


# healthcare design insights

## Welcome to the inaugural edition of *Healthcare Design Insights!*

This issue focuses on daylighting in hospitals, and how to harness the extraordinary power of free, natural light for improved health care efficiency and effectiveness, better buildings, and reduced costs. On the following pages are:

- An introduction to daylight in hospitals, including links to research and more detailed sources. (Click on the headlines in the boxes with  for live web links to further information.)
- Narrative and illustrative detail of specific design concepts for using daylight in Plan, in Patient Rooms, at Nursing Stations, and on the Building Envelope.
- Photos of projects illustrating these design concepts; please see the links on page 6 for further information on these projects.

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Natural light humanizes a trauma care area in a busy emergency room at Providence Newberg Medical Center.

## Daylight, Nature & Power

A patient is recuperating in her room. Over the course of her day, she watches a shaft of light move across the floor, occasionally hidden by clouds. Although she can't see the sun, nature's clock helps her feel connected to natural warmth and light. She feels better.

Over the same day, a nurse is working at his station, lit solely by a buzzing fluorescent tube. He passes no windows on his way to patient rooms, seeing only gurneys, computer screens, and metal and plastic beds. He feels tired.

While these are stark and perhaps obvious contrasts, they illustrate the unique power of natural light—or lack thereof—to affect the human physical and psychological experience.

This webletter highlights some specific and highly effective approaches that forward thinking health care facilities are adopting to use daylight and improve: (1) healing outcomes, (2) staff productivity, retention, recruitment, and, (3) energy performance.

### The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity

by R. Ulrich and C. Zimring  
The Center for Health Design (2004)  
as Abstracted in AIArchitect (Feb 2005)

This report assembles the results of over 600 studies in medical and peer-reviewed journals to establish strong foundation for evidence based health care facility design. The writers apply rigorous research to understand the impact of the physical environment on patients and staff, with the specific goal of reducing medical errors and infections acquired in hospitals.

The design of New Karolinska Solna (a new university research and education hospital in Stockholm, Sweden) emphasizes natural light in all areas, including sub grade spaces via light wells and surgeries placed at exterior walls.



## Daylight, Therapy & Efficiencies

In addition to “feeling good,” natural light entering the eye activates or effects a number of specific physiological processes, specifically the fluctuations in biological activity and behavior coinciding with the 24 hour day/night cycle, the human circadian rhythm. Light can affect body temperature and the hormones cortisol and melatonin, which in turn effect the body’s ability to deal with fatigue and stress. Removing barriers between “inside” (patients and workers) and the “outside” and consciously designing cues (both natural and electric) to engage the circadian rhythm can positively affect alertness, the immune system, and energy levels.

Two studies noted in *The Impact of Light on Outcomes in Healthcare Settings* illustrate the sometimes dramatic therapeutic improvements related to natural light:

**“A retrospective study of myocardial infection patients in a cardiac intensive-care unit treated in either sunny room or dull rooms found that patients stayed a shorter time in sunny rooms (2.3 days in sunny rooms, 3.3 days in dull rooms).”**

**“Patients exposed to an increased intensity of sunlight experienced less perceived stress, marginally less pain, took 22% less analgesic medication per hour, and had 21% less pain medication costs.”**

A recent project illustrates the power of natural light to improve workplace perceptions and staff productivity, leading to increased staff retention. Providence Newberg Medical Center, a new 181,000-square-foot facility, is the nation’s first LEED® Gold accredited hospital. Seeking data to measure the efficacy of design decisions and to inform their future projects, the architect and owner worked with the University of California at Berkeley based Center for the Built Environment (CBE) to conduct a formal post-occupancy evaluation. 68% of survey respondents noted improvement in individual productivity in the new facility, with 41% very satisfied and 24% satisfied (76% total) with its “healthful and productive day lit clinical areas.” Employee satisfaction with work areas has increased since the opening of the new facility, and physician recruitment has benefitted. All this has validated the owner’s dedication to maximizing daylighting in future facilities.

The last benefit of natural lighting is less electric lighting, reducing energy required to power the light fixtures and to offset (cool) the heat gain from the fixtures themselves. A report by Better Bricks notes that energy savings during daylight hours can be as high as 87% in daylit patient rooms.

### The Impact of Light on Outcomes in Healthcare Settings

by Anjali Joseph  
The Center for Health Design (2006)

Joseph’s study is a pioneering and oft-cited resource in the study of daylighting in health care. It is an excellent source for research and scientific data, and includes a detailed bibliography listing dozens of studies and surveys. Joseph summarizes findings about daylight “reducing depression among patients, improving sleep and circadian rhythm, lessening agitation among dementia patients, easing pain, and improving adjustment to night-shift work among staff.”

### Daylighting

by Heather Burpee  
Integrated Design Lab Puget Sound (2008)

The Integrated Design Lab Puget Sound allies research, education, and architectural practice to promote integrated design and the development of high performance buildings in the Pacific Northwest. A research associate there, Burpee elaborates on the biological processes affected by daylight.



## Daylight in Plan

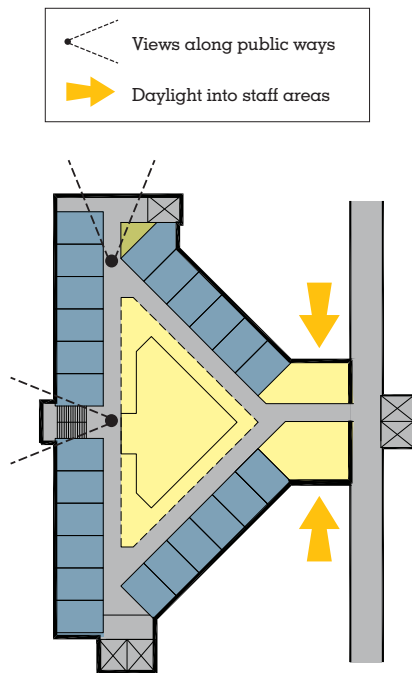
In a typical healthcare project, early design decisions properly account for staff efficiencies and access to patients, but do not consider natural light until much of the opportunity is lost. To realize the benefits of natural light, it must be a consideration from the earliest concept design stages. While no one approach fits all situations, daylight should be considered:

- :: Directly in staff work areas (direct, sky lit)
- :: As wayfinding in public circulation (light at corridor ends or mid-point nodes)
- :: For patient & visitor waiting areas
- :: Within patient rooms

Below are three typical, “genericized” approaches to patient care units, specifically illustrating opportunities for using daylight as wayfinding and in nursing stations.

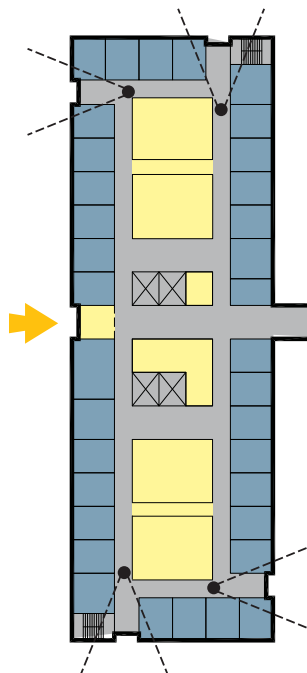


Providence Newberg Medical Center showcases daylight in waiting areas, as well as how it can be used as a tool for wayfinding.



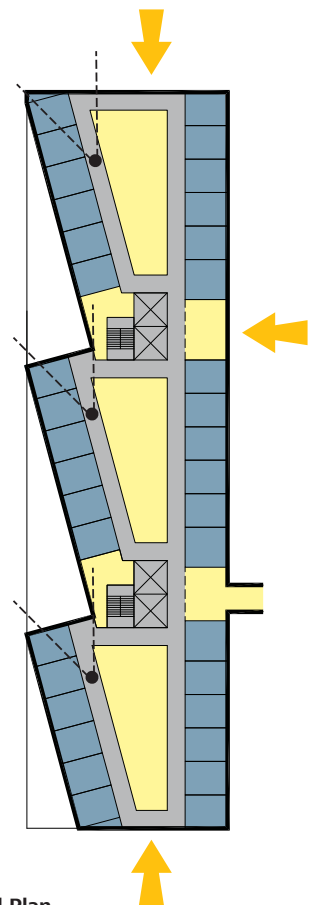
### Triangle Plan

A common approach to maximize patient supervision and efficiency of access, this approach is more inwardly focused, and opportunities for daylight entry are limited to the connections at the building spine and circulation paths.



### Rectangle Plan

This approach provides strong view connections and way-finding support, and the rectangular form is more economical in terms of structure and exterior skin. As with the other plans, direct light to internal nursing areas could be provided by creating openings between patient rooms, perhaps with a waiting area.



### Staggered Plan

With more articulation of the exterior wall, opportunities for daylight use increase, with multiple opportunities for views along public paths and significant daylight from the building ends.



Left: Evergreen Hospital Medical Center;  
Bottom left: Providence Newberg Medical Center;  
Bottom right: Rogue Valley Medical Center



#### Daylighting Hospital Patient Rooms

Better Bricks and Energy Studies in buildings Laboratory at University of Oregon (2005)

Mahlum is one of five northwest architectural firm members of the **Northwest Energy Efficiency Alliance (NEEA)**, a non-profit organization funded by Northwest utilities, the Energy Trust of Oregon, and the Bonneville Power Administration working to accelerate market adoption of energy-efficient products, technologies, and practices.

**BetterBricks** is a related NEEA organization providing specific training and technical resources for improving energy performance in the design, construction, and operation of their buildings. This study, conducted with fellow member ZGF Architects, is a detailed how-to for balancing the many factors affecting patient room design and daylight.



## Daylight in Patient Rooms

Maximizing the power of daylight in patient rooms requires analyzing and balancing:

- :: **The adjacencies of windows and walls, and the glare/shadow areas formed**
- :: **Light received directly through the windows**
- :: **Light reflected from interior surfaces**
- :: **Supplementary electric task lighting**
- :: **Direct visual connections to views out the window**

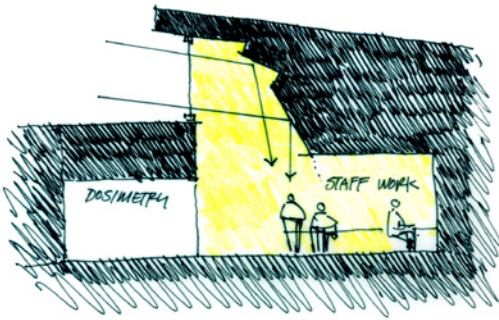
Three examples illustrate the benefits and tradeoffs of different approaches.

1. Keeping the window off the floor creates more opportunity for furniture or casework against the window, both for patients and visitors. This approach also creates a darker zone below the window, increasing visual contrast and view-ability. This approach is illustrated at Evergreen Hospital (top left).
2. The power of windows is also about the link to the natural landscape. The formal post occupancy evaluation and informal patient and staff comments from Providence Newberg Medical Center (bottom left) highlight the soothing

and therapeutic value of the design's maximization of patient views of the surrounding pastoral scenery. Patient room windows are "picture," free of mullions, with the bottoms low enough for views of landscape and earth from the beds.

3. Windows directly abut both the floors and the walls between patient rooms at Rogue Valley Medical Center (bottom right). This helps to visually expand the room to the outside, increases reflected light off of the wall and floor, and provides more opportunity for patient views of sky and landscape.





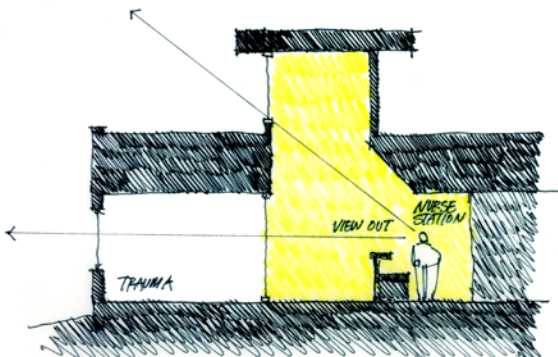
This sketch illustrates how natural light bounces off specific wall angles to draw light deep into the interior with no direct beams or shadows. The result is pictured below.



Diffused, natural light at Evergreen Hospital's Radiation Oncology Department.



A light well above a nurse station at St. Mary's Medical Center's emergency room.



This sketch illustrates how natural light floods the desk area of the nurse station. The result is pictured above, at right.

## Daylight at Nurse Stations

Nurses stations are often "buried" deep within a hospital. Light wells are an effective tool that allows centralized nursing stations to benefit from natural light.

The Emergency Room at St. Mary's Medical Center in Walla Walla (pictured above) includes a wide light well above working nurses, flooding the desk areas in light both direct and reflected off the clerestory walls. This client wanted staff to see and feel the time of day as it passed, directly feeding circadian rhythms.

The Radiation Oncology Department at Evergreen Hospital in Kirkland, Washington (pictured at left), uses diffused natural light, with no direct beams or shadows. Specific wall angles draw the light deep into the interior, while electric lights hidden in the clearstory provide nighttime illumination with similar reflected qualities. This approach provides a consistent "feel" of overhead, natural light.



Moorfields Eye Hospital in London, England, has a skin with almost 100% glazing and a complex arrangement of louvers to reduce solar gain.

## Daylight & the Building Envelope

Much of the challenge with “grabbing” daylight is heat gain from the sun. Hospitals are in cooling mode on most of the planet most of the time. Additional sunlight, while beneficial for other reasons, adds to the heat load and cooling demand. The Moorfields Eye Hospital in London, England, illustrates a highly creative approach that includes a skin with almost 100% glazing (to draw natural light deep into the facility) and a complex arrangement of louvers

(to reduce solar gain). The concept at Moorfields was a collaborative venture of the architects seeking openness and “veils,” an artist working with concepts of “fragmented grids,” and engineers at the London office of Arup analyzing the behaviors of the louvers for solar and heat gain. The resulting design is envisioned as “birds in flight” and together with high performance glazing reduces the peak summer load by 50%.

## Daylight & the Design Process

The final—or original—challenge to maximizing daylighting is the design process itself. We’ve learned that inter-disciplinary “charettes” are key to bringing to the fore potential for daylighting (and other high-performance building features). By assembling broad teams including staff, architects, engineers, contractors, and more; we determine the decision criteria and performance metrics, create multiple options, and build consensus on key issues. The participating individuals represent a variety of outlooks and criteria, and the charrette offers a process to bring out that expertise and balance cost, staff efficiency,

therapeutic benefit, constructability, ongoing-maintenance, and more.

The process works best when it starts with big picture and works to detail. For daylight considerations, teams start with massing options and the building site climate. The team then prioritizes and orients building geometry to program needs. Following comes focus on apertures (windows and doors) and specifics such as glare control and the ergonomics of specific work stations. In this manner daylight can be best considered and utilized in hospital design.



### History of Healthcare Architecture

by Heather Burpee  
Integrated Design Lab Puget Sound (2008)

Burpee summarizes the timeline and development of health care “typology” over the past two centuries, and how traditional hospitals grew into massive blocks and large floor plates with little opportunity for using natural light to enhance operations and therapeutic outcomes. This view and lessons-learned from the past helps improve process for the future.

### The Business Case for Better Buildings

by L. Berry, D. Parker, R. Coile, D. Hamilton, D. O’Neill and B. Sadler  
Healthcare Financial Management (11/2004)

This article provides an overview of the financial and risk-management benefits of improved daylighting in health care settings, presented for financial and administrative professionals.

**Healthcare Design Insights**, produced by Mahlum, furthers evidence-based design, offering practical tools and ideas to healthcare administrators, facility managers, and developers. We welcome your feedback and ideas for future issues!

#### Seattle

(206) 441-4151

#### Portland

(503) 224-4032

[mahlum.com](http://mahlum.com)

[info@mahlum.com](mailto:info@mahlum.com)

## Projects featured in this issue:

Pages 1, 3, 4  
**Providence Newberg Medical Center**  
Newberg, Oregon  
Architect: Mahlum

Page 2  
**New Karolinska Solna University Hospital**  
Stockholm, Sweden  
Architect: White Arkitektur

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**Evergreen Hospital Medical Center**  
Kirkland, Washington  
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**Rogue Valley Medical Center**  
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**Moorfields Eye Hospital**  
London, England  
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Engineer: Arup