

# Making the Connection: Linking Building Design to Healthcare Outcomes

*Assessing the Impact of Environmental Strategies on Outcomes in Healthcare Facilities*

**Presented by:**

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## THE PROBLEM

*“As the healthcare industry’s environmental footprint negatively affects the environment, these environmental impacts may in turn affect human health, and human health issues further increase the need for healthcare services.”*

*-Roberts and Guenther (2006)*

## THE NEED

Need for standard metrics and tools for measuring the affects of sustainable healthcare design strategies on patient, staff and environmental outcomes

Need for benchmarking and comparison for continuous improvement



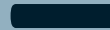
This project: Grant from USGBC (2008-2010) to develop **An open source searchable database to assess the impact of environmental strategies on outcomes in healthcare facilities**

## PROJECT FOCUS

Identify COMMON METRICS  
Healthcare Specific - Performance & Outcomes)



Create a STANDARD PROTOCOL  
For Data Collection



**BENCHMARK**  
Design Strategy Effectiveness

# PROJECT OBJECTIVES

Objectives	Multiple Methods Used
<b>1 Develop Framework</b>	<i>Deep Dive Activity                      Selection Criteria Identification                      Advisory Council                      Focus Area Identification                      Literature review</i>
<b>2 Define Metrics</b>	<i>Literature Review                      Industry Scan of Standard Metrics                      Advisory Council/ Focus Groups</i>
<b>3 Develop Protocols</b>	<i>Advisory Council/ Focus groups                      Tool Exploration/ Development                      Database Development                      Field Data Collection                      Interface Development</i>
<b>4 Promote Evaluation</b>	<i>Field Data Collection                      Web Interface Development                      Data Analysis</i>

# FRAMEWORK

1

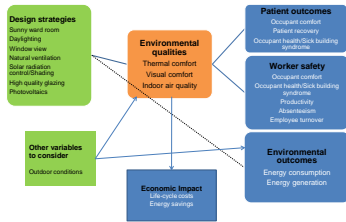
To develop a robust framework for understanding the relationship between environmental design strategies that potentially promotes patient, worker and environmental safety in hospitals with actual outcomes in these areas

# STUDY FRAMEWORKS

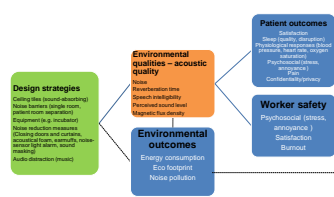
Conceptual frameworks were developed for each of the 8 topic areas to understand the relationships between groups of variables

- Design strategies, environmental quality, patient outcomes, worker outcomes, and environmental safety outcomes.

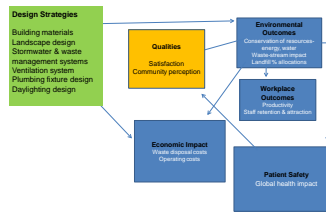
## Building Envelope (Façade)



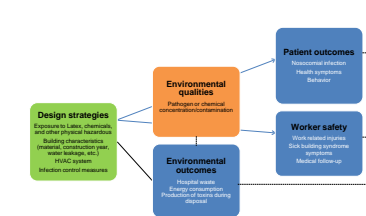
## Acoustic Environment



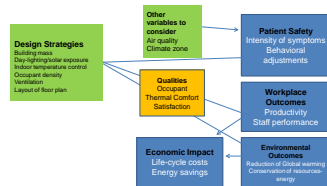
## Conservation of Resources



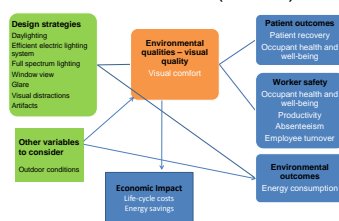
## Hazardous Materials



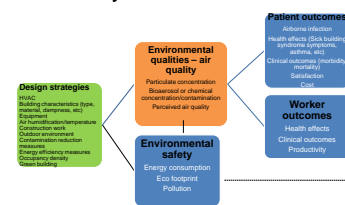
## Thermal Comfort



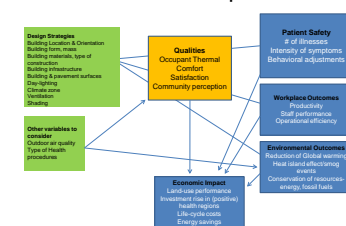
## Visual Environment (Indoor)



## Air Quality



## Overall Climate Response



## METRICS

2

To identify and clearly define standard existing metrics that should be tracked across multiple healthcare organizations to understand the relationship between environmental design strategies and outcomes.

# LITERATURE ANALYSIS

- Information on measurement tools and metrics of sustainable design extracted from a subset of the 300+ articles, publications and case studies.
  - reference information
  - research type
  - building type
  - focus area
  - variable names
  - variable types (independent, dependent, or confounding)
  - metrics (how to measure variables)
  - measurement tools
  - relationships found between variables
  - other findings
  - descriptions about research subjects
- Result
  - 36 design variables
  - 30 outcome variables

# FINAL DESIGN & OUTCOME CATEGORIES

## Design Categories

1. Daylighting
2. Ventilation, thermal comfort and indoor air quality
3. Building envelope
4. Auditory environment
5. Fixture selection
6. Interior materials selection

## Outcome Categories

1. Conservation of limited resources
2. Healthcare associated infections
3. Productivity
4. Staff outcomes
5. Economic impact
6. Patient perception of service

# PROTOCOLS

3

To develop standard protocols for collecting data on environmental design strategies and outcomes from healthcare organizations.

# DATA TO BE COLLECTED VIA ONLINE QUESTIONNAIRES

## USGBC Environmental Safety Survey

### Environmental Safety Survey

The Center for Health Design (CHD) is working to develop an open source searchable database to assess the impact of design on healthcare facilities. An important part of the project is collecting environmental strategies and outcome data from healthcare facilities.

Please identify a recently completed and occupied building at your facility to be the focus of this study. This will be the primary focus of the survey.

We have asked hospital representatives to provide information on selected healthcare outcomes that are likely impacted by design. The questionnaire includes 8 sections:

- General information
- Construction/renovation project and cost
- Conservation of limited resources
- Nosocomial infection rate
- Productivity
- Staff Outcomes
- Patient perception of service quality
- Comments and contact information

We have also asked representatives from the architecture firm that designed the selected facility to identify design areas:

- Lighting
- Ventilation, thermal comfort and indoor air quality
- Building envelope
- Acoustic environment
- Fixture selection
- Interior materials selection

Please be assured that all participants will be anonymous in all publications. The names and addresses of the healthcare facilities will not be accessible by database users. Please fill out the survey sections as completely and accurately as possible. Thank you to the Green Building Council.

**\* Please provide your name, address, and contact information (this should be the contact information for the person filling out the survey)**

Your Name:

1. Environmental design strategies incorporated in healthcare facilities
2. Perceptions of environmental qualities
3. Healthcare outcomes

# TOOL DEVELOPMENT



## Building Envelope

Building envelope is the interface between the building indoor environment and the outside including building facades and the building roof. Depends on different climate, envelope strategies such as air-tightness, insulation, daylighting, glazing choices, natural ventilation, can effectively reduce energy demand and enhance occupant health and productivity. In this section, please provide information around the building envelope design strategies implemented in this building project.

Note: Envelope design strategies for daylighting and ventilation are covered in previous topics and will not be repeated in this section.

**What were your project team's key design goals for this facility and design of the building envelope? Please check all that apply.**

- Reduce heat loss/gain
- Reduce energy consumption
- Reduce pollutant concentration/contamination
- Design for longevity
- Support patient and staff satisfaction
- Support patient well-being
- Support staff productivity

Other (please specify)

**What design standards or metrics did you design toward to achieve goals for this building project?**

**Please check the predominant exterior wall material.**

- Masonry (brick, stone, or concrete block)
- Siding or shingles
- Metal panels
- Concrete panels
- Glass

Other (please specify)

**Please enter the % of wall area that window glass occupies.**



**Please indicate the characteristics of your building envelope below. Please check all that apply.**

	Yes	No	Don't know	Not applicable
Insulating glass (i.e. 2 or more panes)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tinted glass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reflective glass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
High performance glass (low-e glass)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exterior window shading	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Integral window blinds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interior window blinds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operable windows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Curtain wall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Steel framed in-fill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Solid concrete or masonry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other (please specify)

**Please indicate if you have incorporated the following design strategies into this building project. If your design strategy is related to/but different from the ones below, please write in the actual strategy in the 'modify text' box.**

	Yes	No	Don't know	Not applicable
Choose insulating materials with the highest R-values, least environmental impact, and best indoor air quality properties	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design permanent components of the building (foundations, main structural members) for the entire life span of the structure & maximum performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design the envelope with waterproofing and breathable interior finishes to reduce the risk of mold growth in wall spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Replace roof surfaces with vegetated surfaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Incorporate exterior insulated sheathing or spray foam in addition to or instead of cavity insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design the building envelope with specific elements designated to provide air-tightness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Modify the text of any of the above strategies here:

**Please indicate any other design strategies related to the building envelope that you have incorporated into this building project that are not listed above.**

## INTERFACE WITH FACILITIES TO COLLECT DATA

**Timeline:** January to June 2010

**Who:** 30 healthcare facilities and their project's architecture firms invited:

- Facilities that recently completed a major renovation or new construction project and were occupied for at least six months
- Both inpatient and outpatient facilities included

**How:** Administrators at each organization contacted through phone and email

**What:** Results of the data collection would appear on the RIPPLE database

## EVALUATION

A pair of brass scales of justice is shown against a light background. The scales are slightly out of focus, with the central pillar and the chains of the pans being the most prominent elements. The pans are dark and circular, hanging from a horizontal beam. The lighting is soft, highlighting the metallic texture of the scales.

4

To promote evaluation and comparison of performance outcomes between different healthcare organizations.

# ANALYSIS PLAN

## **Analysis:**

- Evaluate commonly adopted design strategies found within the study sites
- Benchmark patient, staff and environmental outcomes
- Develop a plan for categorical analyses to examine the links between certain design variables and outcome variables

## **Result:**

- Analysis framework sets the foundations for comparing the relationship between design strategies and outcomes in different areas
- Benchmarking of outcomes data possible

# WEB INTERFACE

- Develop the information architecture needed to support desired comparative scenarios
- Develop detailed user-interface wireframes
- Two tracks for accessing information:
  - LEARN
  - COMPARE

The screenshot displays the Ripples Database website. At the top, the logo 'RIPPLE Database' is on the left, and navigation links 'The Center for Health Design', 'Pebble Project', 'EDAC', 'Ripple', and 'Store' are on the right. Below this, a secondary navigation bar includes 'ABOUT', 'RESOURCES', 'FAQ', and 'CONTACT US'. A breadcrumb trail reads 'Home > Environmental Safety > Acoustic Environment > Strategies'. A prominent navigation bar features three arrows labeled 'LEARN', 'COMPARE', and 'ACT'. The main content area is titled 'Design Strategies' and includes an introductory paragraph. Below this, a list of strategies is shown, each with a checkbox and a description. A 'COMPARE' button is at the bottom of the list. To the right, a search section titled 'TWO WAYS TO SEARCH:' includes a 'Guided:' section with four dropdown menus for 'Care Setting', 'Design Categories', and two instances of 'What are you looking for?'. A 'SEARCH' button is below these. A 'Keyword:' section follows, with a text input field for 'Your Keyword' and a 'SEARCH' button. A legend at the bottom right shows checkboxes for 'Strategies', 'Outcomes', 'Research', and 'Case Studies'.

**RIPPLE Database** The Center for Health Design Pebble Project | EDAC | Ripple | Store

ABOUT RESOURCES FAQ CONTACT US

Home > Environmental Safety > Acoustic Environment > Strategies

**LEARN COMPARE ACT**

### Design Strategies

The following are design strategies that have been implemented within one or more facilities to improve the acoustic environment. Click on a strategy to read more detail about the facilities that implemented these designs.

- Carpet tile in corridors in patient bed floors to help reduce some noise.
- Walls at noise intensive areas went to deck to reduce noise.
- Connect building occupants with access to the natural environment (connect access and views).
- Conduct an inventory to identify equipment that uses CFC refrigerants and provide a replacement schedule for these refrigerants.
- Design the shape of ceiling soffits was designed to trap sound to prevent it from crossing the corridor.
- Choose insulating materials with the highest R-values, least environmental impact, and best indoor air quality properties.
- Consider replacing constructed surfaces (e.g. roof, roads, sidewalks, etc) with vegetated surfaces (e.g. vegetated roofs and open grid paving, etc).
- Minimize the amount of paging throughout the facility by using a personal communication system that sends calls directly to each other.

**COMPARE**

#### TWO WAYS TO SEARCH:

**Guided:**  
Select from each drop down box to begin connecting strategies to outcomes.

Care Setting ↓

Design Categories ↓

What are you looking for? ↓

What are you looking for? ↓

What are you looking for? ↓

**SEARCH**

**Keyword:**  
Select from each drop down box to begin connecting strategies to outcomes.

Your Keyword

Strategies  
 Outcomes  
 Research  
 Case Studies

**SEARCH**

## FINDINGS: FACILITY GENERAL INFORMATION

- Data collection was completed in **five** occupied facilities during the Spring and Summer of 2010

Facility	Project Type	Size	Urban Context	Acuity Level	Occupant Satisfaction Survey Response Rate
Facility One	New Addition	645 bed	Suburban	Acute Care	41%
Facility Two	New Facility	94 bed	Suburban	Acute Care	38%
Facility Three	New Patient Tower, Diagnostic/Treatment, Renovation	563 bed	Suburban	Acute Care	34%
Facility Four	New Patient Tower	381 bed	Urban	Acute Care Medical Surgical	48%
Facility Five	New Addition and Renovation	N/A	Suburban	Outpatient	16%

# DUBLIN METHODIST HOSPITAL



Facility size: 94-bed general acute care community hospital located in suburban Dublin, OH.

Completed/Occupied: January 2008  
Design Strategies

- Accessible roof gardens
- Nature photograph
- Carpets and sound-absorbing ceiling tiles in nursing units, family space in patient rooms
- Large operable windows, natural light accessible to majority of spaces

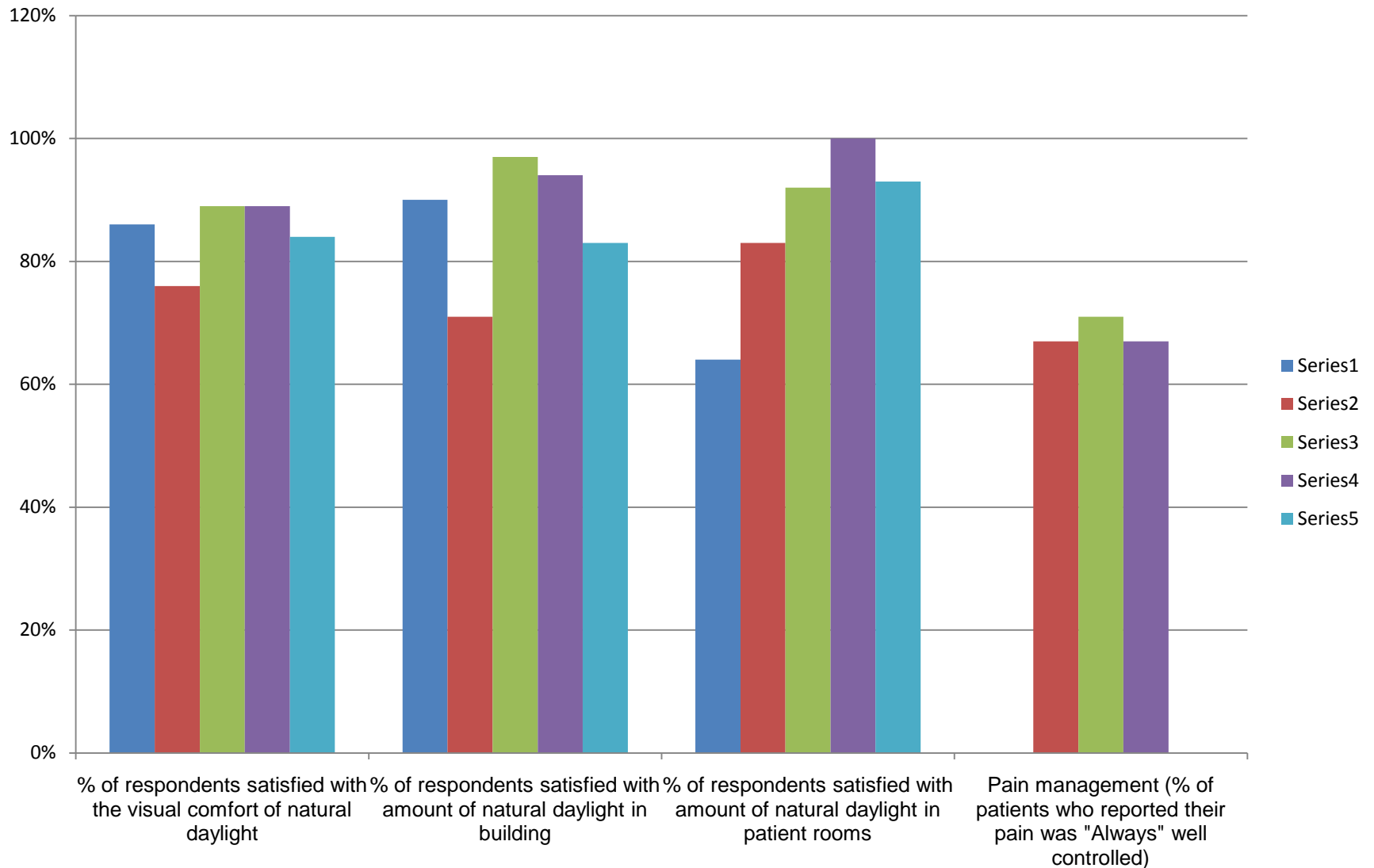
# DUBLIN METHODIST HOSPITAL

## Outcome Summary

- 92% of staff satisfied with the overall building performance
- 83% of patients satisfied with healthcare service
- Environmental aspects that were perceived positively include: thermal comfort and building envelope



# CROSS FACILITY COMPARISON, DAYLIGHTING EXAMPLE



# RELATIONSHIPS YET TO BE EXPLORED

## The potential for research and education is clear

- Large scale data collection made possible
- Initial trends of links between design and outcomes observed
- Database as design decision support tool in the future

## Future analysis

- Continuous benchmarking
- Categorical analyses of satisfaction and outcomes data with presence or absence of various design strategies
- Explore links between design and outcomes – those identified in literature & new and critical links

## LESSONS LEARNED

- Lack of response from some sites
- Qualification to participate
- Performance & outcomes data more challenging to collect
- Aggregated facility data vs. individual building data
- Information from multiple personnel
- Data format

## NEXT STEPS

- Pebble Projects invited to contribute to RIPPLE
- Facilities currently providing data invited to submit their data annually
- Launch and maintain RIPPLE, add additional facilities to the database.
- Future development of 'patient safety' and 'worker safety and effectiveness'
- Identify strategies at the intersection of the three safeties

