Evidence-Based Design for Better Buildings

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Defining Evidence-based Design (EBD)

• Evidence-based design (EBD) is the deliberate attempt to base healthcare design decisions on the best available evidence.

• Goal of EBD is to create environments that improve outcomes.
Currently, there are more than 700 published credible scientific studies (Ulrich and Zimring, 2004)

- Much good research knowledge is already available
Risks
(U.S. national data)

Medical Errors: 44,000-95,000 die
(Institute of Medicine)

Hospital Acquired Infections per year in U.S.– 1.8 million, 80,000 die
(Institute of Medicine)

Nursing turnover: 20% per year

Hospitals are risky and stressful places ... and are made more so by inappropriate designs (Ulrich and Zimring, 2004)
Use EBD to reduce latent environmental conditions that increase staff fatigue, diminish performance, and increase likelihood of errors.
Floor Design to Reduce Staff Fatigue

- Well-designed layout of patient units and rooms:
  - reduces staff walking, fatigue, stress
  - increases time nurses have to monitor patients and provide direct care
Traditional vs well-designed floors: Effects on nurse activity

- **Travel:**
  - Traditional: 10-18 km per day
  - Well-designed: 2-5 km

- **Care time received by each patient:**
  - Traditional: 16-24 minutes per shift
  - Well-designed: 35-45 minutes

- **Time spent ‘hunting and gathering’**
  - Traditional: 40%
  - Well-designed: 10%
Charting and patient observation for a pair of rooms
Design for Reducing Latent Conditions and Environmental Stressors

Problem: **Noise**

- Hospital noise levels far higher than recommended values
  - Noise sources are too numerous and too loud
  - Surfaces are sound reflecting

More than 140 scientific studies (Ulrich & Zimring, 2004)
Hospital noise levels are steadily getting worse

Noise levels everywhere are rising 5 dB per decade (Europe, N. America, Asia)

Much research shows noise worsens patient and staff outcomes
**DAY dB(A) levels in hospitals by year**

- **1960**: dB(A) levels were 35 dB, which is 3300 times above the recommended pressure level.

(Busch-Vishniac, West et al. 2005)
NIGHT dB(A) levels in hospitals by year

(Busch-Vishniac, West et al. 2005)

WHO nighttime continuous max 30 dB

(1000 times too high)
“Influences of Noise on Outcomes in Coronary Critical Care”

- **Patients:** adults (94) diagnosed with acute myocardial infarction in a coronary critical care unit in a Stockholm hospital

- **Intervention:** Acoustics were improved by periodically changing ceiling tiles from sound-reflecting to sound-absorbing tiles

- **Findings:** During good acoustics patients slept better, had less physiological stress, and a lower incidence of re-hospitalization
Effective design measures for creating **quiet** healthcare buildings

- Install high-performance sound-absorbing ceilings
- Reduce noise sources (provide noiseless paging system, etc.)
- Single-bed patient rooms
Problem: Healthcare Associated Infections

How Infections Spread

- Airborne transmission
- Contact
  ➤ Major problem: unwashed staff hands
Problem: **Low Hand Washing Rates**

- Low hand washing compliance has causal link with contact transmission of infection
  - Compliance in busy units: 14-30%
  - Education inadequate

Conveniently located alcohol gel dispensers and sinks + education are more effective than education alone
Design to Increase Hand Washing

Conveniently located sink in single-bed room

- Automatic faucet (no touch)
- Alcohol-based gel dispenser
- Easy-to-clean sink counter (continuous smooth surface)
- Soap dispenser

Patient Bed
Problem: Stress

- Design to ensure exposure to natural light, nature, and calming spaces that reduce stress and help lower pain
STUDY: Natural light and depression
by Benedetti et al., 2001

**Patients:**
602 diagnosed with severe depression

**Findings:**
Those with high levels of morning sunlight (east facing rooms) had shorter stays by 3.7 days
Newhaven Downs
House, UK
Design: Penoyre & Prasad
Design for daylight/natural light

Homerton Hospital, UK
Design: Nightingale

Kidderminster Hospital, UK
Design: MAAP Architects
Provide exposure to nature

More than 30 scientific studies (Ulrich & Zimring, 2004)

- Viewing certain nature and gardens lowers stress
- Reduces pain
**RESEARCH EXAMPLE**

**Skin Conductance Declines During Recovery from Stress**
(Ulrich, Simons et al., 1991)

**Muscle Tension (Forehead) During Recovery from Stress**
(Ulrich, Simons et al., 1991)
Effects of nature window view on recovery from surgery (Ulrich, 1984)

- Shorter stays
- Less pain
- Fewer minor complications
- Better emotional well-being
Comparison of Analgesic Doses per Patient for Wall-View and Tree-View Groups

<table>
<thead>
<tr>
<th>Analgesic Strength</th>
<th>Days 0-1</th>
<th>Days 2-5</th>
<th>Days 6-7</th>
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<tbody>
<tr>
<td></td>
<td>Wall Group</td>
<td>Tree Group</td>
<td>Wall Group</td>
</tr>
<tr>
<td>Strong</td>
<td>2.56</td>
<td>2.40</td>
<td>2.48</td>
</tr>
<tr>
<td>Moderate</td>
<td>4.00</td>
<td>5.00</td>
<td>3.65</td>
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<tr>
<td>Weak</td>
<td>0.23</td>
<td>0.30</td>
<td>2.57</td>
</tr>
</tbody>
</table>

*Ulrich, 1984*
“Distraction Therapy with Nature Sights and Sounds Reduces Pain During Flexible Bronchoscopy” (Diette et al., 2003)

- **Patients**: adult patients (80) undergoing flexible bronchoscopy with conscious sedation

- **Intervention**: Nature scene on ceiling with tape of nature sounds. Control group had no nature scene or sounds

- **Results**: Patients with nature distraction reported significantly less pain
Karmanos Cancer Outpatient Center
Southfield, Michigan, USA

Chemotherapy infusion treatment
Effects of Waiting Room Comfort on Overall Satisfaction with Care: Ambulatory and GP Clinics

Press Ganey Associates

Based on data from 1,201,559 patients treated at 4,392 medical practice offices throughout U.S. (January - December, 2004)
Satisfaction with Care Experience by Amount of Time
Spent in Waiting Room and Comfort of Waiting Room

Overall Satisfaction

Comfort of Waiting Area

Source: Press Ganey, 2005
Mowbray Primary Care Centre
Northallerton
Design: PHS Architects (Chris Potter)
- Quiet, good acoustics
- Nature window views
- Uncrowded
- Seating choices
- Excellent wayfinding
- Natural light
- Separate play area for children
The Business Case for Better Healthcare Buildings

Article by Berry et al. (2004)

• A rigorous economic analysis based on realistic scenario of Fable Hospital, a new 300-bed US hospital

• Fable’s design incorporates wide array of evidence-based innovations and upgrades intended to improve outcomes:
  - Examples: noise-reducing measures; oversized single rooms with large windows; variable acuity rooms; HEPA filters for air quality; gardens, art; etc.
• EBD upgrades add $12 million, or 5.3%, to the construction budget for hospital ($240 million)

• REDUCED COSTS for YEAR ONE:
  - Patient transfers reduced: $3,893,200 saved
  - Infections reduced: $180,640 savings
  - Patient falls reduced: $2,452,800 savings
  - Nurse turnover reduced: $164,000 savings
INCREASED REVENUES for YEAR ONE

- Increased market share: $2,168,100 gain
- Philanthropy increase: $1,500,000 gain

SUMMARY (First Year)

TOTAL REVENUE GAINS: $3,668,100
TOTAL SAVINGS: $7,807,306

TOTAL GAINS and SAVINGS for YEAR ONE: $11,475,406
Evidence-based design makes compelling economic sense

- It would be irrational not to spend more initially for EBD upgrades such as single-bed rooms, and thereby degrade patient outcomes, incur much higher long-term costs, and erode choice and revenues.