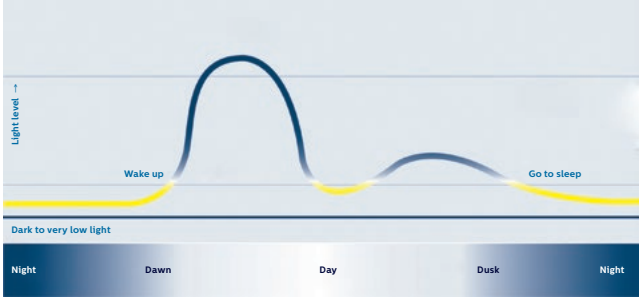
In our modern society, we spend much of our time indoors, at home, in a shop, school, office, or a hospital. Especially people that have to stay indoors for significant part of their time, like patients in a hospital, run a risk that they do not get enough light during the day, to set the bio-clock properly to regulate their biological clock. By compensating for the lack of sunlight entry and mimicking the gradual changing natural light on a sunny day we can induce benefits that are also reported for natural daylight.

Dynamic lighting

In HealWell, the gradually varying light (Dynamic Lighting) during the day simulates some aspects of the natural course of light on a sunny day outside. The dedicated design of the daylight rhythm supports the biological clock of patients in a way that can be tuned to the schedule of the (hospital) department. The automatically changing day-rhythm light curve is schematically shown below:

Dynamic light pattern

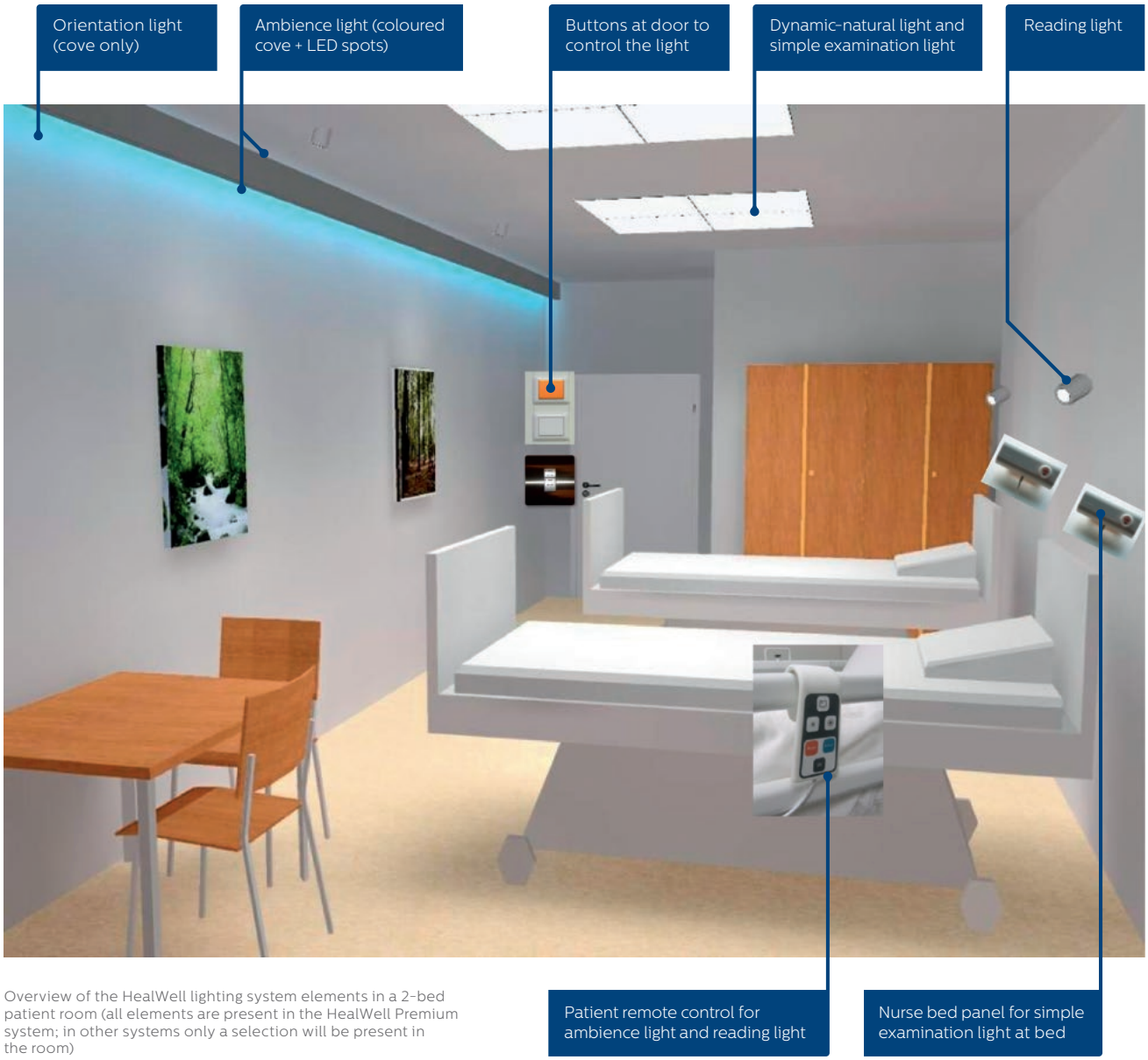
In general, the rhythm starts with low level, warmish light in the morning. The light gradually increases to high light levels in the course of the morning, with a cooler and brighter appearance. Just before noon, the light will be at its highest and coolest level; this is called the light boost. This light boost is maintained for 2 hours (before noon).
In the afternoon the light level will gradually be reduced and in the evening light levels become very low again to create a relaxing atmosphere.



Ambience lighting

The ambience light is provided by accent lights on the wall, creating a pleasant atmosphere in the room. In HealWell Premium colored lighting is added to the ambience light, which can be controlled by the patients, just like the dimmable reading light (only with patient remote control).

The scheme below gives an overview is shown of the elements of the HealWell lighting system; the elements are explained in the next paragraphs. Colored cove light is only present in the HealWell Premium and HealWell Ambience system.

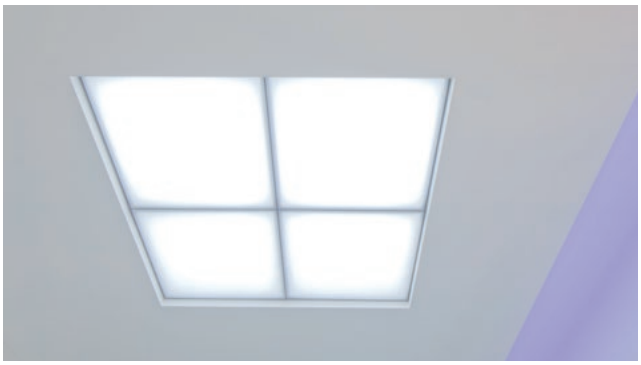


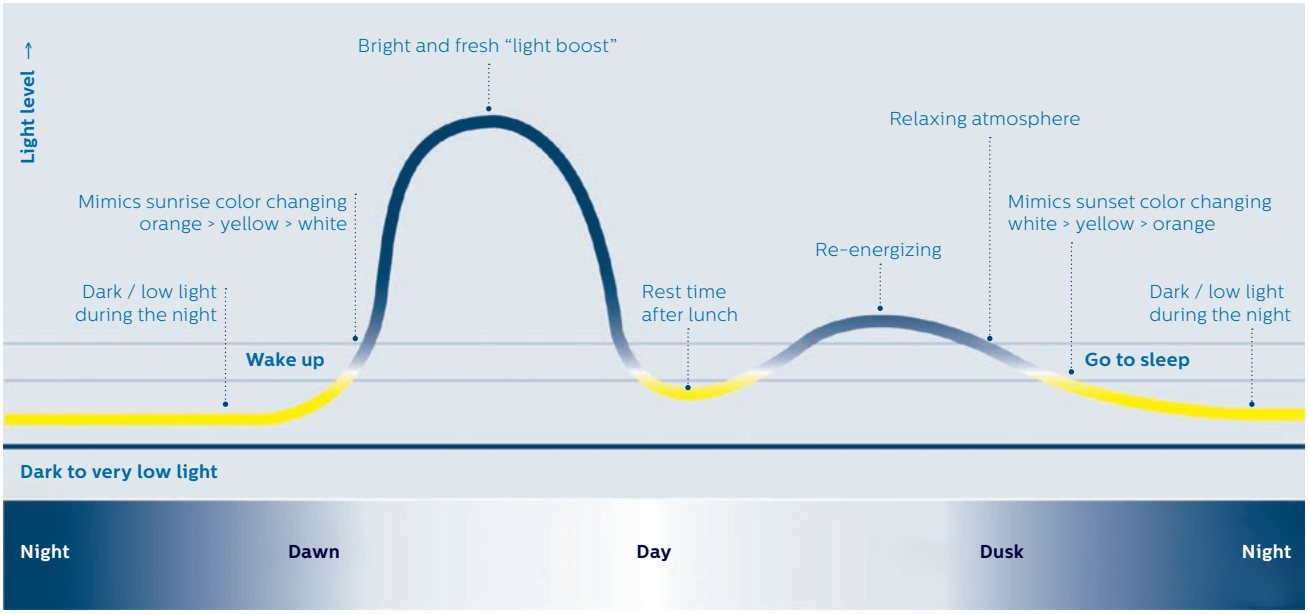
Overview of the HealWell lighting system elements in a 2-bed patient room (all elements are present in the HealWell Premium system; in other systems only a selection will be present in the room)

2.2 Dynamic-natural and simple examination light

The dynamic-natural light provides day-rhythm lighting which is important for patient's health and well-being. It is automatically created by the ceiling light elements above the patient bed during the largest part of the day.

The light in the room will follow a day rhythm of which explanation is shown below:





In the morning the light will automatically switch on (start time can be adjusted according to the hospital schedule): the so-called wake-up sequence. This wake-up sequence starts with gradually increasing light to slowly and comfortably wake up the patient mimicking a sunrise.

During the day the light will vary from a low and warm light level to a higher and cool light level, after which it goes again to a low and warm light level before the evening starts. Just before noon, the light will be at its highest and coolest level; this is called the light boost.

At the evening, the general light above the bed will fade off and the ambience light will go automatically to an amber evening scene. The ambience light provides enough light for evening activities and the indirect light makes the atmosphere in the room more cosy. The ambience scene can be changed when a patient remote control is available, when another pre-defined color is preferred.

Transition to the night depends on the choice of the hospital. When an automatic go-to-sleep sequence has been chosen for, the light will gradually go down and finally the light will switch off. When a colored cove is present, the go-to-sleep sequence is mimicking a sunset and finally the light will switch off.

When it is chosen to switch off the light manually, the ambience light will go to the white night scene.
The night light, which enables patient to orientate at night, can be switched on/off with the general light button at the door or with the patient remote control, when available.

Simple examination light

With the HealWell lighting solution, you can also turn on simple examination light, providing a non-glary, diffuse bright light setting that facilitates the work in the patient room.

2.3 Ambience light

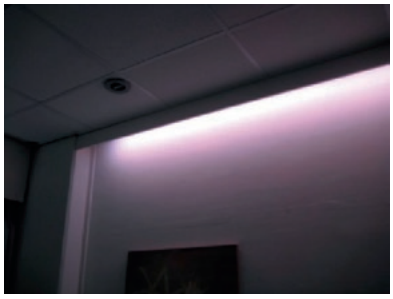
The ambience or atmosphere light is created by a colored cove light opposite to the bed (only in HealWell Premium) and some LED spots. These colored cove light and white accent spot lights create a pleasant atmosphere in the patient room. Accent light spots can be used to light art panels or clip boards on the wall, or just make the light effect on the wall more vivid.

2.4 Reading light

The reading light improves the lighting in the patient's more immediate 'personal space'. The light effect is localized to one patient's space, so as not to disturb other patients more than necessary while e.g. reading a book.

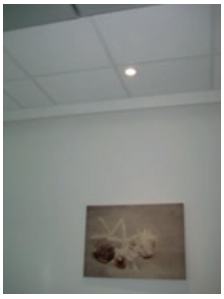
2.5 Orientation light

Orientation light provides low light levels, whilst still enabling medical staff to move around in patient rooms safely and enabling patients to find their way at night without disturbing others in the room.



When cove lighting is present

or



Without cove lighting

2.6 User interfaces of the lighting system

The lighting in the patient room follows automatically the day rhythm that has been programmed. On each moment in time the medical staff can override the lighting setting, to have e.g. more light to perform their tasks, by the use of buttons at the door or by using the button on the nurse bed panel behind the patient's bed (when the latter interface is available in the chosen HealWell lighting system).

Wall mounted box with Patient remote control unit + exam light button for nurse

Furthermore, each patient can have his own patient remote control to control the ambience light in the patient room (pre-programmed presets) and his personal reading light.

In summary, following lights can be controlled in the patient room (HealWell Premium):

- dynamic-natural light, which is the general light during the day
- simple examination light
- ambience light
- reading light
- orientation light at night

3. HealWell: Evidence from a field study

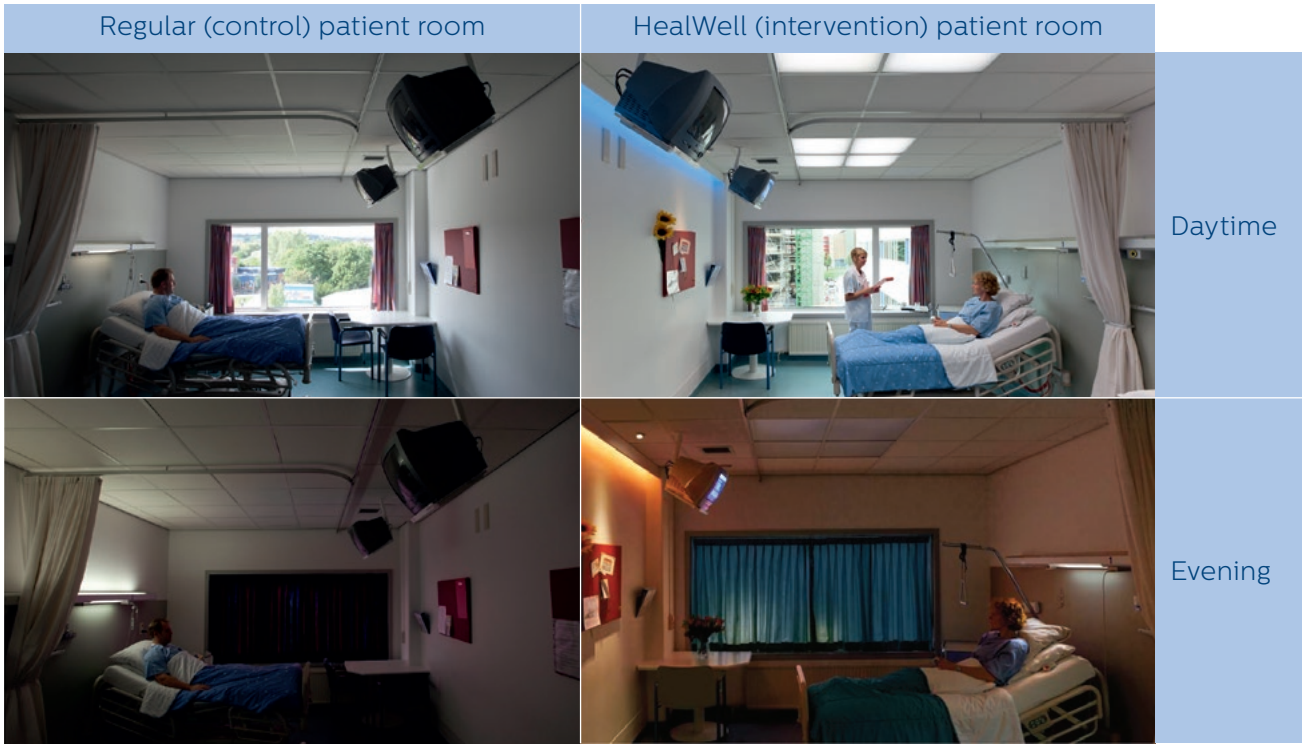
As part of the Philips Lighting initiative to develop and validate the HealWell lighting solution for patient rooms, a field study was carried out at the Maastricht University Medical Centre (MUMC) in the Netherlands. This study was performed in cooperation with the Clinical Trial Centre Maastricht and Maastricht University as research partners.

The study took place at the cardiology ward of MUMC, where various outcome parameters of patients were monitored during their stay in hospital, a.o sleep duration, patient- & staff satisfaction, mood and pain scores. In the study, we compared the results of patients in control rooms (with existing lighting) with those of patients in intervention rooms (with HealWell lighting). There were 4 regular patient rooms used (control rooms) with existing lighting (bed head luminaires) and 4 rooms that were equipped with a first prototype of HealWell (intervention rooms). Both control- and intervention rooms had same number of beds (1x 1 bed room, 2x 2 bed room and 1x 4 bed room), lay out, orientation (NSWE) and staff.

In total approximately 140 patients were included during a 9 months data collection period.

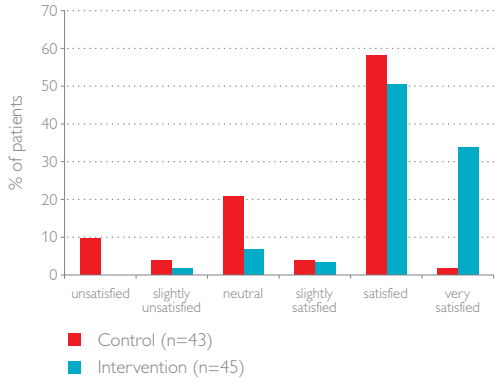
In the study it was found that HealWell has beneficial effects for patients and staff, thus confirming the positive impact that light can have, as shown in earlier studies.

For case studies and projects, please check:
www.philips.com/healwell



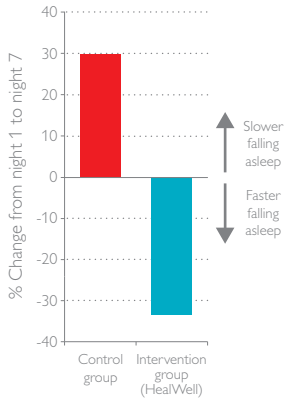
In the figures below you can see that HealWell has particularly led to:
- Improved patient and staff satisfaction
- Longer sleep duration of patients
- Falling asleep more rapidly (reduced sleep onset latency)

Increased patient satisfaction

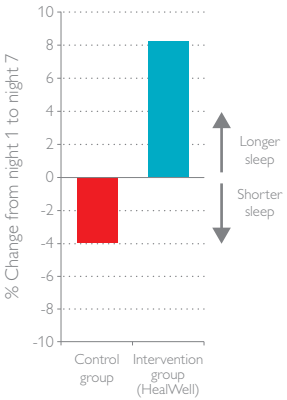


Increased medical staff satisfaction

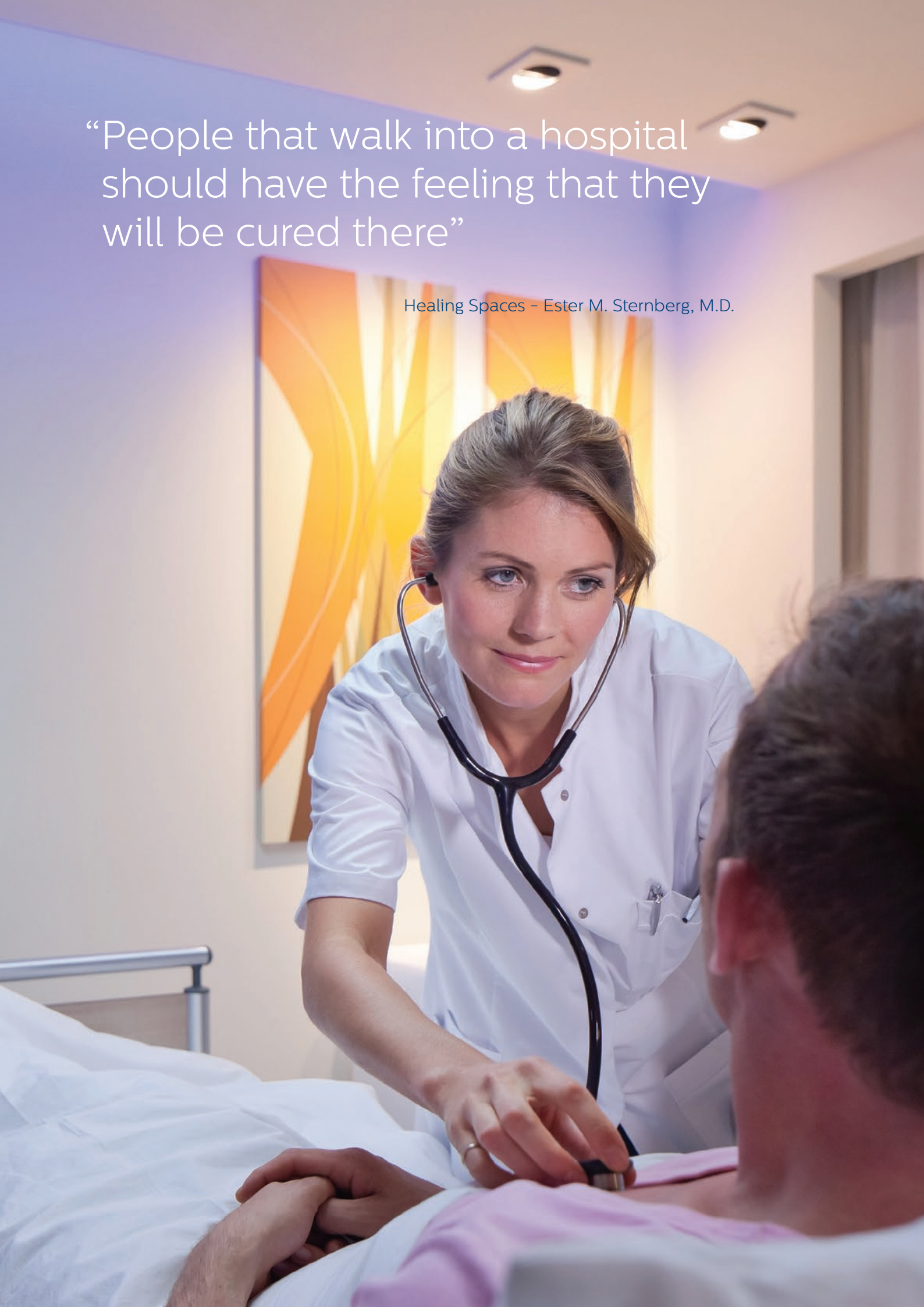
Longer sleeping time



Faster falling asleep



Initial reporting of results: Gimenez et al., Annual Proceedings of the NSWO Volume 22, 2011, p. 56-59


“People that walk into a hospital should have the feeling that they will be cured there”
Healing Spaces - Ester M. Sternberg, M.D.

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