4th Annual South Carolina Patient Safety Symposium
Innovations of the Centers of Excellence in SC

CoEE Health Facilities Design & Testing
HSSC • Clemson University • The Medical University of SC • Spartanburg Regional Health System

David Allison, FAIA, ACHA, Professor/Director
CU Graduate Studies in Architecture + Health
PI HSSC CoEE Health Facilities Design and Testing

in Collaboration with

Dina Battisto PhD Associate Professor
Architecture + Health and PhD Program in Built Environment & Health
and
The Interdisciplinary Design-Research teams at SRHS/NXT, Clemson & Carleton Universities
Design-Research-Redesign

Charge to in effect create a new design/research discipline that:

- integrates practice, research and education
- merges design & evaluation in an iterative process
- merges health and design research

Develop new, rigorous and replicable research models/methods

Create a National Design research ‘observatory’ or ‘testing laboratory’

where it is possible to develop and test NEW concepts – and take creative risks
Health Facilities Design and Testing Concept
Collaborative Interdisciplinary Design & Research

Healthcare Architecture

Industrial Design

Engineering
- Biomedical
  - Industrial
  - Mechanical
  - Electrical
  - Computer science
  - Materials

Healthcare Providers
- Government [DoD]
- Health Systems [SRHS]
- Health Professions

IT Industry
- Hardware
- Software

HC Building Industry
- Construction
- Building Materials

HC Equipment Industry
- Patient Care
- Interventional Medicine
- Diagnostic Imaging
- Clinical Equipment

Human Factors

Clinical Disciplines
- Medicine
- Nursing
- Allied Health
- Infection Control

Indoor Environmental Health

Collaborative Design and Testing of Prototype Settings
Research Agenda:

1. How design impacts operational efficiency and clinical effectiveness
   
   *Do more, better, quicker - with fewer resources*

2. How design impacts therapeutic outcomes and patient/staff safety
   
   - Errors, infections, falls,
   - Improved health status
   - Reduced stress, need for pain medication and length of stay
   - Improved environmental footprint and indoor environmental quality

3. How healthcare facilities design impacts the healthcare experience
   
   - Patients, family and staff

4. How health facilities can be designed to accommodate changing needs over time:
Nursing Task Analysis
At Spartanburg Regional Medical Center

Research Question
- Identify critical nursing tasks involving the headwall in existing acute care nursing units

Methodology
- Shadowed/Interviewed 12 RNs and 2 RTs

Findings
- Most frequent headwall tasks: oxygen, suction, vital signs, and administer medication through IV
- Identified poor functionality - difficult to access service components, inadequate units/service ports, location problems and lack of storage
Patient Room Prototype 2006-9

2006 Healthcare Environments Awards Professional Conceptual Winner, Contract Magazine
Clemson University Architects + Health, Carleton University and SRHS/NXT
David Allison, FAIA, ACHA, PI
Patient Room Prototype

Design/Testing

• Concept room designed/built by students in Clinical Learning & Research Center at Clemson as part of design studio

• Mockup room features informally evaluated and refined at Clemson

• Refined research prototype built and tested at NXT/Clemson Lab on the SRHS Pelham Campus

Design Concepts

• Flexible and Adaptable “Chassis”
• Neutral to the exterior wall
• Inboard headwall toilet
• Projecting headwall
• Footwall as “hearth” with bench/bed
• Multiple staff work areas
Room Design Hypotheses:

Optimizing comfort and control for patients, families and staff can improve patient care, therapeutic outcomes and satisfaction for all parties involved in the inpatient experience

- Family accommodations
- Patient control of environment
- Flexible staff work areas

It is possible to reduce visible institutional clutter and create a less institutional settings in the patient room while maintaining efficient and effective care delivery.

- At the headwall
- At the footwall
Bath/Entry Design Hypothesis

It is possible to improve access to a usable toilet for the majority of patients in an industry standard room size with an inboard headwall toilet while maintaining a high degree of visibility and access into the room from the corridor.

- Reduce travel distance for patient from bed across open area.
- Minimize umbilical cord conflict
- Reduce travel distance and effort for staff when assisting patient
- Eliminates need to move through family zone for patients and staff
- Transom window to corridor
Headwall Design Hypothesis

It is possible to improve staff usability of the patient headwall for critical headwall tasks while minimizing the institutional image of the patient room. The headwall can become a user friendly and esthetically simple design feature of the room.

- Improve access to headwall utilities - reduce bending, reaching and effort
- Minimize umbilical cord conflicts
- Minimize patient/family sight lines to clinical features without compromising access/use for staff
- Improve clean ability, maintenance & flexibility of headwall elements
Patient/Family Hypothesis

It is possible to provide ample patient/family accommodations without compromising clinical care

- Family areas outside of care zone around bed without toilet conflict
- Family seating “Hearth” at footwall with fold down bed for rooming in and digital display wall
- Large window placed to optimize views with low window sill for visitor seating at bedside
- Patient “Everything table” allows dining with patient or staff use
Patient Room 2020

*Envisioning Technology Integration into the Patient Room for the DoD -TATRC*

2010 Healthcare Environments Awards Professional Conceptual Winner, Contract Magazine
Clemson University Architects + Health, with Birdtree Design Studio and NXT
Dr. Dina Battisto, PI
Creating Evidence-Based World Class DoD Healthcare Facilities
Military Health System [MHS] Contract through Noblis, with NXT, Clemson, and Georgia Tech

- Refine and finalize world class/evidence based design objectives and strategies as a usable design checklist
- Develop Design Guidelines for world class/evidence based design practices
- Identify and evaluate world class “evidence based design” case studies for ambulatory care facility design
- Develop a standardized Post Occupancy Evaluation [POE] Instrument
- Identify standardized metrics for design review, case study and post occupancy evaluation instruments

North Portland Clinic
World-Class Facilities

The Portfolio Planning and Management Division of the Office of the Secretary of Defense, Health Affairs is committed to delivering world-class medical facilities that support a care experience that is patient and family-centered, compassionate, convenient, equitable, safe, and always of the highest quality. This site is a place of learning and sharing for everyone involved in making this happen.

Enjoy the use of tools developed specifically for this endeavor. Learn from the vast amount of information compiled here. Post your thoughts and peruse others’.

Become a part of the World-Class movement.

WORLD-CLASS UPDATES NEW!
The World-Class Checklist (BETA) is now available. To use the Checklist or learn more about it, visit the World-Class Checklist on this site.

EVENTS
24 Oct – 28 Oct: Health Facility Institute 21st Annual Conference
Today: HFSC 1391 Work Group
28 Oct: HFSC UFC Template Meeting
28 Oct: HFSC Acquisition Workgroup

CONNECT (click a logo to visit connections)
World-Class Checklist

The World-Class Checklist Tool

Checklists are everyday items used to keep us on track. The beauty of a checklist is that you can actually check (✓) your progress and see the areas that still need work. The World-Class Checklist is designed to guide, educate and monitor the progress of your project.

GET STARTED

Begin Building Your World-Class Facility

1. Create your new checklist by assigning it to a project and entering a few lines of information about what you are trying to accomplish.

2. Use the World-Class Checklist tool to select, comment on, and learn about strategies and objectives that will guide you as you build your facility. Use the checklist to collaborate with team members across domains, to track your progress as a group, and to ensure discussion and innovation.

3. Use your checklist to point to all the steps you have taken toward creating a world-class facility when you submit your project to TMA or other higher headquarters if you are not part of the Military Health System.
<table>
<thead>
<tr>
<th>Objective 9: Optimize communication among patients, caregivers, family</th>
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<tbody>
<tr>
<td>□ Strategy 55: Provide patient bedside access to internet, education systems, television, blinds, lighting and temperature controls, menus, etc.</td>
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<td>□ Strategy 179: Provide the ability to conduct bedside data entry</td>
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<tr>
<th>Objective 10: Provide a range of opportunities for respite, positive distraction and stress reduction</th>
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<tbody>
<tr>
<td>□ Strategy 81: Provide positive distractions in waiting areas and public spaces</td>
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<tr>
<td>□ Strategy 153: Provide access to nature</td>
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</table>

<table>
<thead>
<tr>
<th>Objective 11: Maximize connections to nature</th>
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<tbody>
<tr>
<td>□ Strategy 22: Maximize glazable dimension on outside inpatient room wall.</td>
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<tr>
<td>□ Strategy 153: Provide access to nature</td>
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<thead>
<tr>
<th>Objective 12: Optimize exposure to natural light</th>
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<tr>
<td>□ Strategy 22: Maximize glazable dimension on outside inpatient room wall.</td>
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<tr>
<td>□ Strategy 38: Provide lighting that supports natural circadian rhythm</td>
</tr>
<tr>
<td>□ Strategy 1008: Provide automatic dimming controls or accessible manual lighting controls, and appropriate glare control</td>
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<tr>
<th>Objective 14: Optimize patient care coordination</th>
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<tr>
<td>□ Strategy 56: Provide interoperability among all technology platforms.</td>
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<tr>
<td>□ Strategy 1014: Provide access to healthcare information technology in all staff/provider work areas</td>
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Design Guidelines

David Allison, FAIA, ACHA Lead Investigator

Design Guidelines are intended to provide designers and design decision makers with specific performance-oriented tactical guidance on **how** to achieve world class and evidence-based design strategies, meet related objectives and ultimately achieve MHS Guiding Principles through the design of the built environment.

**Guidelines Content**

- **What to do**
- **Why do it**
- **When/Where it applies**
- **How to achieve it**
- **How others have achieved it**
Design Guideline Tools

**Guideline Maps** link guidelines to:
- Related Strategies
- Related Issue Specific Case Studies

**Guidelines** show how to achieve strategies:
- Conceptually
- By case study examples
Initial Design Guidelines Framework
6 Domains, 30 targeted guidelines, 10 executed FY10

GUIDELINE MAPPING

1. Daylight, Natural Ventilation, Connections to Nature

2. The Patient Care Unit and Inpatient Rooms

3. Outpatient Units

4. Wayfinding & Circulation: Campus and buildings

5. Accommodating Change: Flexibility, Adaptability, Growth

6. Site Planning and Landscape Design Strategies
Example Design Guidelines Map
Linking Strategies, Design Guidelines and Case Studies

1. GUIDELINE MAPPING
   Daylight, Natural Ventilation, Connections to Nature

   STRATEGIES
   - 22. Minimize glare/diffusion on outside exposed windows.
   - 24. Provide natural light in or near acceptable environments.
   - 38, 39. Provide lighting that supports natural circadian rhythms for staff and patients.
   - 42. Provide adequate lighting in staff work areas.
   - 674, 675, 38, 39. Reinforce natural circadian rhythms (day/night patterns) in patients.

   GUIDELINE 1
   COURTYARDS IN INPATIENT STAFF & PUBLIC AREAS
   Provide access to daylight and connections to nature through light wells and courtyards in staff and public areas in inpatient care units.

   GUIDELINE 2
   SKYLIGHTS & CECRESTORES IN INPATIENT STAFF & PUBLIC AREAS
   Provide access to daylight through skylights or clerestory windows in staff and public areas where light wells or courtyards are not feasible.

   GUIDELINE 3
   NARROW BUILDING FOOTPRINTS
   Provide access to daylight, connections to nature & natural ventilation through narrow building footprints.

   GUIDELINE 4
   PERFORATED THICK BUILDING FOOTPRINTS
   Optimize access to daylight in diagnostic treatment, emergency and clinic areas through courtyards and atria in staff, patient and public areas.

   GUIDELINE 5
   CONNECTIONS TO NATURE IN PUBLIC REALMS
   Provide connections to nature (views and access) in public places for public activities, circulation, waiting and respite.

   CASE STUDIES
   - KIZ Children’s Clinic, Innsbruck, Austria
   - REHAB Bowl, Center for Spinal Cord and Brain Trauma, Basel, Switzerland
   - Kutsa Public General Hospital, Japan
   - New York University Hospital, New York, USA
   - Texas Hospital, Knivell, Austria
   - Allerwolde Community Hospital, North Wales, England
   - Dall Children’s Medical Center, San Diego, California
   - Kommunal Hospital, Oslo, Norway
   - Konstanz Children’s Hospital, Konstanz, Germany
   - Nordeus Emergency Department, B.C., Canada
   - Reina Sofia Hospital, Toledo, Spain
   - Køge Hospital, Denmark
   - Launceston General Hospital, Australia
   - Kremenchuk Hospital, Kremenchuk, Ukraine

   Date of completion: 2006
   Date of completion: 2002
   Date of completion: 2002
   Date of completion: 2000
   Date of completion: 2000
   Date of completion: 2000
   Date of completion: 2000
   Date of completion: 2011
   Date of completion: 2011
   Date of completion: 2003
   Date of completion: 2003
   Date of completion: 2003
LOCATION WITHIN THE INPATIENT UNIT

Courtyards can be located in the core of a square inpatient unit and surrounded by support rooms and patient rooms as seen in Example 1 and 4.

This inpatient unit configuration provides daylight and outside views for the nursing station as well as short walking distances. Also, the courtyard can be integrated in the core support zone of a race track plan as built in the Children's Hospital in Graz (Ex.2) as well as in Nogoya Hospital, Japan (Ex.3).

GREEN GUIDE FOR HEALTHCARE

The Green Guide of Healthcare is a self-certifying, best practice toolkit and has an emphasis on daylighting. 5 points can be achieved with daylighting.

To get 2 point for daylighting in inpatient units the window configuration in patient rooms has to ensure that all patients have visual connection to the outdoors. In addition a window direct to the outdoors from 75% of regularly occupied staff work spaces and non-inpatient rooms has to be provided to get the first point. To get the other point, 90% instead of 75% of regularly occupied staff work spaces and non-inpatient rooms have to have a window direct to the outdoors.
COURTYARD DAYLIGHTING:
CONCEPTS

ORIENTATION AND SIZE
- Orient courtyard south-north for optimal sun penetration (Ex.5).
- The ratio of the courtyard's floor perimeter to the height should be equal or greater than 5. (Muhonen 2005)
- According to the GGHC (Green Guide of Healthcare), the width of the courtyard per floor should be at least 1.5 feet per floor or 60 feet in total to qualify as "outside".
- Atriums with one glazed and qualify as "outside" if they are at least 10 feet wide per floor or 40 feet in total.

COURTYARD SHAPE
- Deep courtyard forms achieve maximum internal shaded areas in summer. Shallow forms however have the advantage to obtain sunlight areas during winter. (Muhonen 2005)
- Adapt the height of the south-facing building to let the sun penetrate deep into the courtyard.
- Cone-shaped and sloped roofs increase the daylit area as seen in example 6.

ENVIRONMENTAL ISSUES
- Courtyards function as a climate buffer and help to reduce energy consumption. In Dell Children's Hospital in Texas, the courtyards function as air-intake locations, resulting in intake air up to 6°F (3°C) cooler than conventional rooftop intakes. (Source: Karlsberger)

MATERIAL AND ROOF
- Use bright roofs on the ground of smaller courtyards to increase the illumination level through reflected diffused light (Ex.5 and 6).
- Art in the center of the courtyard offers a stimulative site (Ex.8).
- If the atrium is a main source for daylighting, the atrium roofs should be carefully chosen and designed. They can decrease the daylight factor by about 45% (Calvi 2004)

Ex. 5 Kutna Public General Hospital, Shizuoka City, Mie Pref., Japan

Ex. 6 Children's Hospital Berlin, Austria
Architects: Baccetti Architects
COURTYARD DAYLIGHTING:
CASE STUDY REHAB, SWITZERLAND

REHAB Basel, Center for Spinal Cord and Brain Injuries, Basel Switzerland
Architects: Herzog & de Meuron, Basel Switzerland
Completed: 2002
Inpatient beds: 92
Hospital size: 246,386SF
Comprehensive Case Study Review Instrument

Dr. Dina Battisto, PI and Lead Investigator
1.0 BASIC INFRASTRUCTURE

The Cleveland Clinic operates 12 family health and ambulatory surgery centers in surrounding communities. Four Family Health Centers were studied to capture best practices in outpatient/ambulatory care at Cleveland Clinic. These clinics range in size, year built and services offered. They include:

- Strongsville Family Health Center
- Wooster Specialty Family Health Center
- Brunswick Family Health Center
- Twinsburg Family Health Center

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
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<tr>
<td>STRONGSVILLE 1990 161,000 SF</td>
<td>WOOSTER 2003 72,155 SF</td>
<td>BRUNSWICK 2008 38,000 SF</td>
<td>TWINSBURG 2011 198,000 SF</td>
</tr>
</tbody>
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- [List of features for each case center]
Post Occupancy Evaluation [POE] Instrument

Dr. Dina Battisto, PI

10 STEP POE PROCESS

STEP 1 PROJECT PLANNING
- Scope of Work
  - [2 weeks]
- Contract Negotiation
  - [2 weeks]

STEP 2 ARCHIVAL DATA
- Facility Data
  - [sources: Architect and Facilities Management]
- Plans and Photo Analysis
- Draft Facility Profile

STEP 3 PHASE ONE
- Phase Analysis
- Policy and Planning Analysis
- Strategic Plan
- Safety Plan and Standards
- Nursing Survey Continued
- Tabulation of Results for Nursing, Survey and Pedometer Study
- Informed Place Centered Observations
- Technical Recordings and Verification Studies

STEP 4 PHASE TWO
- Create Verification
  - Walk-through
  - Photo Sequence
  - Nursing Survey
- Draft Facility Profile
- Summary Report of Interview and FG
- Individual Facility Final Report: Findings/Results
- Benchmark and Trend Analysis
- Discussion
- Recommendations
- Design Guidelines
- Presentation

STEP 5 PHASE THREE
- Informal Focus Group with Pedometer Nurses
- Add 3 Questions to Interviews and FG
- Summary Report and PCO to be Added to Facility Profile

STEP 6 PHASE FOUR
- Refinement of POE Methodology
- Explore Applications in Additional Settings
- Future Directions:
  - Policy
  - Research
  - Design Tools

STEP 10 DATABASE CONSTRUCT

PROJECT TIMELINE:

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>STEP 2</th>
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<th>STEP 5</th>
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<th>STEP 7</th>
<th>STEP 8</th>
<th>STEP 9</th>
<th>STEP 10</th>
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<tr>
<td>8 weeks</td>
<td>2-3 weeks</td>
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DELIVERABLE SCHEDULE:

1. Draft Performance Metrics Template
2. Draft Facility Profile
3. Survey Results
4. Complete Facility Profile
5. Individual Facility Final Report
6. Revised POE Tool Kit
7. Composite POE Final Report
8. Composite POE Presentation
9. Composite POE Presentation
10. Composite POE Presentation

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3.1 Overall Patient Care Unit Characteristics.

The patient care unit characteristics include unit typology, overall square footage, general layout conditions and space allocations.

- **Characteristics of Unit and Definitions:**
  - Patient care unit layout
  - Private/semi-private room ratio
  - Total DGF
    - Departmental Gross SF
  - Total NSF
    - Net Square Foot
  - Net to Gross
  - Typical Patient Room Layout

- **NSF Space Allocations:**
  - Patient Care Areas: 7,267 NSF
  - Clinical Support: 2,553 NSF
  - Staff Support: 851 NSF
  - Family/Public Support: 709 NSF
  - Building Support: 606 NSF
  - Total: 8,361 NSF
  - Public/Staff: 4,387 NSF
  - Staff Only: 1,974 NSF

- **Floor to Floor Height**
- **Column Grid Size**
  - Unknown

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[b case study analysis | patient care unit]
clemson university | fall 09
3.1 Overall Patient Care Unit Characteristics.

The patient care unit characteristics include unit typology, overall square footage, general layout conditions, and space allocations.

Characteristics of Unit and Definitions:

- Patient Care Unit Layout
- Private/Semi-Private Room Ratio
- Total DGsf (Departmental Gross SF)
- Total NSF (Net Square Foot)
- Net to Gross
- Typical Patient Room Layout

 NSF Space Allocations:

- Patient Care Areas: 9,997 NSF
- Clinical Support: 2,942 NSF
- Staff Support: 416 NSF
- Family/Public Support: 1,328 NSF
- Building Support: 1,193 NSF
- Circulation: 6,942 NSF

Floor to Floor Height

Column Grid Size: Varies
Summary

Thank you

Questions and Discussion