

Daylighting in Practice:

a German and American collaboration by:
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Within Surgical Environments



daylight OR

- a condensation is controlled by low U-levels and floor heating
- b horizontal louvers are integrated into a double skin facade to block the sunlight
- c blinds are used to block the daylight, if needed. No blinds are used in 9 of 10 procedures.
- d within the surgical department: 3 ORs are facing west, 2 ORs are facing north and 5 don't have direct daylight access.
- e dimension of the OR: 6,27m x 6,25m (39,19m²/422sf)

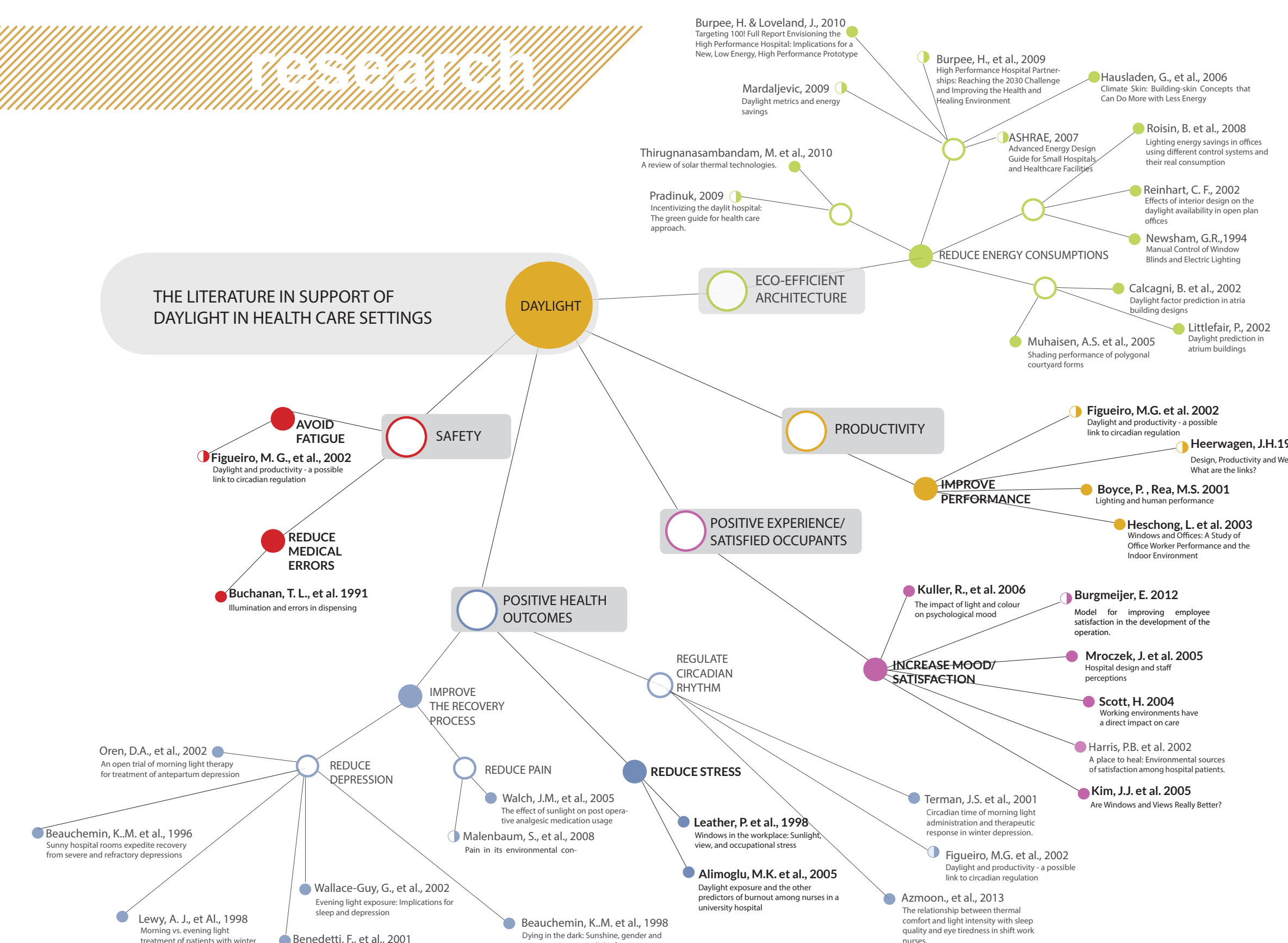
Abstract

Increasingly, research indicates that access to daylight and connections to the outside can improve health outcomes for patients, and health status for healthcare staff. Conversely the lack of access to adequate daylight can potentially have a negative impact in both populations. Literature and research studies to date suggest that positive impacts in healthcare environments overall include improved productivity, reduced task errors and fatigue, improved mood and satisfaction, stress reduction, reduced need for pain medication in patients and overall improved energy efficiency.

There is little evidence to date that is specifically focused on surgical environments or operating rooms. It can however be inferred from research in other healthcare settings that the greatest potential positive impact of controlled daylight in surgical environments would be in improving task performance, reducing fatigue, stress and task errors among staff. As surgical procedures become increasingly minimally invasive, and anesthesia protocols evolve over the life of operating rooms being built today, there is also the potential that patients will be more alert, at least at some point, in the surgical process within the OR. If so, the direct impact of daylight and views has the potential to include stress and pain reduction, and improved satisfaction for patients.

This poster demonstrates that modern layouts of surgical departments, enabling access to daylight and views to the outside, can be functionally efficient, without compromising patient safety, internal flow or increased travel distances. In contrast, limitations of daylighting within surgical environments (some procedures require specific lighting), as well as strategies to control daylight to prevent glare and unwanted heat gain, will be displayed. From case studies of several hospitals in Germany and the US, attendees will see best practices of surgical departments and ORs with connections to the outside.

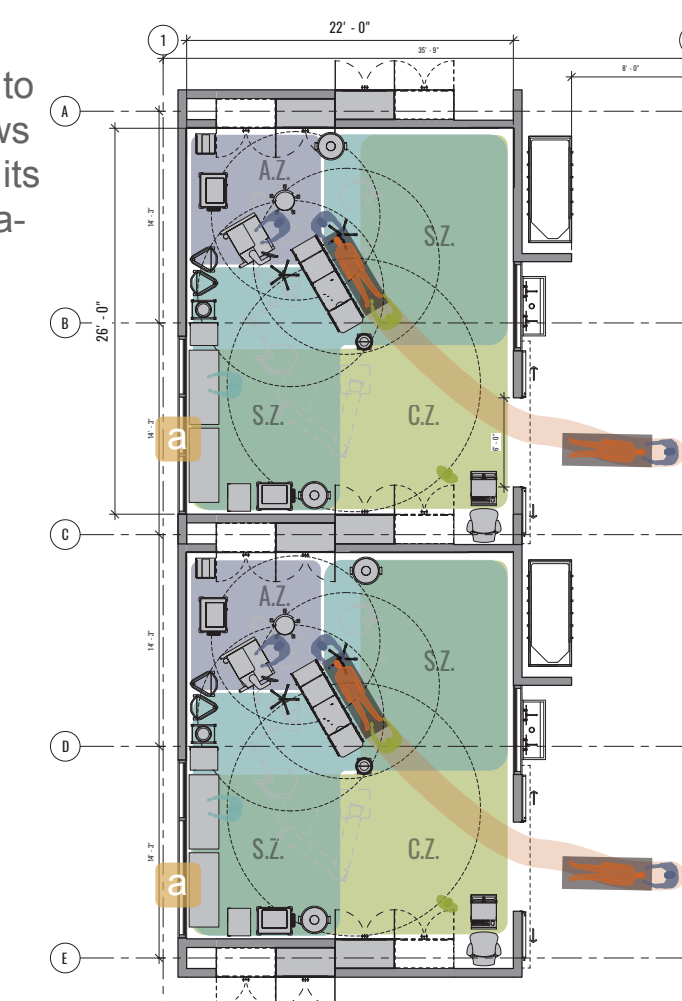
research



operating room prototype



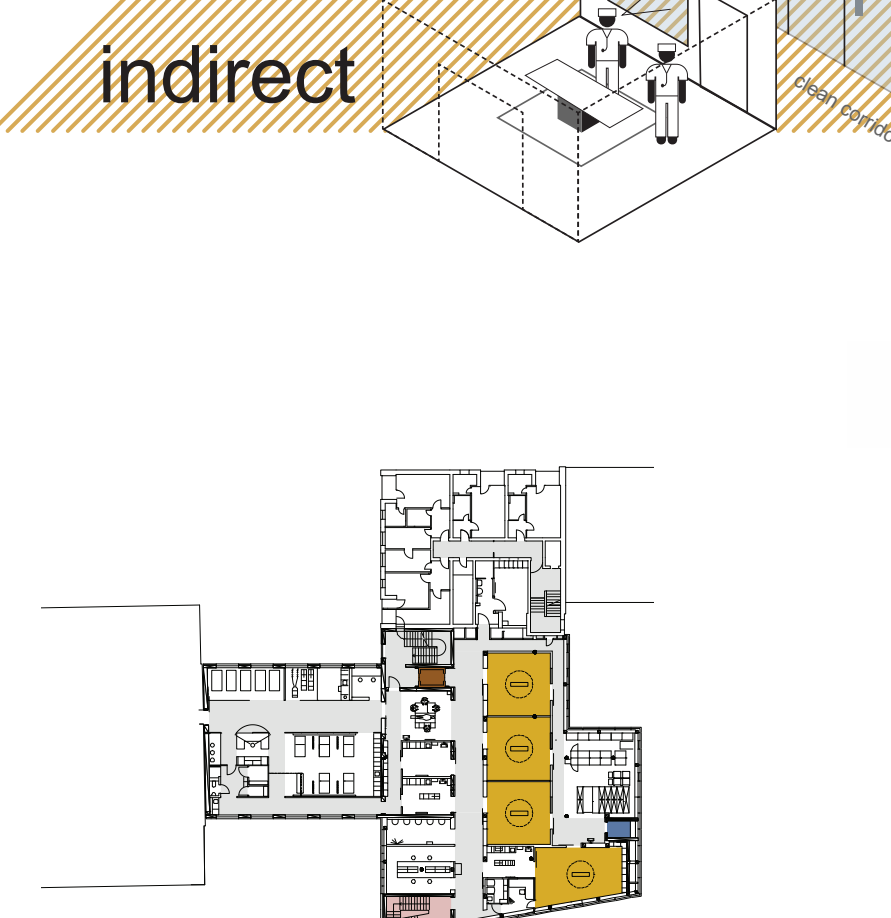
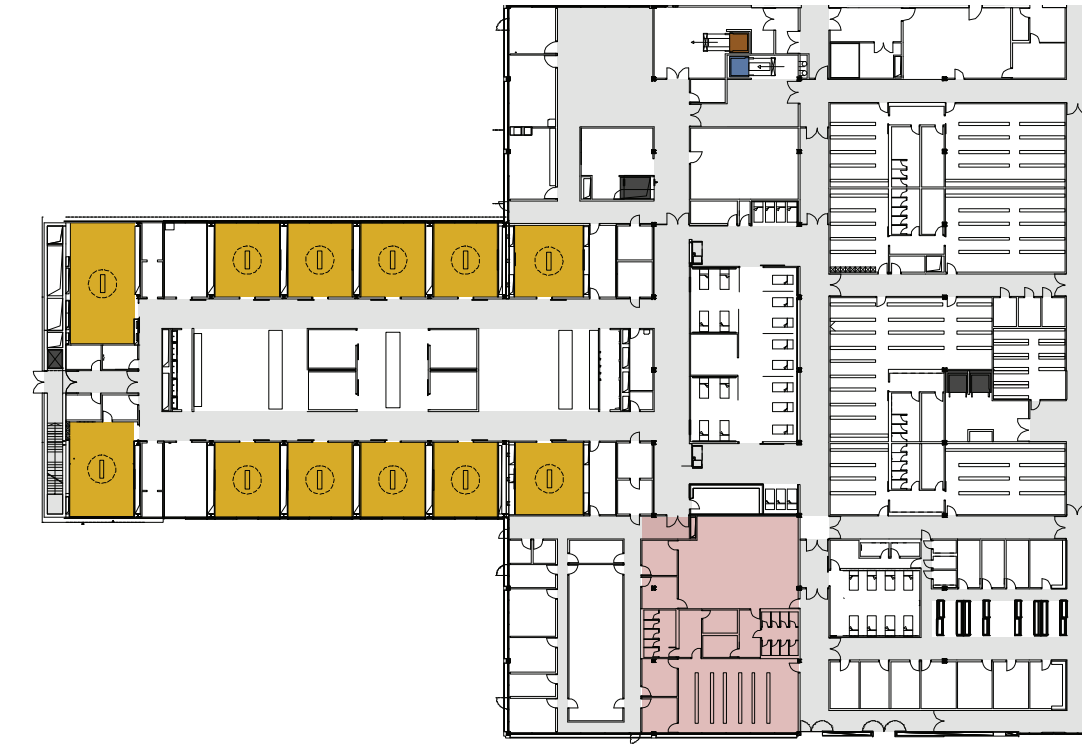
a exterior window wall with access to daylight and views to the outside or its virtual representations



Clemson University and Medical University of SC RIPCHD. OR Operating Room Prototype

The Clemson OR Prototype Project is part of an ongoing Realizing Improved Patient Care through Human-Centered Design (RICHCD) AHRQ funded multi-year research effort that includes the design, fabrication and testing of a full-scale operating room mock-up. This mock-up and its design features are serving as a test prototype for an optimal, adaptable and flexible ambulatory surgery OR "platform" or "chassis". It was executed as part of an interdisciplinary research-design-research-rebuild project involving architecture and health students and faculty in collaboration and consultation with researchers, clinicians, consultants, practicing architects and industry collaborators. The project built upon prior research knowledge, observations of surgical procedures and best practices to address and advance current design concepts for the Operating Room. The intent was to integrate both the art and science of healthcare architecture, and demonstrate that interdisciplinary design built upon a rigorous and systematic research study of issues, problems, opportunities and constraints can raise the quality, safety, efficiency and adaptability of design in healthcare contexts while addressing a broad range of patient, staff and family needs. Design features included the introduction of a window wall that could be either real, virtual or both which could transform as needed for both patient and clinical staff needs.

access & layout



- 1 Hospital Brandenburg (SKB) (Germany) completed: 2003
number of beds: 336 (ratio bed/OR 34:1)
number of ORs: 10
size of OR: 6,27m x 6,25m (39,19m²/422sf)
- 2 University Hospital Duesseldorf (Germany) completed: 2012
number of beds: 328 (ratio bed/OR 41:1)
number of ORs: 8
size of OR: 6,25m x 7,78m (48,63m²/523sf)
- 3 Military Hospital Ulm (Germany) completed: 2012
number of beds: 496 (ratio bed/OR 41:1)
number of ORs: 12
size of OR: 6,34m x 7,38m (46,79m²/504sf)
- 4 DRK Hospital Berlin (Germany) completed: 2011
number of beds: 260 (ratio bed/OR 65:1)
number of ORs: 4
size of OR: 6,325m x 6,25m (39,53m²/426sf)
- 5 Palomar Medical Center West, CA (USA) completed: 2012
number of beds: 360 (ratio bed/OR 20:1)
number of ORs: 18
size of OR: 8,42m x 7,49m (63,07m²/679sf)
Net to gross ratio: 1.9
- 6 UCLA Outpatient Surgery&Oncology Center (USA) completed: 2013
number of beds: 0 (outpatient)
number of ORs: 8
size of OR: 6,02m x 7,04m (42,38m²/400sf)
Net to gross ratio: 1.57



Architect: Heinle, Wischer und Partner
photo credits: Bernadette Grimmstein



Architect: Heinle, Wischer und Partner
photo credits: Tomas Riehle/Universitätsklinikum Duesseldorf



Architect: Heinle, Wischer und Partner
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Architect: Heinle, Wischer und Partner
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Architect: CO Architects
photo credits: courtesy of CO Architects

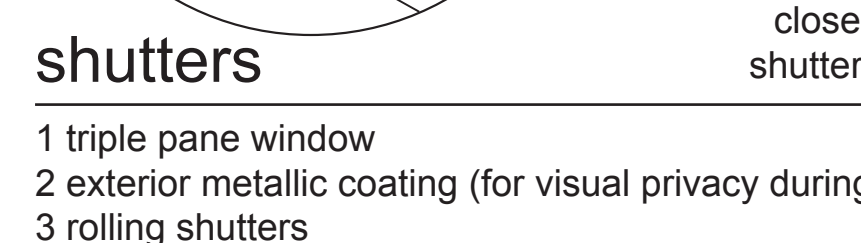
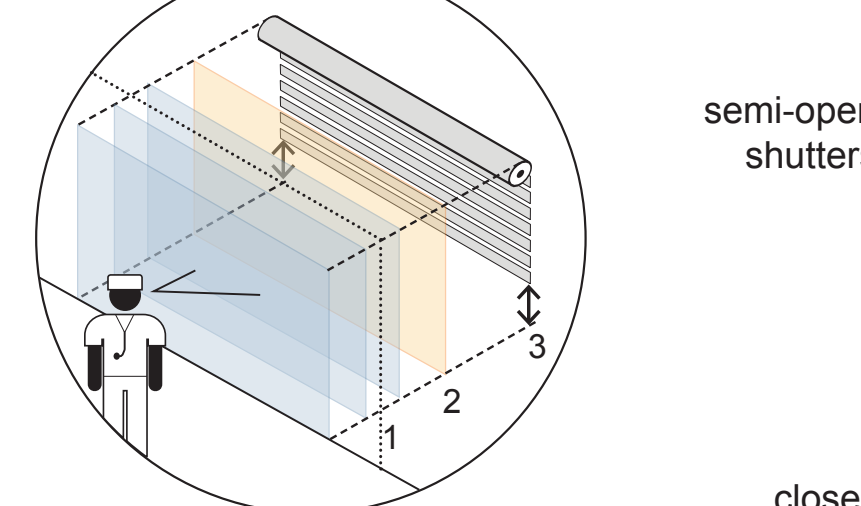
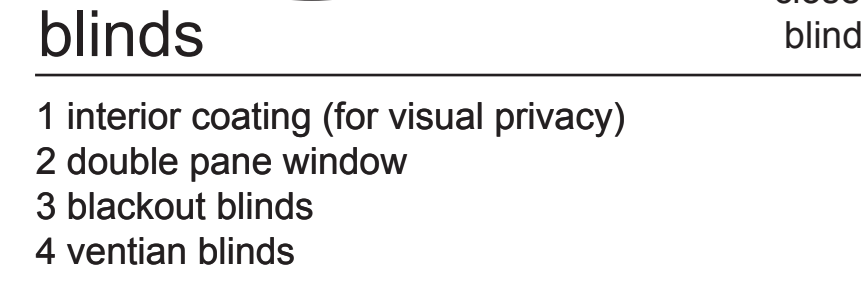
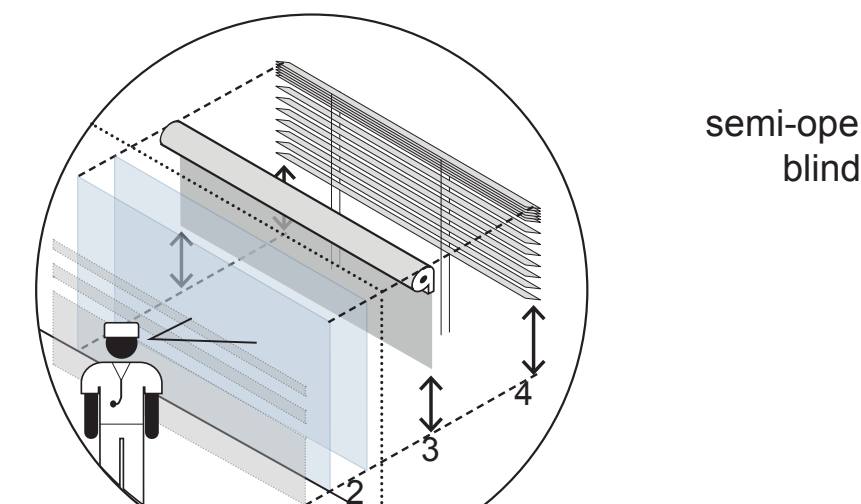
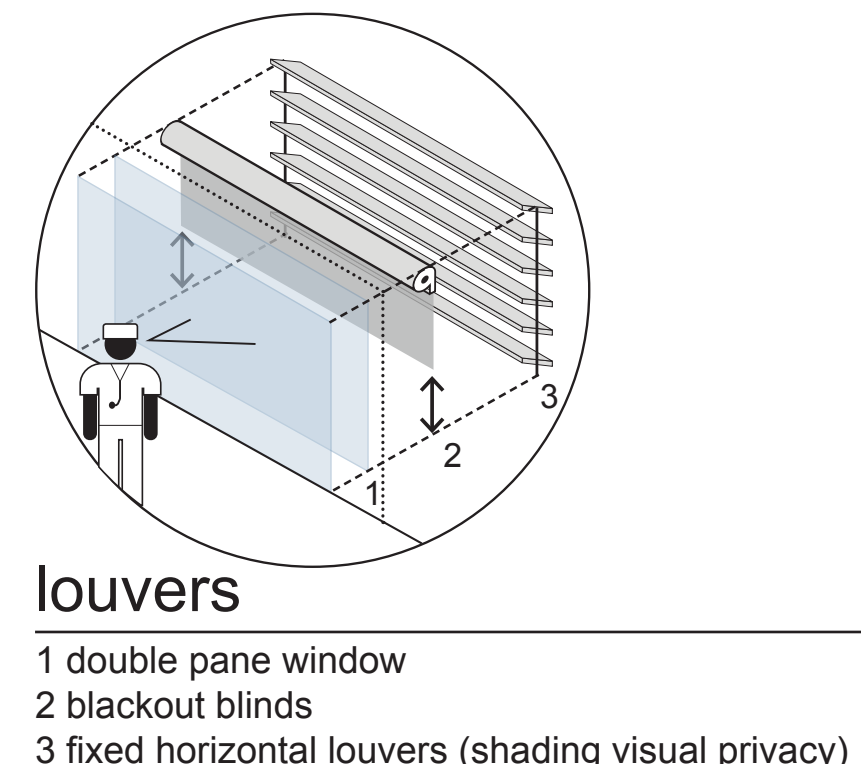


Architect: Michael W. Folonis Architects
photo credits: http://www.folonisarchitects.com/ucla-1/

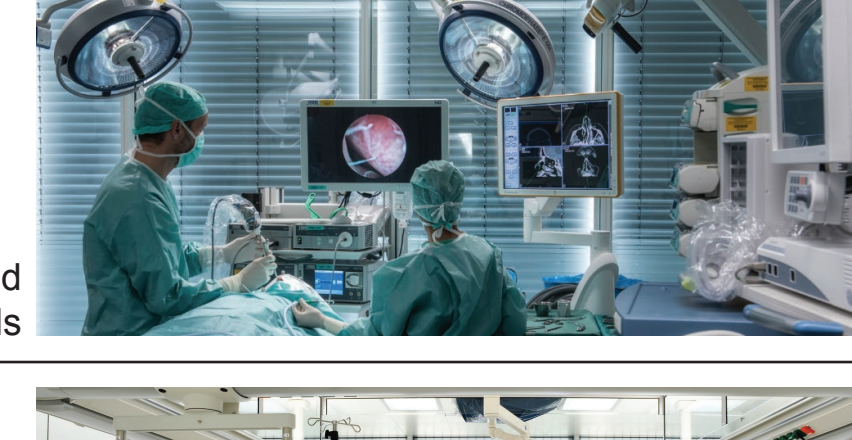
design guidelines

- 1 | orientation
 To minimize distraction, glare or heat gain due to shallow sun angles, avoid ORs along the perimeter facing east or west.
 The preferable orientation for ORs with daylight access is north or south. ORs facing south need careful designed shading devices for sun control, such as louvers, shutters or blinds.
- 2 | avoiding condensation
 very low u-value: 2,0 W/m²k
 e.g. triple pane window
 SKB: double pane window: low u-value heated aluminum frame (u-value 2,0 W/m²k) compact floor heating along the facade
 ZOM II: double pane window: u-value (1,0 W/m²k) aluminum frame: (u-value 1,5 W/m²k) compact wall heating (1m deep)
 Ulm: triple pane window: u-value (0,6 W/m²k) aluminum frame: u-value (1,1 W/m²k)
- 3 | visual privacy
 a) place OR with windows on upper floor
 SKB: OR on first floor
 ZOM II: OR on first floor
 b) use coating or exterior louvers
 exterior louvers
 interior coating
 exterior coating (OR mainly used during daytime)

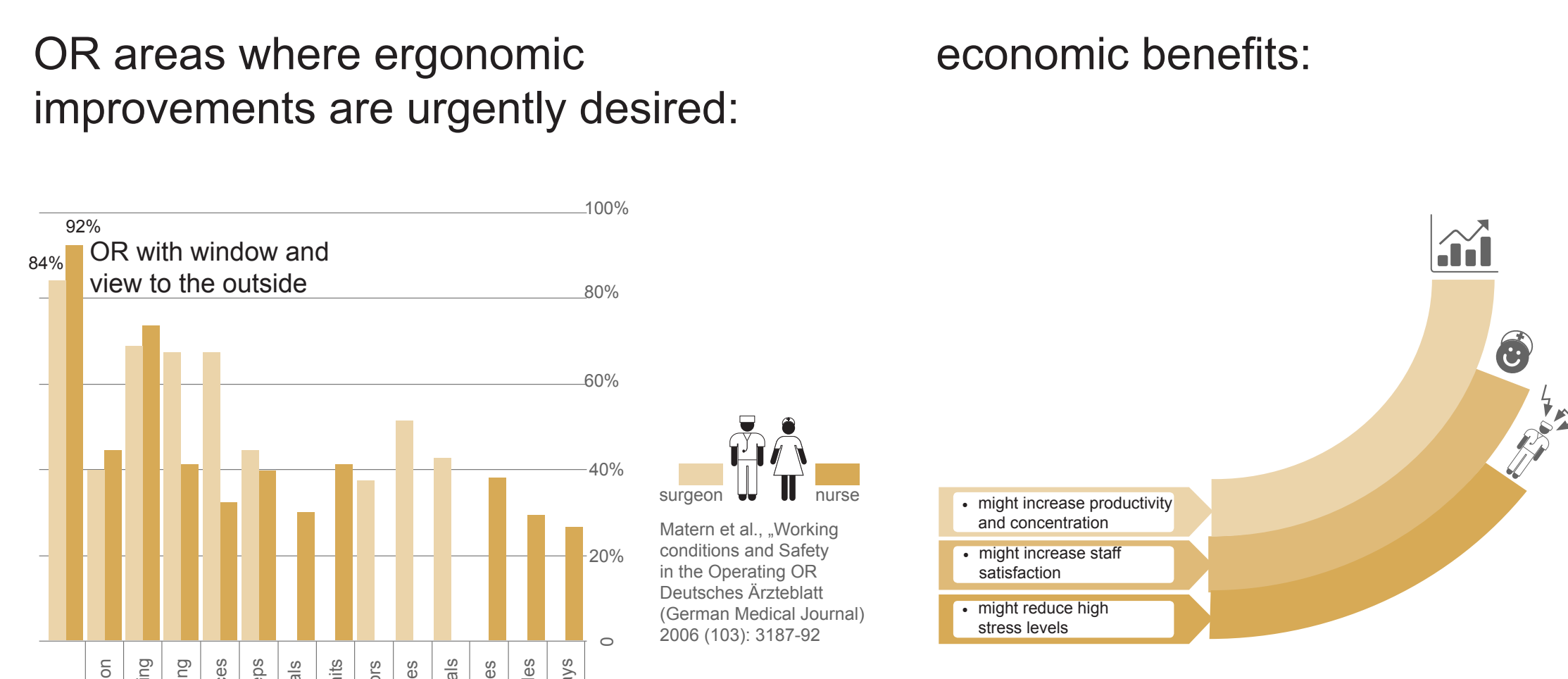
4 | shading/blinds



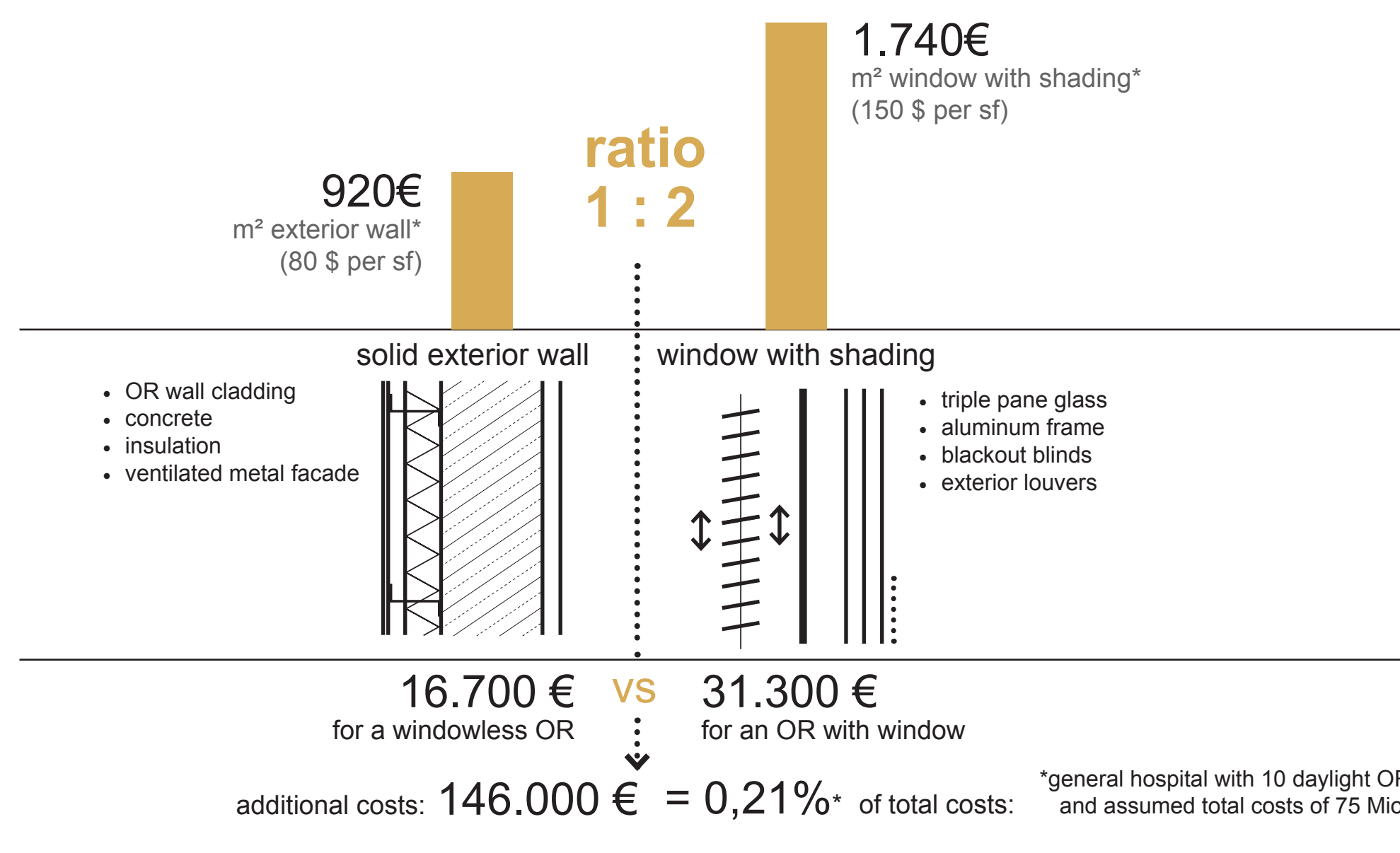
* no blinds are used in 9 of 10 procedures performed in the daylight ORs (case study of SKB)
 Bl blackout blinds are **always** used during:
 • endoscopic surgery
 • ocular surgery
 • a fluoroscopy procedure
 • procedures using UV-light



quality of work environments



cost comparison



*general hospital with 10 daylight ORs and assumed total costs of 75 Mio €