

How Collective Design Triumphed Over Competition in the Fight Against HAIs

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How Collective Design Triumphed Over Competition in the Fight Against HAIs

When the Boston-based Healthcare Associated Infections Organization (HAIO) challenged seven local architecture firms to design a single-patient room in January 2015, the result was surprising. What began as a competition ended as a collaboration between the highly competitive health care design firms.

The dynamic process of collaboration that ultimately took place went far beyond the traditional means of sharing ideas through conferences, publications, and workshops and allowed the participants to communicate in real time, developing creative solutions to the problem of designing a patient room to address risks from health care-associated infections (HAIs). In the end, many of the group's recommendations were implemented on a hospital floor undergoing renovation in Boston. The participants gained much from working together in this fashion and hope other architecture firms will replicate the collaborative process to focus on other health care design issues.

Participating Architecture Firms

E4H Environments for Health Architecture

CannonDesign

NBBJ

Perkins & Will

Shepley Bulfinch

Steffian Bradley Architects

SmithGroup

The Competition

The HAIO competition goal was a design for a single-patient room that would “raise the bar [by proposing] innovations in design, use of materials, cleaning, and/or other considerations” by incorporating concepts that could reduce risks from HAIs and support best practices for staff workflow and cleaning. The introduction to the Patient Room Challenge written by HAIO noted that hand hygiene has proven to be a critical factor in infection prevention efforts in the inpatient environment. Other factors that can affect the spread of pathogenic microbes from the environment to the patient include room design and detailing, building material selection, location of hand sanitizers and hand-washing sink, amount of time needed for ease of cleaning the room between patients, and design of HVAC systems.

Each firm entering the competition put together a team composed of architects, health care planners, interior designers, and engineering consultants. Over a three-month period, the teams devoted considerable time and financial resources to developing a prototypical medical/surgical patient room in a 30' x 36' structural grid. The teams used the 2014 edition of the FGI *Guidelines for Design and Construction of Hospitals and Outpatient Facilities* along with the Massachusetts Department of Public Health compliance checklists based on the *Guidelines* to ensure regulatory requirements were addressed in their submissions. Each team considered all aspects of the patient room and provided solutions they believed would reduce patient exposure to potentially deadly pathogens.

The designs were submitted on a single 24" x 36" foam core board. The selection committee, consisting of several members of the Massachusetts General Hospital (MGH) Infection Control and Environmental Services team assisted by members of the HAIO Steering Committee, reviewed the entries carefully. Paula Wright, RN, CIC, project manager in the Infection Control Unit at Massachusetts General Hospital, collected feedback from the MGH and Brigham and Women's Hospital teams and developed the categorization scheme with five target areas the committee used in

their review of the boards. She summarized the results of the review in a table organized by the five target areas, melding ideas from the different firms (see Table 1: Room Design Elements by Target Category) on the next page.

In January 2016 the Boston Society of Architects Healthcare Facilities Committee hosted a meeting to unveil the presentation boards and discuss the submissions with the design teams and the public. The committee explained that evaluation of the boards was based on two categories—Positive/Interesting Concepts and Negative/Questionable Value—in the following five target areas:

- Room cleaning facilitation
- Equipment cleaning and management
- Waste management
- Hand hygiene accommodation
- Splash and touch contamination minimization

At the well-attended event, the selection committee went through each submission board using a spreadsheet summary of room design elements, noting how each submission addressed the categories. The selection committee explained they had not been able to determine a clear winner, but they believed some compelling ideas from each entry merited further pursuit. They presented these concepts as shown in Table 1.

In the spirit of their mission to consider all avenues to eradicate HAIs in patient rooms, HAIO set in motion the idea of continuing the competition by asking representatives from each submitting team to participate in a series of pro bono working group meetings that would focus on the renovation of a patient room at Brigham and Women's Hospital (BWH) in Boston.

Figure 1: Brigham and Women's Hospital



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Architect: Bertrand Goldberg Associates, Inc.

Table 1: Room Design Elements by Target Category

Room cleaning facilitation	Equipment cleaning management	Waste management	Hand hygiene accommodation	Splash and touch contamination minimization
ROOM DESIGN ELEMENTS				
Smart glass (eliminates need for shades or curtains)	Nurse-server passthrough for PPE and supplies	Alcove for trash/soiled linen	Electronic hand hygiene monitoring stations	Hand-washing sink away from patient zone
Solid-surface wrap around bed	Waste passthrough	Enclosed linen hamper and waste containers	Hand-washing monitoring system	Extra deep sink
Flush-mount headwall	Storage for PPE and supplies outside the room		Light cues for hand hygiene	Offset sink drain (minimizes splash)
Smooth headwall	RFID tracking of cleaning equipment		Unidirectional flow of staff in entry vestibule (relies on staff to follow entry and exit pattern)	Hand-washing sink in caregiver zone
Solid surround around bed	Self-contained bedpan washer			
Flush washable headwalls				
Solid-surface canopy				
Rounded corners				
Separate door to enter room: allows environmental services staff to enter and clean without disturbing patient				
Monolithic floors				
Built-in bench for family zone				
Inboard toilet				
Trench drain around shower				

The Collaboration

Why would the participating firms, often competitors for the same projects in the Boston area, willingly work together without compensation on a joint project? One answer may have been to be considered for future work with the competition organizers. However, the underlying reason for most was the chance to continue the work from the competition and be part of a process of discovery and evaluation that would be greater than the sum of the individual efforts. This unique approach to the conclusion of a competition was recognized as a rare opportunity to work with others who shared a passion for seeing design as an avenue to positively affect patient outcomes.

Each firm had already committed substantial time and resources to produce their competition entry. All expressed enthusiasm about continuing the challenge to build on the work they had done and dive more deeply into the subject. As a benefit of participation, the outcome of the joint work would be nonexclusive information available for their team members to share freely with co-workers and clients and through presentations about the process at conferences around the country.

Conversations with several participants also revealed the designers were very receptive to working together. This type of collaboration recreated an essential part of a designer's educational training that stresses a collective approach to design while working in groups and freely sharing ideas. Sarah Markovitz of NBBJ reported, "Our team truly appreciated the collaborative approach throughout—the camaraderie, the openness to test different solutions together, to debate what was achievable, and to prioritize what was most important to test."

The Working Group Meetings

The collaboration was designed as a series of six four-hour meetings during which participants could capture their collective knowledge

and experience and design a single-patient room that would encompass the best ideas from all those submitted. The meetings were held from November 2016 through March 2017, and the working group explored these aspects of the challenge:

- How do you recalibrate the design process to look at every part of a room through the lens of protecting the patient from HAIs at the same time making cleaning the room easier and more effective?
- What happens when competitors become collaborators?
- What are the lessons learned from working together?
- What should be considered when assembling a collaborative team?

The working group meetings were facilitated by representatives from Massachusetts General Hospital, who brought in infection preventionists, engineers, and contractors to support the participants' efforts as they began their collaboration. This was not an evidence-based design process and measurable outcomes would not be documented, but the group's intention was to focus on strategic planning and dissemination of information related to reducing HAIs that could be implemented immediately in design of the patient room at BWH. An added benefit would be that many of the design features could potentially be implemented in the remaining nine inpatient rooms in the BWH unit being renovated and could be considered for the firms' other active projects.

The group developed the following goals for design of the single-patient room with the intention of streamlining their task. The design would:

- Facilitate appropriate handwashing.
- Provide hand sanitizers and personal protective equipment (PPE) storage at the room entrance.
- Create a clear separation of clean and dirty functions.
- Support easy cleaning and maintenance of the room by using durable, moisture-resistant materials that would hold up to hospital cleaning protocols.

An important first step in the process was for the infection preventionists to describe ways in which patients can acquire HAIs. The MGH infection preventionist in the group explained that HAIs generally fall into five categories:

- Infections caused by pathogens (e.g., multi-drug resistant organisms) that can be spread from patient to patient via contact (e.g., via unclean hands, contaminated equipment, an inadequately cleaned environment)
- Communicable diseases (e.g., influenza) that can spread from patient to patient or staff to patient
- Infections (e.g., *Legionella*) that result from exposure to an environmental source
- Infections that result from placement of in-dwelling devices (e.g., intravenous lines and urinary catheters)
- Infections (e.g., surgical site infections) that result from medical procedures

Understanding these five categories provided a focused framework for the working group to research specific materials and processes. The group explored product literature, discussed group members' past project experiences, and looked at how other industries handle similar sanitary concerns that could be relevant to patient rooms.

Throughout the design process, the facilitators and infection prevention representatives encouraged the group to have a healthy skepticism for claims made by manufacturers about products and cleaning processes that would eliminate the need for cleaning by staff. The cost of materials and equipment also was a critical factor for consideration. The message to the group was to simplify the room design to encourage intuitive use by health professionals, other hospital staff, and families entering the room in ways that would reduce the risk of spreading HAIs to patients.

Room Design Elements

A sampling of room design elements and considerations the HAIO working group explored is discussed below:

Hand-Washing Sinks

- Wall-mounted hand-washing sink located at the entrance to the room to encourage use as soon as an individual enters from the corridor and before exiting
- A splash zone, free of casework and equipment, that extends 3 to 4 feet around the sink to avoid contamination of clean storage areas
- Automated, non-touch hand-washing systems or a countdown timer above the sink to support the recommended time needed for handwashing
- Consideration of hand sanitation techniques used by food service and other industries in food preparation areas

Built-In Casework

- Simple details to avoid deep shelving
- Minimal joints, reveals, and crevices that could be difficult to clean
- Cabinetry that extends to the ceiling to eliminate dust shelves and extends to the floor or is left open below for easy cleaning access
- Consideration of hotel industry methods for handling luggage storage that might suggest means of accessible storage for patient and family belongings without using hard-to-clean lockers or drawers

High-Touch Surfaces

- Cleanability of specific surfaces in the room and the appropriate cleaning products and methods to use on each surface
- Equipment that is durable, with maximum stability, for the patient room and patient toilet room
- Product options that could minimize the spread of pathogens on high-touch items such as bed rails, over-bed tables with spill containment, side tables, IV poles, light switches, door handles, wrist blades, window shading and privacy devices, and grab bars in bathrooms
- Consideration of non-touch technology from other industries, such as voice-activated commands, electrochromic glass that can go from clear to opaque, and wave technology to open doors

Other Finishes

- Homogeneous flooring materials with an integral base
- Prefabricated drywall with inner rounded corners
- Solid-surface materials for vertical applications
- Impact-resistant/cleanable covers for materials, cushions, and technology
- Protective, cleanable glass placed in front of screens to reduce dust
- Consideration of maintenance methods for surface materials and how these materials can be repaired or refreshed in case of accidents or intensive use

Toilet Rooms

- Locations in the toilet room for enclosed automated bedpan cleaner-disinfectors

- Bedpan cleaner-disinfectors selected based on unit costs and infrastructure requirements and on the willingness of nursing staff to use this type of product
- Shower fixtures that allow drainage between uses to avoid stagnating water in hoses or shower heads

The Room Design

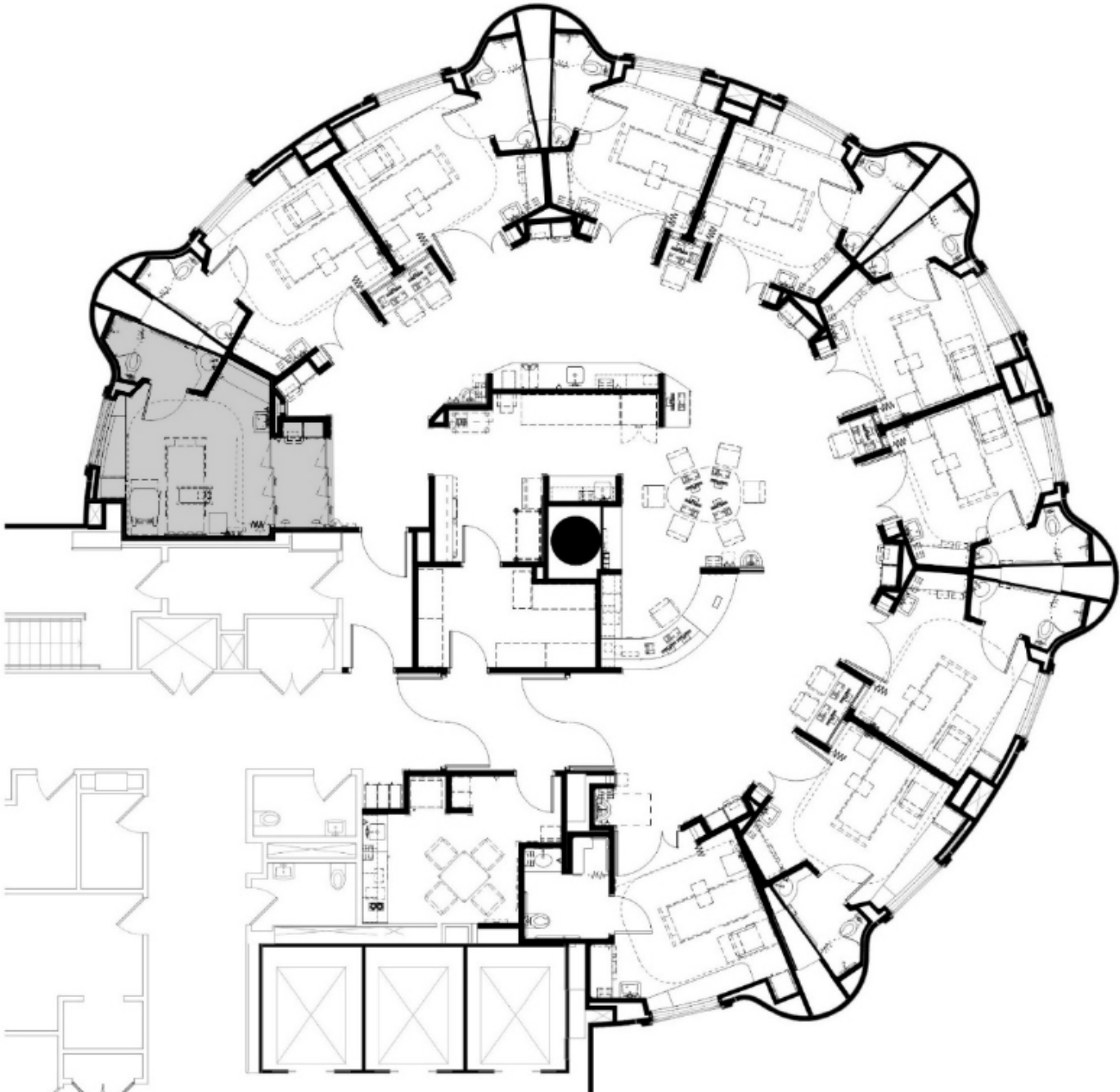
To give the working group an actual room to work with, the SmithGroup team participating in the collaboration (Robert Peterson, Andrew Brumbach, and Alison Faecher) provided schematic design plans for a protective environment room in a bone marrow transplant unit at the BWH Tower Building, which was part of an ongoing interior renovation of the 1980 building at Brigham and Women's Hospital being carried out by SmithGroup and Suffolk Construction. The group used this room to consider application of the design concepts they had developed to support best practices that could reduce opportunities for HAI transmission.

When the working group evaluated the design for the renovated BWH room, it became apparent the room's size (149 square feet) and wedge shape did not offer an ideal test environment for evaluation of the group's design concepts. Nonetheless, the room realistically represented issues confronted when renovating existing spaces to comply with new regulatory standards. Challenging renovations in existing spaces are typical for this and other projects located in the densely populated Longwood Medical Area in Boston.

A number of design concepts put forth by the group were considered for the room, and the following treatments—which fit into the existing infrastructure—were implemented after approval by the BWH nursing staff and facility department:

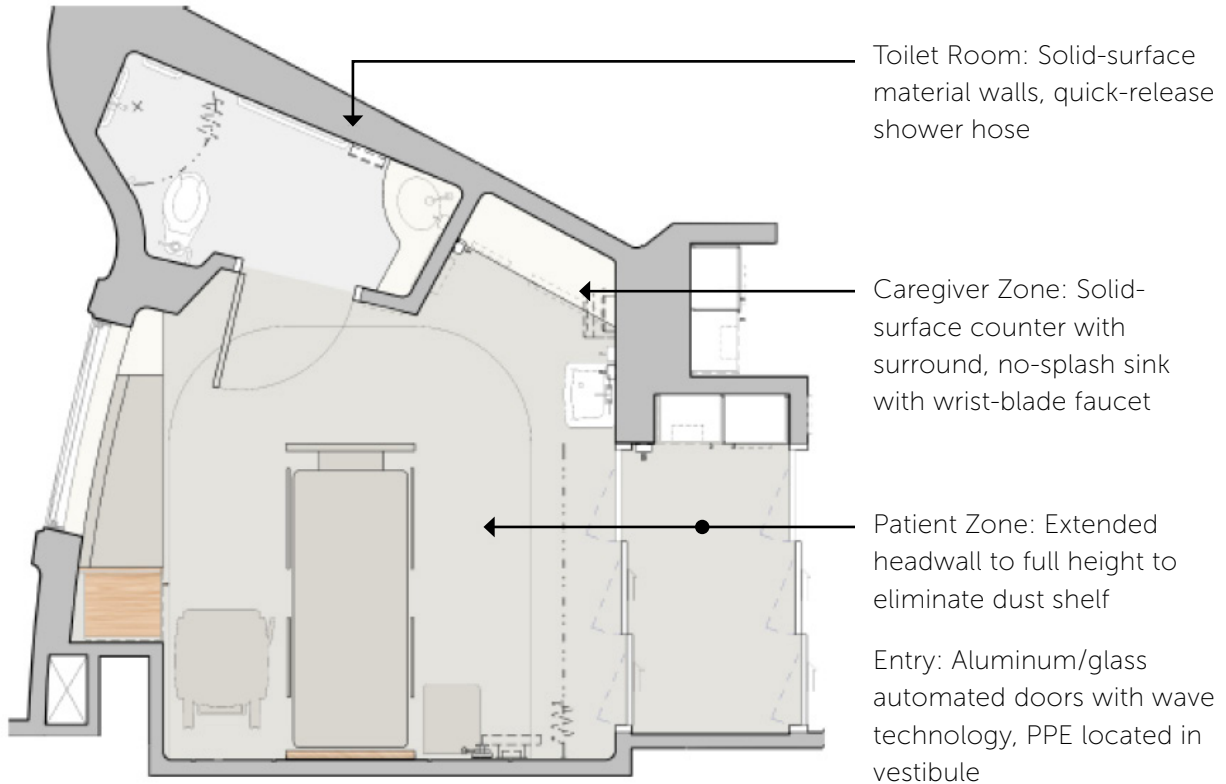
- Hand-E-Wave™ technology for room entry
- Rounded drywall board corners
- Extension of headwall system to full height to avoid dust shelf

Figure 2: Overall Floor Layout



SmithGroup (Architect of Record)

Figure 3: Subject Room for Redesign



SmithGroup, Inc. (Architect of Record)

- Staff hand-washing sink separated from staff work counter and supply storage to avoid splash contamination
- Solid-surface shower surround and wall in patient toilet room
- Quick-release hose for shower head cleanout
- Elimination of greeting card shelves and other horizontal surfaces
- Dedicated solid-surface work counter

A couple of recommendations were not implemented: An integrated bedpan washer unit would not fit into the tight bathroom layout, and the protective glass cover for the digital TV/information center screen was too expensive.

Despite concern about increasing first costs, the team ultimately decided the rounded drywall corners, solid-surface walls in the bathroom, and Hand-E-Wave technology at the vestibule doors were too beneficial not to include in the project. Because these items were prefabricated, the need for on-site customization was minimal and BWH and the design team believe the ongoing benefit of reducing HAIs will outweigh the costs of providing them.

The remaining design elements that were implemented were cost neutral. Further, Suffolk Construction, the contractor for the BWH renovation, noted that overall the design changes suggested by the working group would not add significant costs or delays.

Figure 4: Patient Room Inward View



Key

- A—Extension of headwall to ceiling to eliminate dust shelf
- B—Elimination of horizontal surfaces above and below cabinet
- C—Amenity lighting
- D—6-in. covered base

SmithGroup, Inc. (Architect of Record)

Figure 5: Patient Room Outward View

Key

A—Handwave door control

B—Sliding vestibule doors

C—Freestanding hand-washing sink

D—Faucet selected for reduced splash

E—Simplified work surfaces



SmithGroup, Inc. (Architect of Record)

Postoccupancy Evaluation

After the renovated room was occupied in May 2018, SmithGroup wanted to see if there were insights to be found after the room was in service. They sent a short list of postoccupancy questions to nurses who had worked in the space before and after renovation.

Although the survey was limited, the nurses provided a look into how the room design functions. Areas such as the vestibule, which had sufficient space to accommodate the HAIO recommendations, received satisfactory scores. It was confirmed, though, that the primary challenge to implementing the recommendations of the working group was the size and irregular shape of the room. Recommended follow-up for the group included having environmental services and infection prevention staff evaluate the selection and installation of finish materials used in the room.

Postoccupancy Evaluation Survey

Nurses working in the renovated room were asked to evaluate the effectiveness of these aspects of the room design:

1. Patient room sink location and type of facilities—promotes proper handwashing
2. Location of hand sanitizer and PPE at room entrance—helps prevent contaminants from entering the room
3. PPE storage area—well laid out and meets needs
4. Patient room layout—helps maintain clear separation of clean and dirty functions
5. Placement of the sink—prevents splashing on the work counter
6. Patient room and toilet room designs—allow for easy and thorough cleaning

Lessons Learned

The shift from competition to collaboration was rapid for most architecture firm teams that participated on the working group. They quickly became comfortable working together and generously shared their information and research. Comments collected from some members about the process identified these benefits of working together:

- **Input from a multidisciplinary group when reviewing products and designs:** Teaming with health care design colleagues from other firms, including engineers; contractors; and specialists from several Boston hospitals, was empowering as it allowed for real-time evaluation of design solutions.
- **Opportunities to share knowledge with colleagues on current projects:** Participants were able to start conversations in their own offices about how design can help reduce HAIs.
- **Early definition of HAI goals and objectives for the project:** Spending time at the outset of the project to clearly define

these goals and objectives with a multidisciplinary team helped clarify the expectations of individuals and the group.

- **Streamlined vetting process for research and materials:** The group developed a way to review information in a timely manner to help them evaluate solutions more quickly.
- **Early involvement of environmental services and facility staff:** Involving representatives of the environmental services department as part of the collaborative working group allowed the team to understand the current state of room cleaning and turnaround and to get feedback during design on how proposed design changes would benefit or detract from these efforts. Inclusion of facility staff allowed input from those who would be involved in construction and maintenance of the room going forward.

In addition, the participants noted one element that made their work more difficult, though it had nothing to do with the collaboration. The unusual geometry (wedge shape) of the patient room was not representative of most inpatient rooms and ultimately could not accommodate implementation of some of the group's recommendations.

Recommendations

The working group's process captured the knowledge and passion of the design teams and inspired them to listen and work together. It is the hope of HAIO and the seven teams that the collaborative process used in this project will inspire others who would like to accelerate and better inform their innovative design thinking by working collaboratively in multidisciplinary teams.

The HAIO competition participants encourage hospitals and designers to consider this experience as an example and starting point for their own investigations into how processes and designs can be improved to enhance delivery of care. Collaboration is a strong catalyst for change, and the collective knowledge of collaborators can push forward new best practices that strengthen the practices of your

team. Whether you create a competition or invite specific groups to participate in your own efforts, expect to be met with enthusiastic professionals who will rise to the challenge and eagerly share their knowledge.

The list of considerations for assembling a collaborative team and the abbreviated design process shown in the sidebar can be used as a starting point for your own collaboration. Good luck in your efforts, and we look forward to hearing from you in the future.

Steps for Launching a Collaborative Design Effort

This list of suggestions for putting together a collaborative team and the outline for a design process are based on the HAIO Patient Room Challenge collaboration.

Considerations for Assembling a Collaborative Team

1. Work with a local hospital or professional organization to create a competition or charrette about a health care topic you believe would benefit from a collaborative spirit. This is a great way to generate attention and excitement about the topic and encourage alternate approaches.
2. Find a local outlet as the HAIO group did with the Boston Society of Architects to share your information and spark interest in the working group.
3. Identify and invite the following participants to the working group:
 - a. Local hospital champion to be the coordinator and facilitator
 - b. Health care team, including representatives from nursing, infection prevention, facilities, and environmental services as well as others with expertise relevant to the topic
 - c. Multidisciplinary group of design and engineering professionals and consultants
1. Consider if your collaborative project would be a good candidate for an evidence-based design (EBD) process. A team member(s) with EBD accreditation and certification (EDAC) credentials can help the group determine if an EBD approach is appropriate for your goals.
2. Create and gather research and share experiences and ideas that are nonexclusive and to be used by all.

3. To start the working group process:
 - a. Schedule meetings on a monthly or bi-monthly basis; select a meeting location or rotate meetings among participants' offices.
 - b. Set up a clear decision-making process.
 - c. Create a resource for regular communication and information sharing and develop a process for capturing group comments.
 - d. Provide professional learning credits for participants.
 - e. Identify an existing facility or new project that can be used to implement and evaluate the group's design concepts.
 - f. Document and share the process and results through meeting notes, photos, and/or videos of the sessions.
 - g. Create a repository for all conference presentations that result from the collaboration.

Design Process

1. Define goals and objectives.
2. Conduct a literature search to define what has been done to date related to the topic (in this case, reducing HAIs in the patient room) and collect baseline performance measures.
3. Critically interpret and evaluate information for its credibility and generalizability for this project.
4. Create and innovate concepts and design interventions.
5. If following evidence-based design precepts, develop a hypothesis related to the desired outcome of the proposed design interventions and identify metrics to be used to measure the results.
6. Develop a business case for inclusion of the interventions in the project.
7. Monitor implementation of the interventions during design and construction.
8. Measure postoccupancy performance results.

ABOUT THE AUTHOR

Teresa Wilson is a director at the Boston office of Colliers Project Leaders, where she represents owners' needs on health care projects throughout the Northeast. She was previously executive principal and managing director of Steffian Bradley Architects' (SBA's) Boston office. She also served as a principal in Sterling Planning Alliance, SBA's health care consulting firm, providing services in strategic planning, programming, operational and facilities master planning, and targeted lean events throughout the United States and Canada. She has more than 25 years of health care design and planning experience.



Teresa regularly speaks to the health care community about future trends and their impact on the built environment. In 2017 she received the Healthcare Facilities Symposium Distinction Award, Individual Award Winner, which is presented to a professional in the fields of health care planning, design, construction, and operations who has displayed leadership and vision over a significant period of their career to enhance the healing environment. Teresa can be reached at teresa.wilson@colliers.com.

Note: The working group described in this paper reassembled in 2019 to build on previous work and consider new opportunities to use design as a tool to reduce HAIs. Teresa is part of this new team, which is working on the redesign of a hospital room in the Boston area.

HAIO Working Group Participants and Advisers

Architecture Firms

(Participants are listed with the firms where they worked during the collaboration.)

CannonDesign: Brian McKenna, AIA

E4H Environments for Health Architecture: Kevin Neumann, AIA; Dale Taglienti, LEED AP

NBBJ: Sarah Markovitz, AIA; George Takoudes, AIA, LEED AP

Perkins & Will: Alberto Salvatore, AIA, NCARB, EDAC

Shepley Bulfinch: Cathleen Lange, AIA, LEED AP; Anne Garrity, LEED AP

SmithGroup: Andrew Brumbach, AIA, EDAC; Alison Faecher, IIDA, NCIDQ, EDAC, LEED AP; Robert Peterson, AIA, LEED AP

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