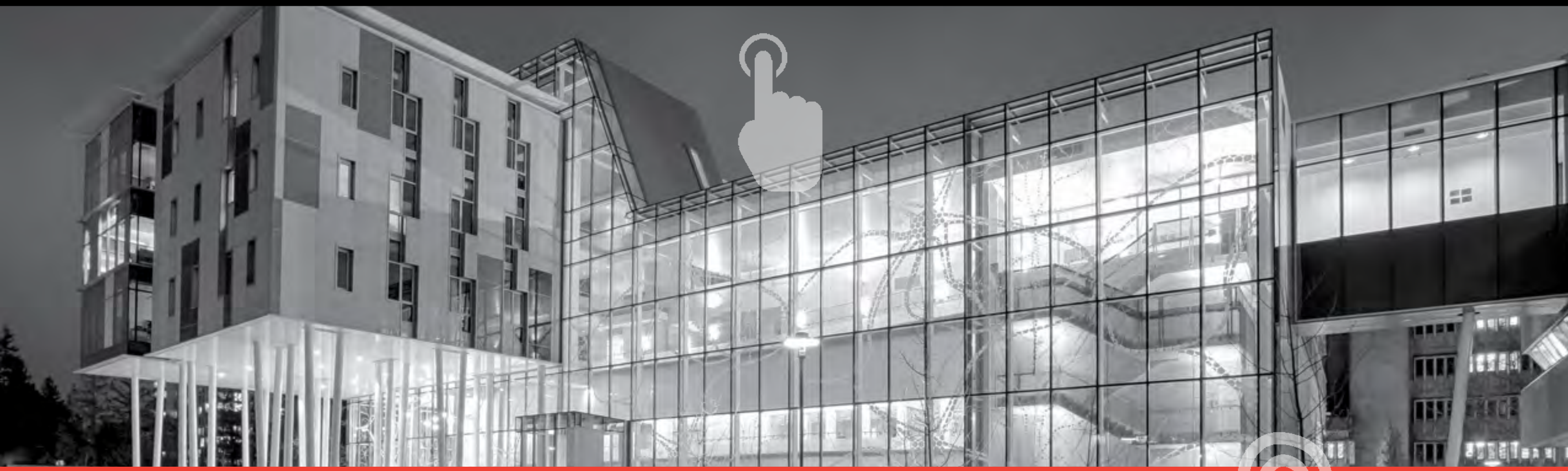
no. **17**

AIA Academy of Architecture for Health | **Academy Journal 2015**



Mission of the Academy Journal

As the official journal of the AIA Academy of Architecture for Health (AAH), this publication explores subjects of interest to AAH members and others involved in the fields of healthcare architecture, planning, design, and construction. The goal is to promote awareness, educational exchange, and advancement of the overall project-delivery process and building products.

About the Academy

The Academy of Architecture for Health (AAH) is one of 21 member communities of the American Institute of Architects. The AAH is unique in the depth of its collaboration with professionals from all sectors of the healthcare community, including physicians, nurses, hospital administrators, facility planners, engineers, managers, healthcare educators, industry and government representatives, product manufacturers, healthcare contractors, specialty subcontractors, allied design professionals, and healthcare consultants.

The AAH currently consists of approximately 6,954 members. The mission of the Academy is to improve both the quality of healthcare design and the design of healthy communities by developing, documenting, and disseminating knowledge; educating design practitioners and other related constituencies; advancing the practice of architecture; and affiliating and advocating with others that share these priorities.

Please visit the Academy's Website at www.aia.org/aah, for more information on the Academy's activities. Please direct any inquiries to aah@aia.org.

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Letter from the Editor

This is the 17th edition of the *Academy Journal,* published by the AIA Academy of Architecture for Health (AAH) knowledge community. As the official publication of the Academy, the *Journal* electronically publishes articles of particular interest to AIA members and the interested public involved in the fields of healthcare architecture, planning, design, research, and construction. Since 2005 we have also published a hard copy version of the Journal that has expanded our distribution worldwide. The goal has always been to promote awareness and educational exchange between architects and healthcare providers and to broaden our base of understanding about our clients.

Articles are submitted to, and reviewed by, an experienced nationally diverse Editorial Review Committee (ERC). Over the years, the committee has reviewed hundreds of submitted articles and responded to countless writers' inquiries, and encouraged and assisted numerous writers in achieving publication. *The Journal* has provided valuable opportunities for new and seasoned authors from the architecture and healthcare professions. With this issue, four articles have been selected and printed supporting the enhancement of the built environment for healthcare. Throughout the 17 year history of the *Journal,* the authors have included architects, physicians, nurses, other healthcare providers, academics, research scientists, and students from the United States and many foreign countries.

Published articles have explored a broad range of medical topics, including trends and future of healthcare architecture, cardiac care, future and evolving technology, patient rooms and patient safety, lighting design for healthcare, psychology, workplace design, cancer care environments, emergency care, women's and children's care, and various healthcare project delivery methods. Visit the *Academy Journal* archives at http://network.aia.org/academyofarchitectureforhealth/home/publications for earlier articles you may have missed. We would like to encourage more graduates who have received healthcare research scholarships and others involved with research within the architecture for healthcare fields to submit their research to the *Journal* for publication consideration. We will continue to develop a cross-referenced article index and a broader base of writers and readers. The deadline for the 2016 Call for Papers is May 31, 2016.

My special thanks to the AIA for its continued support and hard-working staff and to the many volunteers who have contributed to our growing and continued success. I would especially like to thank the other members of the 2014 ERC: James G. Easter Jr., Assoc. AIA, FAAMA, (Tenn.); Ed Jakmauh, ACHA, LEED AP (Pa.); Joyce Redden (Tenn.); John Sealander, AIA, ACHA (Calif.); Professor Kent Spreckelmeyer, PhD, FAIA (Kan.) and Janice Stanton, RN, MBA, EDAC, LEED Certified (IL).

As always, we appreciate feedback, comments and suggestions by emailing aah@aia.org or calling me at 631-246-5660.

Orlando T. Maione

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Editor, Academy Journal
October 2015

Behavioral Healthcare Design: Ten Things You 'Know' That 'Just Ain't So'

by JAMES M. HUNT, AIA, NCARB

ABSTRACT

Preliminary meetings involving architects, psychiatric hospital management, and unit staff members often result in decisions that crystallize into critical details of facility design very early in the planning process. These can be very difficult, if not impossible, to change later on.

During these sessions, it is not unusual for psychiatric hospital staff to state any number of time-honored platitudes that, through sheer repetition, have come to be "known" as unchallengeable facts of psychiatric facility design. Typically, staff comes to "know" such things because they have heard them during their education and throughout their professional lives in the facilities in which they have worked. But using such "common knowledge" while designing new psychiatric facilities can be very problematic and very costly.

Former baseball great Satchel Paige explained the problem best when he said,

"It's not what you don't know that will hurt you; it's what you 'know' that just ain't so."

And so it is, I find, with the design of psychiatric hospitals. The intelligent and highly educated people who are brought together in preliminary design meetings frequently fail to consider whether what they have come to "know" about psychiatric facility design is now (or ever was) valid. Let's look at the data available from some credible sources to see if some of these "known" statements are actually correct.

ARTICLE

Behavioral Healthcare Design: Ten Things You 'Know' That 'Just Ain't So'

. . .

Preliminary meetings involving architects, psychiatric hospital management, and unit staff members often result in decisions that crystallize into critical details of facility design very early in the planning process. These can be very difficult, if not impossible, to change at a later date.

During these sessions, it is not unusual for psychiatric hospital staff to state any number of time-honored platitudes that, through sheer repetition, have come to be "known" as unchallengeable facts of psychiatric facility design. Typically, staff comes to "know" such things because they have heard them during their education and throughout their professional lives in the facilities in which they have worked. But using such "common knowledge" while designing new psychiatric facilities can be very problematic and very costly.

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And so it is, I find, with the design of psychiatric hospitals. The intelligent and highly educated people who are brought together in preliminary design meetings frequently fail to consider whether what they have come to "know" about psychiatric facility design is now (or ever was) valid. "Evidence Based Design" is a popular concept these days. It is used (and sometimes abused) frequently. Let's look at the data available from some credible sources to see if some of these "known" statements are actually correct.

How Behavioral Healthcare Facilities Are Different

At the root of many of the design ideas that "just ain't so" is a bad assumption, an assumption that may be shared by practicing architects, clinicians and hospital administrators. The assumption is that, from a design standpoint, psychiatric hospitals are very similar to general hospitals and, therefore, the traditional design ideas that evolved in general hospitals are valid in psychiatric hospitals as well.

I know that this assumption is wrong. I know because my consulting practice continues to be called upon by the owners of newly constructed or newly renovated psychiatric hospitals to develop remedial solutions for problems that were designed into their facilities. To see why the design features of psychiatric hospitals must be significantly different from those of general hospitals, one need look no farther than the design and function of the patient room in a general hospital and consider how its design and functional requirements differ from those of a psychiatric hospital. General hospital patients seldom leave their rooms. They see their doctors, receive treatment, eat their meals, visit with friends and family in their rooms. Typically, behavioral healthcare patients do not use their rooms for any of these activities. Their rooms are used almost exclusively for sleeping and resting. The rest of their time is spent in common areas and activity, group or day rooms where they can be observed and their interaction with others noted (see Figure 1).

Erroneous Assumptions In Psychiatric Hospital Design

Based on the many design-related discussions I've heard over the years, and after having addressed many of the problems that erroneous design ideas have caused, I've developed a short list of the most common and problematic design ideas that I've heard. Here they are, together with a few suggestions that might help designers respectfully, yet effectively, refocus problematic ideas into safer, more cost-efficient and more appropriate solutions.

1. Virtually all behavioral health/psychiatric hospital facilities can be built around a single, state-of-the-art planning model.

2. "Suicide assessment tools now available are reliable."

3. "Not all of our patients are suicidal, so we only need a few specially equipped rooms near the Staff Station to monitor suicidal patients."

4. "15-minute checks provide sufficient observation for patients on suicide watch."

5. "We put our suicidal patients on one-to-one (with a sitter) to prevent them from committing suicide."

6. "Building deficiencies can be compensated for by increasing staff."

7. "Tight fitting doors between patient rooms and corridors pose a risk for ligature attachment, but those doors are a code requirement, so the hazard is unavoidable."

8. "The blocking or barricading of in-swinging corridor doors is not a problem, so long as furniture is anchored in place (in patient rooms), or staff are present (in activity rooms)."

9. "It is not necessary to protect against ligature attachment for items less than 18 inches above the floor."

10. "Break-away shower and window curtains provide an adequate measure of safety."

Each if these will be explored in more detail below:

(1.) VIRTUALLY ALL BEHAVIORAL HEALTH/PSYCHIATRIC HOSPITAL FACILITIES CAN BE BUILT AROUND A SINGLE, STATE-OF-THE-ART PLANNING MODEL. Models such as "treatment mall" or "house/neighborhood/downtown" may work well for facilities with long lengths of stay- such as state hospitals-but not so well for hospitals with 5-7 day average lengths of stay or varied patient populations. Generally, the treatment mall concept assumes that all patients will move from the unit to the treatment mall during the daytime on weekdays. Yet, some facilities built around this model have found that often there are patients who are too upset/too unstable to leave the unit. Because these patients must stay behind on the unit, staff must also stay behind, a problem that complicates staff assignments and drives up staffing costs.

Staff in units with 3-7 day average lengths of stay often report that their patients are not stable enough to move off the unit. Accordingly, they recommend that patients be kept within the unit for their relatively short period of treatment.

I've come to believe that terms like "treatment mall" or "house/neighborhood/downtown" are often used rather loosely-as a fashionable way to refer to different portions of self-contained units that provide required facility functions rather than as terms that reference the kind of long-term treatment environment referenced above. I recall one recent discussion with an architectural firm that stated that they are firm believ-

How do Behavioral Healthcare Units need to be different from General Hospital Units?

General Hospital Unit

Focus is on treating medical conditions.

FUNCTION OF SPACE

Treatment takes place in patient rooms.

Family visitation takes place in patient rooms.

Patient is in room majority of the time.

FLOOR PLAN SOLUTIONS

Travel distance for staff from service core to patient room is primary traffic flow issue.

Access to unit is unrestricted.

Group Rooms and Activity Rooms are not required.

Interview Rooms and Visitation Rooms are not required.

Observation of corridors from staff station is not required.

Seclusion Rooms are not required.

Direction of door swings for patient rooms are not important.

Alcoves and hiding places are not problems.

PRODUCT AND MATERIAL HAZARDS

Typical patient rooms *have* the following:

Medical gasses

Monitors and cables

Sharps containers

IV poles

Cubicle curtain tracks

Open grab bars

Open flush valves

Open bed pan washers

Accessible ceilings

Windows

Heating and air conditioning systems and grilles

Light fixtures

Electrically operated beds

Wardrobes and clothes hangers

Wall mounted television sets

Beds

Lavatories

Toilets

Headwalls

Behavioral Healthcare Unit

Focus is on treating mental disorder, keeping patient safe from self-harm and protecting other patients and staff.

FUNCTION OF SPACE

Treatment takes place in Interview Rooms, Group Rooms and Activity Rooms

FLOOR PLAN SOLUTIONS

Observation of corridors and Day Rooms from staff station is a primary concern

Access to and from the unit is restricted

Travel distance for staff from service core to patient rooms not critical

Group Rooms, Activity Rooms, Interview Rooms and Seclusion Rooms are required

Direction of door swings to resit barricading is important

Alcoves and hiding places are hazards

LESS HAZARDOUS PRODUCTS AND MATERIALS

Typical patient rooms and toilets *do not* have the following:

Medical gas outlets, monitors with related cable, sharps containers, IV poles, curtain cubical tracks, accessible ceilings, television sets, telephones, nurse call systems, bed pan washers

Typical patient rooms and patient toilets *do have* the following:

Shatter resistant windows and mirrors, platform beds that are secured in palace, wardrobes with only open fixed shelves, ligature resistant door hardware and toilet accessories, vandal resistant heating and cooling systems and light fixtures, ligature resistant plumbing fixtures and concealed piping

FIGURE 1

ers in the house/neighborhood/downtown model for behavioral health/psychiatric facility development and that they "would not hire any consultants that were not in agreement with that approach."

This sounds dangerously like proposing a one-size fits all solution before the variables are known. The fact is that the design of behavioral health/psychiatric facilities must account for many factors:

- patient populations
- average lengths of stay
- diagnoses
- acuity levels
- staffing patterns
- organization's culture

These factors, among others, all provide vital information that needs to be accumulated and thoroughly understood before important decisions regarding the general organization of the various elements of the unit can be determined.

(2.) "SUICIDE ASSESSMENT TOOLS NOW AVAILABLE ARE RELIABLE." This addresses an issue that is located in the very core of many clinical decisions that are made on a behavioral health unit and may not be well received. Asking the following questions may provide a way to get clinical staff to open up and entertain the idea that this may need to be revisited.

QUESTION 1: How do you know which patients are suicidal? The response will likely be that they utilize one of the various risk assessment tools or suicidality scales that are available for this purpose. The following information may be useful in getting the hospital staff to consider the fact that this mindset could be dangerous and may create a situation which could result in patient deaths by suicide.

RESPONSE 1: The American Psychiatric Association has released several studies on inpatient suicides in inpatient psychiatric units:

The 2003 study showed that 1,500 inpatient suicides occurred annually and that 1/3 of those patients were on 15-minute checks. (Placing patients on 15-minute checks is often standard practice for patients that have been identified as being actively suicidal. This practice will be discussed later in this paper.) Perhaps the more significant conclusion that can be reached from these studies is that 2/3 (or over 1,000 deaths) were patients that staff had not identified as being suicidal and placed on 15-minute checks.

RESPONSE 2: In March of 2012, the Veterans Hospital Association released a study that concluded that the assessment tools that they are using are not reliable. This study is titled "Suicide Risk Factors and Risk Assessment Tools: A Systematic Review".[2] It was conducted by the VP\s Evidence-based Synthesis Program. The entire report is available for download at: http://www.hsrd.research.va.gov/publications/esp/suicide-risk.cfm.

In response to the question, "What assessment tools are effective for assessing risk of engaging in suicidal self-directed violence in Veteran and military populations?" the conclusion stated on page 35 of this document is "Insufficient evidence overall to recommend screening with these risk assessment tools based on this evidence. Future research is warranted, particularly for risk assessment instruments that are already in use within the VA System."

This report also asks the following question on page 95: "Are there any clinical performance measures, programs, quality improvement measures, patient care services or conferences that will be directly affected by this report? If so please provide detail." Conclusion #5 under this question is that there is a "...lack of data to support the use of specific risk assessment instruments ..."

In short, the suicide risk assessment tools currently in use by the VA hospital system were found to be unreliable. There is some impressive work being done by several groups to develop more reliable information, but most of them are not ready for widespread use at the present time.

Therefore, since many decisions regarding the design of patient use facilities hinge on knowing the suicide risk for individual patients at a given time, and because this information is largely obtained from risk assessment tools that have been judged to be unreliable, it is more prudent to design all patient accessible areas to be as suicide resistant as possible.

(3.) "NOT ALL OF OUR PATIENTS ARE SUICIDAL, SO WE ONLY NEED A FEW SPECIALLY EQUIPPED ROOMS NEAR THE STAFF STATION TO MONITOR SUICIDAL PATIENTS." At first, this sounds like a cost-saving suggestion, but only deeper questioning and discussion can expose its dubious underlying assumptions. Designers might ask these questions:

- How will you know which patients are suicidal? The idea to build a few specially designed rooms places a heavy burden on staff to accurately identify all of the risks in the patients' environments and then make appropriate adjustments. Staff must accurately decide which patients need the "safer" rooms and exactly when they need them. (See item 2 above.)
- What if you have more "suicidal" patients on the unit than your secure rooms will allow? How will you decide which patients get them? What will

your defense be if the patient you moved to a less-secure room commits suicide that night? Such questions may expose the unnecessarily high responsibility this design decision places on staff to accurately judge every patient situation. It may also lead to consideration of how disruptive-and costly in staff time-the process of moving patients can be, and whether the cost of a single misjudgment that results in an adverse outcome might more than erase any short-term savings.

(4) "15-minute checks provide sufficient observation for patients on suicide watch." This is a widely held concept that has been around for decades. But it must be challenged, because it is not backed by evidence.

I would suggest that a designer start a discussion with this question: "Why do you think that checking on patients at 15-minute intervals is an effective suicide deterrent?" Typical responses may note that an individual could not accomplish a suicide by strangulation or suffocation in that period of time.

But that is not the case: medical studies verified by The Joint Commission’’ establish that patients can tie something around their necks tightly enough to cause death or irreparable brain damage in as little as 4 to 5 minutes by inducing a condition called anoxia. Another study” also concluded that 15-minute checks do not prevent suicides. It is clearly possible for patients to "time" suicide attempts between checks.

(5) "We put our suicidal patients on one-to-one (with a sitter) to prevent them from committing suicide." A study at Johns Hopkins Hospital in Baltimore found that 9% of successful suicides were by patients who were on one-to-one supervision. You may ask, "How can this be?" It is actually very simple. In some cases the patient physically incapacitates the staff member, sometimes they trick the staff into letting them go into the bathroom alone, and sometimes they just wait until the staff member falls asleep or is otherwise distracted.

(6) "Building deficiencies can be compensated for by increasing staff." Some facilities compensate for patient and staff safety hazards by increasing the staff-to-patient ratio to increase the level of observation possible. This creates an increase staffing patterns (FTE per Patient) or in overtime pay.

To expose the potentially costly long-term trade-off that added staffing involves, a designer might ask these questions:

- Does the additional staff time and expense result in better patient care, or is it solely to safeguard patients against these risks? Responses from staff members may be both positive and negative on this point.
- How would the one-time cost of fixing the deficiency compare to the ongoing personnel cost of your remedial practice? An evaluation of alternatives, followed by an estimate, may show that the cost of an appropriate remedy is available at a fraction of the cost of additional staffing.

(7.) "Tight fitting doors between patient rooms and corridors pose a risk for ligature attachment, but those doors are a code requirement, so the hazard is unavoidable." This statement is partially true: Every facility has tight-fitting doors to patient rooms because they are required by building codes and other regulatory agencies. However, it is not true that the safety risks of such doors are unavoidable. In this situation, the key question is this: Is it acceptable to ignore a known serious hazard just because it's required by code and "everyone else is doing it?"

Discussion here might center on the fact that suicides (or suicide attempts) that employ ligatures using the joints between the door and the frame of patient room-to-corridor doors-remain a frequent occurrence. Patients can tie a knot in almost anything (a bed sheet, a pair of trousers, a sweatshirt) place it over the top of a sturdy door, and use the other end as a ligature. There are safety alternatives available, including pressure sensitive or electric eye type devices that mount on door edges, connect to a central alarm system, and sound alarms when they are activated by the presence of an object, such as a ligature. These are available from several companies. Of course, the edge of the door is not the only ligature attachment hazard: care must also be taken when choosing the door hardware, since hinges and lockset handles can be ligature attachment points.

(8.) "The misuse of furniture to block or barricade in-swinging corridor doors is not a problem, so long as furniture is anchored in place (in patient rooms), or staff are present (in activity rooms)." This is an inaccurate assumption because it is always possible for a group of patients to enter any patient or activity room, with some able to block the door (even if furniture is anchored in place), while others commit harm to other patients or staff members.

While some might advocate the need for additional staff to prevent this situation, I would ask: How can we add or modify existing doors to mitigate this safety threat?

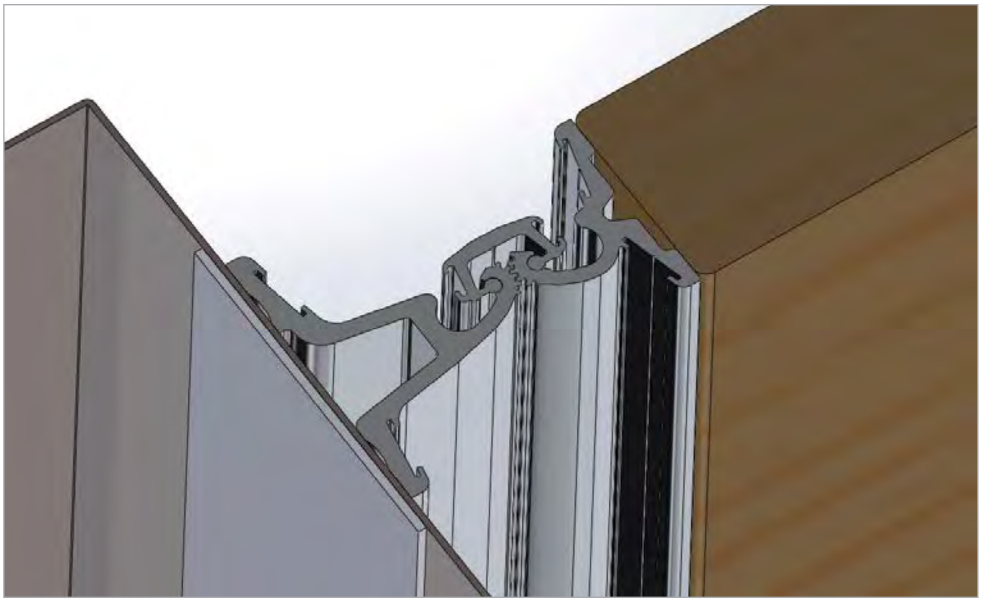

FIGURE 2

The first solution is to add a second doorway to the room. This can be ideal for larger rooms, such as activity rooms, particularly if the second door swings outward.

When a second door is not practical and the existing door swings inward, there are still several options:[7]

- Install or retrofit the door with double-acting continuous hinges, which allow the door to swing out into the corridor in an emergency. These doors are equipped with an emergency stop that extends the full height of the door, as well as a keyed lock to resist unauthorized use (See Figure 2).
- Install or retrofit a door-within-a-door or "wicket" door. These doors contain a hinged panel in the center of the door that is secured by a deadbolt lock on the corridor side. When unlocked, the movable panel swings outward into the corridor, ensuring staff entry to the room.
- Install an unequal pair of "double doors," with the larger leaf hinged to swing inward (toward the patient or activity room) and the smaller hinged to swing outward. To maximize the width of the opening, install the doors so they are free swinging. To increase strength and reduce noise, separate the doors with a vertical frame member (see Figures 3 and 4).

(9.) "It is not necessary to protect against ligature attachment for items less than 18 inches above the floor." Many years ago, the "standard of care" for preventing ligature attachment was to protect "any attachment point at or above waist level." Then, the standard of care was reduced to 18 inches above floor height. But in fact, there is no level below which the risk of ligature attachment and strangulation is not a concern. A ligature attachment point need not be elevated: it could be the leg of a chair or even the crack at the bottom af a door. There is no "safe zone".[1,8]

Current practice requires that ligature attachment risks be mitigated throughout the environment, notably in areas where patients will be alone, such as patient rooms or toilet rooms. But, a designer might ask: What about "non-patient areas" like staff offices, storerooms or other areas where patients are never expected to be alone?

Even these areas should be designed with safety in mind. Despite the best efforts of staff, I find on site visits that it is not unusual to find the doors to such areas unlocked, with patients inside and unknown to staff. Incorporating ligature resistant features in these rooms can reduce the pressure on staff to constantly secure such areas by locking doors or exercising extreme vigilance.

(10.) "Break-away shower and window curtains provide an adequate measure of safety." This, I believe, is a questionable proposition. Here's why: even when specially designed, all break-away curtain hangers hold some weight; some patients have been known to bunch these hangers together to share a bigger load. Even when these fasteners function properly, the curtains themselves can easily be tied around the neck as ligatures, so the consideration of break-away weight alone is not sufficient to prevent hazard. One hospital recently reported that a patient was able to thread a

FIGURE 3

FIGURE 4

ligature above the break-away hangers and into the ceiling-mounted track. This connection provided substantial holding force.

For these reasons, current best practice is to design all patient-accessible areas without curtains or drapes. Whenever possible, showers should be designed to contain water without the presence of a curtain or door. European type toilet rooms (rooms in which the floor space is sloped to drain, or equipped with trench-type drains, and all fixtures are designed to tolerate shower spray) are an effective alternative. Such designs require a water barrier pan beneath the entire floor area as well as slip-resistant flooring.

When shower curtains are required, they should be equipped with the minimum number of breakaway fasteners and consist of a "breathable" fabric that reduces the suffocation risk.

Windows with integral blinds eliminate the need for curtains and drapes. The tilt of the blinds can be controlled by patients with thumbwheels, ligature-resistant knobs, or pushbuttons; or by staff with key-operated, motorized units.

Cubicle curtains and their tracks are not required in behavioral health units[10] and are strongly discouraged.

Conclusions

Good design requires good dialogue. Examples like those above demonstrate the potential dangers that can result when long-term facility design decisions involving the lives and safety of patients and staff are based on incorrect information and differing or untested assumptions about the real risks and costs involved. Such discussions require real effort, but are vital to project success. They can be aided by a design team that uses appropriately worded questions to prompt the client to explore the validity of potentially dangerous design decisions.

Throughout the design process, the client remains the decision maker. The designer's role is to identify potential safety concerns, foster dialogue, consider and present possible solutions, and explain the positive and negative elements of each.

If, in the designer's opinion, a client's decision creates a potential risk of self-harm or harm to others, it may be necessary for the designer to put his or her concerns in writing, then ask the client to provide written instructions regarding the design element in question. Hospitals are encouraged to carefully review and document the need for these elements with the help of their internal safety and risk management programs, legal counsel, and liability insurance carriers.

Should the design elements in question become the basis of legal action in the future, this review process may provide some protection for both the design team and the hospital.

About the Author

James M. Hunt, AIA, NCARB, is the president of Behavioral Health Facility Consulting, LLC in Topeka, Kansas. Hunt is the co-author of the "Design Guide for the Built Environment of Behavioral Health Facilities" that is published by the National Association of Psychiatric Health Systems and available at http://www.naphs.org.

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Patient-Population Based Design: A Needs-Assessment Approach for Designing Healthcare Environments

by SHARON E. WOODWORTH, AIA, ACHA

ABSTRACT

This paper addresses four of the suggested topics: 1] Basic Architecture Services for Hospitals—Improved Design Techniques; 2] Healthcare Delivery Trends and Issues—Emerging Medical Trends & Needs-Based Assessments; 3] Service Delivery Issues and Opportunities—Specialty Centers at All Levels; 4] The University Teaching Hospital—Academic Health Science Centers & The Teaching/Research Environment.

Traditionally, healthcare environments are designed to support diagnosis and treatment of aliments rather than identifying environmental factors that foster wellness for those aliments. When designing healthcare spaces to foster wellness, it is crucial to first understand the particular patient illness being served and then determine the fundamental needs for that patient population; this process is referred to as Patient-Population Based Design and has been successfully employed in a range of completed facilities, encompassing acute to long-term care and serving specific patient populations as diverse as rehab and dementia care. This paper presents for the first time the use of Patient-Population Based Design in an outpatient setting, further reinforcing the validity of this process as a universal approach to needs-assessed healthcare design. Furthermore, the patient population for this new facility is an ideal learning case due to the variation of patient needs, spanning the full range of neuro-psychiatric diseases from Lou Gehrig's, Multiple Sclerosis, Parkinson's, and Alzheimer's to resistive Psychosis. The primary tool for this process is a Population-Based Matrix; a template of this tool is included for readers use in their institutions. This article outlines the concept and illustrates in detail a case study utilizing this design process.

ARTICLE

Patient-Population Based Design: A Needs-Assessment Approach for Designing Healthcare Environments

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Conceptual Perspective

Consider two questions: 1] Where on the continuum does health end and disease begin? 2] How healthy can a diseased individual be? I believe our healthcare environments should begin with these questions in mind, and specifically address how we as designers can design from a perspective of wellness rather than illness.

Modern healthcare environments are typically designed with an illness perspective, focusing on spaces that function to support diagnosis and treatment of an aliment rather than a wellness perspective, which identifies environmental factors maximizing wellness for that aliment. For the latter, the designer must understand more than what supports wellness for the general population; the designer must first understand the disease being served and then translate what wellness would look like for the patient population with that particular illness in order to potentially impact the individual's wellbeing. This is a process referred to as Patient-Population Based Design, which begins with a needs assessment outlining the patient's clinical diagnosis, the environmental goals that are therapeutic for that illness, and the environmental features that would foster independence from the disease or aliment.

The method used in Patient-Population Based Design begins with an Assessment Matrix detailing the four fields of: Illness Definition, Clinical Presentation, Environmental Goals, and Environmental Features, which are then cross referenced with the specific patient illness being served as determined by the institution or healthcare provider. A sample Needs-Assessment matrix is shown in Table 1 with the four fields noted on the left and the patient populations across the top; the three populations exhibited here, Dementia, Psychosocial, and Complex Medical, are three of six distinct patient populations as determined by this specific long-term care institution serving residents in an inpatient setting.

For any healthcare provider or institution, the process for developing a Needs-Assessment matrix requires that the Illness Definition and Clinical Presentation fields be developed by clinicians specializing in the patient populations being served; the Environmental Goals and Environmental Features are then developed by the architectural team through a review of the literature, evidence-based documentation, and anecdotal but proven experience.

The matrix has been designed as a generic tool capable of generating specific results for any patient population, and following this process ensures its generalizability. Prior to this process, environments for age-based populations (such as pediatrics or senior care) were subconsciously or intuitively modified to be child or elderly "friendly" designs, but the formal, conscious process proposed here is intended to create a universal process with a wellness perspective in healthcare settings. Also note that the universal process inherent in Patient-Population Based Design allows for customization to meet specific needs while remaining flexible for other populations, which differs from "accessibility" design where a high standard is set to accommodate individuals with varying abilities but can unintentionally restrict options for some patient populations. The end-objective of a universal, patient-based process that can be generalized to a variety of settings is to have a process that increases the likelihood that healthcare environments will be designed to foster health rather than emphasize illness.

To date, Patient-Population Based Design has been employed in a range of completed facilities, encompassing acute to long-term care hospitals serving specific patient populations as diverse as rehab and dementia care settings. This paper presents for the first time the use of Population-Based Design in an outpatient setting, further reinforcing the validity of this universal process for healthcare design.

Case Study

The case presented is a newly constructed translational medicine facility combining research labs with patient clinics dedicated to serving severe neurological and psychiatric diseases. Vancouver's University of British Columbia Centre for Brain Health is a 135,000-square-foot clinical research facility containing wet and dry labs in addition to patient clinics, all of which are dedicated to serving the full range of neuro-psychiatric diseases from Lou Gehrig's disease, Multiple Sclerosis, Parkinson's, and Alzheimer's to resistive Psychosis. Designing environments for the treatment and cure of chronic neurological and psychiatric disorders are among the greatest challenges in healthcare architecture, made even more so when the driving vision for this institution was to maximize patient research.

The success of Patient-Population Based Design was crucial in this case study because the client's objective was to have 100% patient participation in clinical research. As a benchmark for this high expectation, patient participation in research is known to range from as low as 2% based on a 2007 study of US cancer clinical trials, to as high as 67% according to a 2007 study of Canadians volunteering for randomized, controlled trials.[1] [2] Notably, even if research funds are unlimited, little research will be done if there are no patients upon which studies can be conducted; therefore, patient participation is critical. Research participation is always a patient dilemma and especially so for the neurological patient, as he or she may feel 'untreated' in a controlled study and donating brain tissue post-mortem requires sensitive ethical considerations; clinical trials for cancer patients carry similar risks as there is always a chance a new treatment may be ineffective or worse than their current treatment. For patients of any clinical diagnosis, before they can commit to clinical research they must first have felt cared for—and that means the architectural environment must meet their physical and emotional needs. A wellness-based setting allows patients to consider research dilemmas and prepares them for time sacrificed, tissue or organs donated, and risk missing a miracle drug or treatment. A wellness-based setting reinforces patients' trust that researchers and clinicians are committed to the patient's care regardless of the outcome. Hence the importance of Patient-Population Based Design.

This case is ideal for exhibiting the generalizability of Patient-Population Based Design because the needs of neuro-psychiatric patients are frequently contradictory. For example: patients with neurological diseases most often have opposing movement disorders such

TABLE 1: Sample Assessment Matrix

	DEMENTIA	PSYCHOLOGICAL	COMPLEX MEDICAL
DEFINITION	Unable to manage self-care at home or in community settings due to progressive dementia or non-progressive cognitive impairments. *Indefinite length of stay*	Complex psychosocial problems often due to a medical diagnosis. Rehabilitation is the ultimate goal for this population. Goals of treatment include lessening of symptom severity, improvement in ability to relate to others, improvement in ability to perform activities of daily living, and reduction of specific target behaviors that impact the resident's ability to interact safely and socially in another environment. *Varied length of stay*	Multiple medical problems with concomitant psychosocial issues. Most residents are alert, oriented and able to communicate. However, despite being cognitively intact, many have significant social or behavioral issues. Unlike the Psychosocial population whose therapeutic goal is rehabilitation back into the community, the Complex Medical residents' behavioral goal is to restore social interactions for maximum independence in a group setting. *Indefinite length of stay*
CLINICAL PRESENTATION	• Alzheimer's Disease • Multi-Infarc Dementia (MID) • Short-term memory impairment • Judgment impairment due to perception (such as left/right neglect) • Impulse control due to an unmet need or anxiety (such as wandering)	• Spinal cord injury • Multiple sclerosis • Substance abuse • Delusional presentations • Depression • Judgment impairment or impulse control due to behavioral problems (such as acting out)	• Mild retardation • Spinal cord injury • Cerebral vascular accident (CVA) • Continuous Dialysis (CAPD) • Diabetes • Wound care • Huntington's
ENVIRONMENTAL GOALS	Dependent upon environment for a therapeutic setting with the goal of safety and security.	Like Dementia residents, Psychosocial residents are also dependent upon their environment as a therapeutic setting, but the goal is clarification of the environment as opposed to comfort and predictability of the environment.	Due to the psychosocial component of Complex residents' care, their environmental needs are similar to the Psychosocial residents' needs with an additional requirement to accommodate medical care.
ENVIRONMENTAL FEATURES	Cueing opportunities (such as which room is their bedroom, where is the toilet room, etc.) provide important visual "clues". • Personalization of rooms (such as "memory cabinets", picture rails, etc.) helps reclaim a sense of self-identity, maximizes attention span, and reinforces directional cueing. • Stimulation control (such as private bedrooms, small-group dining rooms, etc.) help minimize intake overload. • Stimulation outlets (such as indoor/outdoor wandering paths, come-and-go activities, etc.) allow release of anxiety and agitation. • Security issues (such as protection from aggressive residents, non-axial entries and exits, etc.) increases feelings of security and improves emotional well-being. • Creative resolution of paradoxes (such as need for stimulation but problems of over stimulation, need for predictability versus value of prompting curiosity, etc.). • High spatial/storage needs to accommodate bulky assistive devices unique to the declining dementia resident (such as "ultimate walkers".)	Orientation to place (such as wayfinding) helps the resident adjust to the environment. • Personalization of rooms (such as private rooms) helps reclaim a sense of self-identity as well as reduce territorial issues. • Behavior control (such as small-group dining rooms, time-out rooms, etc.) helps modify inappropriate actions. • Behavior outlets (such as access to the outdoors, vigorous activities, etc.) • Range of security issues (such as protecting frail residents from psychosocial residents, observation of the residents for behavior control, etc.) • Rehabilitation opportunities (such as cooking, self-medication, group therapy, egalitarian rooms, etc.) • Average spatial/storage needs associated with skilled care residents.	• Orientation to place (such as wayfinding) helps the resident adjust to the environment. • Personalization of rooms (such as private rooms) helps reclaim a sense of self-identity as well as reduce territorial issues. • Behavior control (such as small-group dining rooms, time-out rooms, etc.) helps modify inappropriate actions. • Behavior outlets (such as access to the outdoors, varied activities, etc.) • Range of security issues (such as protecting frail residents from psycho-social residents, observation of the residents for behavior control, etc.) • High spatial/storage needs to accommodate numerous assistive devices unique to the medically-dependent Complex Medical resident, which are often bulky and high maintenance (such as Vail beds, Broda chairs, PVC toilet frames, power wheelchairs that need re-charging, etc.)

as the simple need to stop and rest while others have difficulty starting and stopping altogether; patients with psychiatric disorders need shielding from overstimulation but simultaneously need to visually scan all that the environment may pose for them; lack of spatial clarity stresses both patient populations for different reasons, such as neurological patients distracted by the physical effort navigating even simple environments, while psychiatric patients become easily confused due to the mental effort navigating unfamiliar settings. Developing a matrix of environmental needs for this range of patients highlights features that support both populations while calling attention to features that exacerbate either patients' condition. While Patient-Population Based Design hones in on specific patient needs, the end-result is a facility design that is not narrowly customized to one single patient population but instead is flexible enough to support a variety of patient needs.

Before and after floor plans illustrate how Patient-Population Based Design thinking was utilized to support the neuro-psychiatric patient population while remaining functional for the general patient population. The Pre-Design diagram (see Figure 1) shows the preliminary clinic layout as a loop corridor with doors at both ends of the loop and a single waiting zone. The Design diagram (see Figure 2) shows the final clinic layout with a single primary corridor, only one option for both entry and exit, and internal clinic sub-waiting in addition to the main waiting zone.

In this final clinic layout, three critical design parameters are established:

- Single clinic entry and exit;
- Redundant pathway;
- Break points.

How these three design elements maximize the environment for both neurologically impaired patients as well as patients with psychiatric conditions is summarized in Table 2.

These three design parameters for the Centre for Brain Health each address the unique day-long clinic visits experienced by both patient populations, who typically cycle in and out of waiting and clinic exam rooms between various procedures or consultations. General design parameters not specific to this case study, but to be anticipated for any facility serving neurologic and/or

FIGURE 1: Pre-Design Clinic Plan

FIGURE 2: Final Design Clinic Plan

TABLE 2

CENTRE FOR BRAIN HEALTH	POPULATION	
	NEUROLOGICAL	PSYCHIATRIC
SINGLE CLINIC ENTRY EXIT	Same way in and out is physically more manageable with less seek-and-find wasted movement due to its predictability;	Same way in and out is emotionally more manageable with less unknowns and requires less thought due to its predictability;
REDUNDANT PATHWAY	Single shorter corridor is physically more manageable with less seek-and-find wasted movement due to its predictability; Single decision point (one turn off corridor) is physically more manageable with less seek-and-find wasted movement due to its simplicity;	Single corridor is emotionally more manageable with less unknowns and requires less thought due to its predictability and visibility Single decision point (one turn off corridor) is emotionally more manageable with less thought due to its memorability;
BREAK POINTS	Sub-waiting alcoves offer stopping points for rest of physical movement; Sub-waiting alcoves offer landmarks from which to mark physical progress.	Sub-waiting alcoves offer escape points to pull away from corridor traffic; Sub-waiting alcoves offer landmarks from which to gauge mental effort.

psychiatric patients are summarized in Table 3. Overall, patients with neurological ailments have a weakened sense of space with safety as a primary concern, therefore design parameters should focus on things they touch; patients with psychiatric conditions have a vulnerable sense of self with composure as a primary concern, therefore design parameters should focus on things they see.

A review of the literature reinforced and influenced the environmental parameters that would be ideal for neuro-psychiatric patients. One concept put forward by Antonovsky [3] states that individuals with numerous emotional resources, referred to as a high Sense of Coherence (SOC), were more confident and therefore better able to adapt to stressful situations.* Patient-Population Based Design assumes that patients may have a high SOC, and offers them an environment with choices to meet their physical and mental needs when in a stressful situation; more importantly, for patients who do not have a high SOC, the patient-population designed environment offers supportive features appropriate for several levels of coping ability.

The concept of Cognitive Maps put forward by Dilani [4] [5] stresses that landmarks in buildings are closely related to the perception of stress and can serve as reference points for easier orientation. In the Centre for Brain Health, the sub-waiting alcoves are distinct elements creating a Cognitive Map that fosters the neurological patient's need for rest and reassures the psychiatric patient's need for escape, thereby reinforcing the well-being of both populations.

Case Study Specifics

Beyond the concern for Population-Based Design, two concepts in the final clinic layout were specific to maximizing overall clinic efficiency for the Centre for Brain Health: Clinic Pods and Dual-Purpose Exam Rooms. Figure 4 illustrates how the total 18-exam room clinic was configured into self-contained pods comprising six exam rooms, two support rooms, and a touch-down space for staff and sub-waiting alcove for patients. This pod concept simplified the patients' experience by reducing his or her exposure down to a smaller number of rooms, while increasing the staff's efficiency through in-the-pod access to support rooms and work space. Figures 5 and 6 illustrate how the same exam room functions either for an exam-table neurological

TABLE 3

NEURO-PSYCH POPULATION CONTINUUM: GENERAL ENVIRONMENTAL NEEDS		
MOVEMENT	COGNITION	PSYCHOSIS
Pacing is key to their movement through the environment; Focus on features that allow stopping & starting, such as: *Corridor 'pull outs' or niches;* *Deeper elevator / entry vestibules;* Create a 'new normal' environment by acknowledging / celebrating differences / imbalance through asymmetry such as: *Corridors lit from one side;* *Parallel planes treated differently;* Predominately seated population, therefore: *Assume low view angle with focus on floor more than ceiling (typical 60-degree cone of vision is from about 8 feet, 6 inches down to the floor);* *Consider wheelchair 'rear view mirrors' for backing out of elevators, exam rooms, etc.;* *Assume reach is limited regardless of front or side approach;* *Push plates needed throughout patient pathway.*	Guide their (limited) thinking; Focus on features that are touched more so than seen and offer simple decisions, such as: *Bathroom stall swivel latches;* *Sliding doors where ever possible (5# limit).* Therapeutic way finding, such as: *Strong differentiation between left versus right;* *Shortest distance to meaningful space;* *Previewing of adjacent spaces through transparency will create visually open plans for orientation;* *Details that differentiate (asymmetrical color coding, staggered doors, etc.) will trigger individual cueing.*	Limit choice & decision-making; Focus on features that are seen more so than touched and offer predictable cues, such as: *Hand rail different color than wall;* *Small alcoves with 1 or 2 seats;* Avoid creating paradoxes through predictable spaces that progress from small to large (alcove, sub-waiting, full waiting to lobby); each space will act as transition space and enhance their sense of control; Stimulating spaces will over stimulate; smaller groups & waiting rooms help minimize intake overload/over stimulation and reduce territoriality; Simple decision points at meaningful spaces (a space they will use) reduces anxiety; Behavior outlets (access to the outdoors, quite rooms, time-out rooms, etc.) help dissipate or modify inappropriate actions.

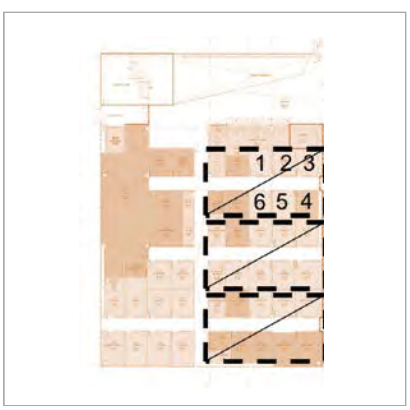

FIGURE 4

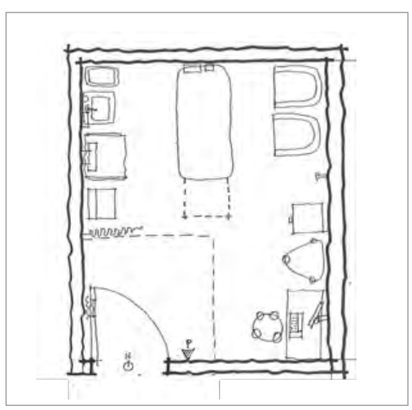

FIGURE 5

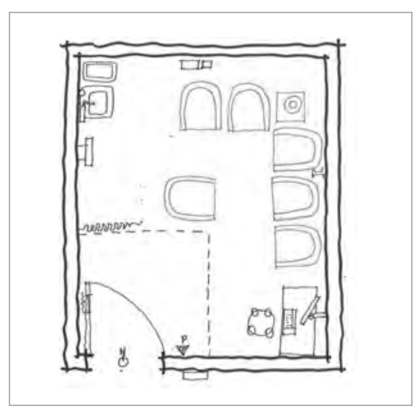

FIGURE 6

assessment or for a group-seating psychiatric consultation. This dual-exam room concept was achieved by fixing only the door and sink location with all other items being movable, allowing the clinic to flex from neuro to psychiatric services as needed.

Also specific to the Centre for Brain Health were sustainability goals. Because this building is a translational medicine facility combining research labs with patient clinics, only 60% of the building needed to have the 10 to 12 air changes per hour that is required in most research labs compared to only 4 air changes per hour needed in the patient clinics. With this in mind, separate zone systems were created for each area to maximize energy savings; the building systems overall were designed for the populations within, rather than the lowest common denominator for all. In addition to a variety of sustainability measures, one of the most important was access to natural light, which pours into the facility through three different atriums, one of which is dedicated solely to patients in the clinic proper, allowing the healing effects of natural light in a protected zone.

Footnote

* Antonovsky, A. pg. 725 "If adaptive coping is indeed the secret of movement toward the healthy end of the health ease/disease continuum, then primary attention must be paid to what I had earlier called "generalized resistance resources" [4]. What came to concern me more and more, however, was a theoretical understanding of why such resources-wealth, ego strength, cultural stability, social support-promoted health. Or, to put it in other words, what did they have in common? I came to call the answer to this question the sense of coherence (henceforth, SOC). Resources were seen as leading to life experiences which promoted the development of a strong SOC, a way of seeing the world which facilitated successful coping with the innumerable, complex stressors confronting us in the course of living. The SOC is defined as follows: a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement."

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FIGURE 7: Centre for Brain Health

(4) Alan Dilani, PhD (2001) Design and Health—The Therapeutic Benefits of Design, p. 31-38.

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Credits

All tables and matrixes by Sharon E. Woodworth
All floor plans by Anshen+Allen, Architects
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Increasing the Inclusivity of the Design Process for Transformative Design

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ABSTRACT

Orchestrating a collaborative and inclusive design process requires a wide range of perspectives, specifically those of the C-Suite, clinical and support staff, architect and contractor. By evaluating patient/staff flow, facility flexibility and technology integration, this case study of a new project at Reading Health System speaks to a multi-generational approach for the transformative design that helps caregivers provide the best patient care. The design team engaged beyond the typical stakeholders, and included members such as the EVS staff, Infection Control, and Transport in the early planning phases and through all 24 rounds of intensive user group sessions to fully understand design impacts on the processes of flow of patients, materials and staff. The goal of this inclusive design process was to transform the convoluted OR processes, consolidate programs from multiple buildings, introduce new patient and supply chain processes, and co-locate the surgery and procedural platforms in a single building with direct access to the ED and 150 new private Surgical Beds. This ambitious change from a process standpoint required a radically different approach and buy-in from all perspectives and representatives, but was rooted in a consistent 35 + year relationship. This deep knowledge base between the owner and the design team allowed for the continuous design evolution and, ultimately, a transformative design process and exemplary OR platform.

ARTICLE

Increasing the Inclusivity of the Design Process for Transformative Design

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Expanding technology and a rapidly changing healthcare delivery environment requires the design team to engage the C-Suite, the clinical and support staff with the architects and the construction team holistically to create a collaborative and inclusive process. It is within the design process that an opportunity exists for all stakeholders to express their wide range of perspectives, and for the design team to respond appropriately in order to yield measurable improvements, and transformative patient care.

To further complicate the equation, current staff at most institutions spans a range of generations – from the Silent Generation to Baby Boomers and GenX, and soon GenY and beyond. This multi-generational workforce has a wide range of needs and often differing priorities that define a satisfactory work environment, and within each of these generational groups, participants in the design process have different styles of learning (Figure 1). When planning and designing new facilities, hospital leadership can globally address the needs of this variable workforce through an interactive planning and design process, which improves staff, and patient flow, functions efficiently and effectively, and incorporates flexible concepts to benefit both staff and patients.

Reading Health System has recently completed a planning and design process for a 465,000 SF patient care building that consolidates all surgical services, expands emergency medicine and cardiology capabilities, and adds 150 new private patient rooms to this urban

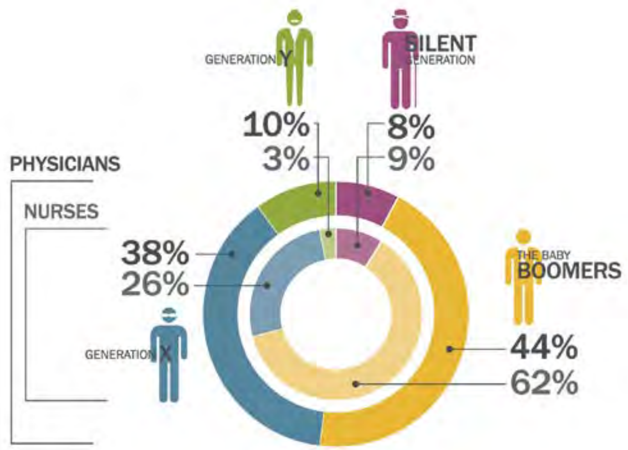

FIGURE 1: Staff by Generation

FIGURE 2: Transformative Patient Care

institution. Through its early engagement of multi-generational and diverse user groups, the Hospital shows its commitment to design for the future while simultaneously providing an excellent work environment for staff. Early on in the process the team worked to develop guiding principles for transformative patient care including: 1st Class Patient Care, Operational Efficiency, Financial Stewardship, Facility Modernization, Balancing Flexibility with Standardization, and Supporting Integration (Figure 2).

These guiding principles became the foundation for all discussions and framed the goals of the facilities and the design process. Throughout the design process these guiding principles acted as a lens to evaluate and refine decisions beginning with early planning and even during the current CA process. The focus on consistent goals and transformative patient care allowed all of the stakeholders to participate in the design process from their unique vantage points, thus contributing to the goal of the Hospital, and ultimately refining the building.

User group meetings involved not only the executive level, but representatives throughout all disciplines of the Hospital to thoroughly understand clinical flow of staff, supplies, patients and information. With 24 rounds of meetings, and 42 distinct user groups, the process included representatives of 10,800 staff hours of direct user group discussions. The inclusive user group process lead to many discussions between clinicians, administration, and materials management regarding how the supply chain of materials and the physical environment affected the clinician's ability to deliver the best possible clinical care for patients.

In addition to addressing the varied perspectives of the staff the design process sought to reach all four learning styles within the user groups: Visual, Auditory, Tactile, and Kinesthetic (Figure 3). For the Visual learners, the design team actively utilized drawings, renderings, and plans. With the Auditory learners the focus was on group interaction during the user group meetings, including ways to incorporate discussion within the presentation on a continual basis.

Physical to-scale 3D models were constructed of the entire site, along with 3D printed models for many of the primary OR rooms. All equipment, OR tables, and scale figures were printed and able to be re-configured by the user groups to establish the best relationships between

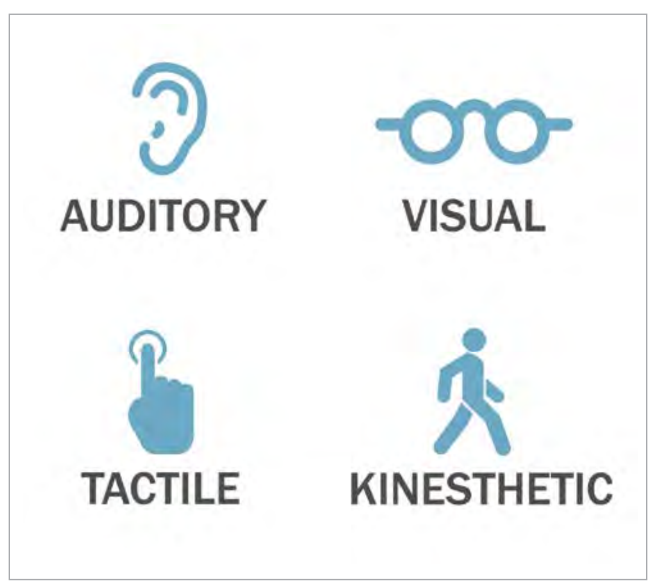

FIGURE 3: Learning Styles

the fixed architecture of the space, and the mobile equipment for various procedures. This process was geared toward the tactile learners, and created opportunities to increase the flexibility of the standard ORs, because different constituents could readily see and change the set-up of the rooms. In order to connect with the Kinesthetic users, physical full size mock-ups were used to engage the staff in tight collaboration with the administration to accommodate new developments in healthcare delivery options.

This level of consistent commitment from the Hospital brought together all levels of staff in a single "war room" for vigorous and comprehensive user group sessions. Mock-up rooms were intentionally located next to the war room to create a living learning lab where design concepts could be tested in real-time with administrative, architect, facilities and caregiver input. While the full scale mock-ups were particularly effective, one option that resonated with all four types of learners was the live Revit mock-ups and fly-through of the working model. Since this project was produced in Revit, the design team was able to bring a copy of the working model to the user groups and make real-time adjustments.

All MEP disciplines were active in the model, and users could comment and adjust equipment, millwork, light switches, as well as walls. More importantly the entire group could engage with a 3D virtual reality that is cost prohibitive to accomplish for a full scale mock-up of every room. Elements such as the hand sanitizers were included in a three-dimensional way, so that the Infection Control staff, the clinicians, and the EVS representatives could all participate together in the discussion of where to appropriately locate the hand sanitizers to encourage the greatest compliance of use.

Incorporating Flexibility into OR Standardization

Today's workforce, particularly in the healthcare sector, is made up of members from the Silent Generation to Baby Boomers and GenX, and ever expanding GenY and beyond. Many of those in senior administration are in the Silent and Baby Boom generation, which typically has a very different attitude toward work, life, and the importance of the physical environment. Gen X and Gen Y, tend to focus more intently on how to balance work and life with greater ease, and have different demands of their physical environment largely driven by the fact that they are digital natives, and prefer a more collaborative work environment.[1] These perspectives are particularly evident in the design of the OR platform, and the integration of new technology and surgical procedures.

More experienced surgeons were taught techniques which did not require any computer technology to accomplish, while the surgeons entering the workforce today typically rely heavily on DaVinci robots, or other interoperable modalities. In a 2009 review article entitled "The Problem of the Aging Surgeon," Orthopedic surgeon Ralph Blasier wrote that "essentially every treatment technique taught 25 years ago has been abandoned and replaced (and) All surgical specialties have had similar turnover of treatment methods."[2] This dramatic shift in how surgeries are performed has an incredible impact on the physical space and layout required to perform them. Compounded with the digital integration and robotic emergence within the OR platform, the design team must work with the multi-generation workforce to design an OR platform that is simultaneously effective for experienced surgeons and those from other generational vantage points. This intense, collaborative user group process resulted in fresh design ideas that incorporate future flexibility while balancing the needs of standardization.

This project replaces the entire fragmented OR department from multiple buildings, an outdated Central Sterile area, difficult way finding for patients and families, and challenging clinical sterile flows. The design process began with the guiding principles: 1st Class Patient Care, Operational Efficiency, Financial Stewardship, Facility Modernization, Balancing Flexibility with Standardization, and Supporting Integration. To fully transform the Operating Room platform, everyone from the EVS team to senior administration participated in process discussion, design discussion, and consensus building.

Overarching decisions such as standardizing the ED treatment bay with the Cardiology Prep and Recovery bay were instrumental early in the process and were driven initially by the desire to modernize the facility. As the user groups began discussions about the nuances of the typical room layout, detailed discussions emerged from the EVS group and the distribution of clean supplies and linens. The design moved away from built in cabinetry at the headwall for personal belongings and supplies, and instead focused on the opportunity to use mobile carts for ease of cleaning and stocking. This decision allowed the rooms to become standardized, and at the same time more flexible for the individual departments.

The same approach to standardization was applied to the Operating Rooms: designating 6 rooms as hybrid / robotic rooms capable, 11 rooms as general ORs, and

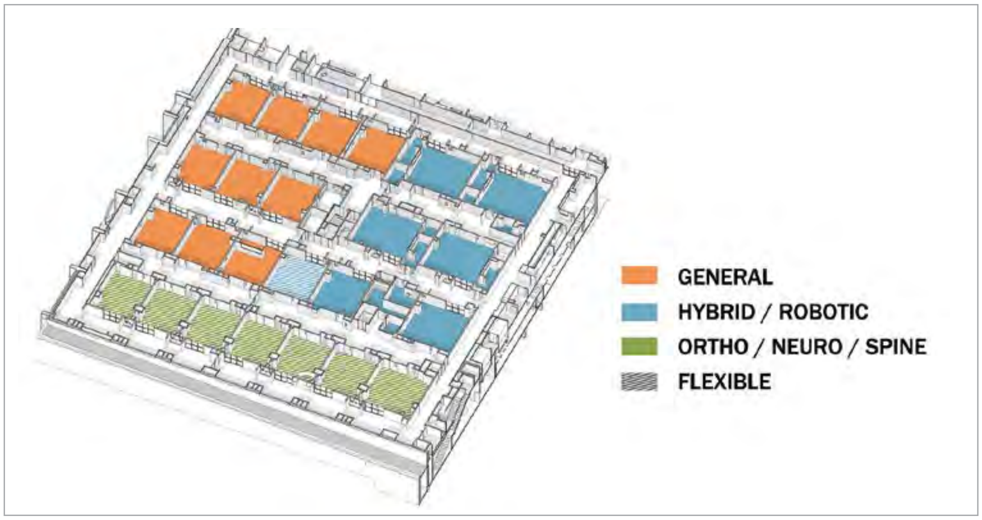

FIGURE 4: OR Platform Organization

seven Ortho / Spine / Neuro Rooms (Figure 4). Currently the platform is designed with two Zeego rooms for interventional imaging capabilities, and all six rooms are adaptable for the Zeego, bi-plane or other specialty equipment. Two rooms also accommodate DaVinci equipment with provisions for a third room. The zones of pre-investment allow the platform to grow and change overtime with new technological advancements.

Within this structure of standardized room types, the case cart system, OR integration systems, and block scheduling allow additional flexibility between surgery types to maximize utilization of all of the rooms at an operational level. This level of coordination between architectural decisions, and operational issues was aided by the user group meetings attendees beyond the traditional constituents for a construction process. Additionally, a prefabricated flush filtered diffuser system in all 24 ORs and three of the procedure rooms, which includes lighting, sprinkler system and integral structural support, allows these rooms to be quickly converted and adaptable to future technologies. The offsite pre-fabricated system is estimated install in one-sixth of the traditional field built system.[3]

Collaborative Space for Improved Clinical Care

Each generational cohort has a different vantage point and thus a different perspective. In addition to the generational shifts, the focus is no longer on a fragmented, provider centric, fee for service treatment of disease, but rather an integrated, patient centric, pay for quality approach to wellness. Layering the needs of each generational group with Evidence Based Design goals incorporates the generational resonance of design elements for both the staff and the patients (Figure 5). While some design elements such as a desire for minimized travel distances apply to all different generational groups, there are scales to the rank.

The American Association of Nurses in 2012 listed the average age of employed RNs at 44.6 years,[4] with a 55% of the nursing population over 50.[5] For the Baby Boom and Silent generation nurses, minimizing travel distances means less physical stress and more time at the bedside with their patients. These same sentiments were frequently discussed in the user group meetings, and deeply affected the design process.

The public entry point to each of the five patient bed floors is in the center of the unit with a central clinical hub, decentralized nursing stations between each pair of mirrored patient rooms, and team rooms located in the central core at both ends of the units. This layout and variety of work space provides a multitude of benefits to the clinical staff by limiting staff travel distances, and offering a variety of work environments to accommodate changes in treatment and technology.

In addition to a variety of locations throughout the unit, the work spaces such as the central clinical hub has three levels of work zones: a public front desk, a central gathering area for groups, and a quiet enclosed zone for dictation or other single provider work. The public front desk is minimized to limit gathering of staff at the desk and thus lowers the sound transmission of conversations, and reduces the possibility of disrupting patients. The central gathering area has a standing height table and stools to encourage group discussion, but segregates this zone from the main part of the patient floor. The third zone is enclosed for dictation and other work which requires greater privacy.

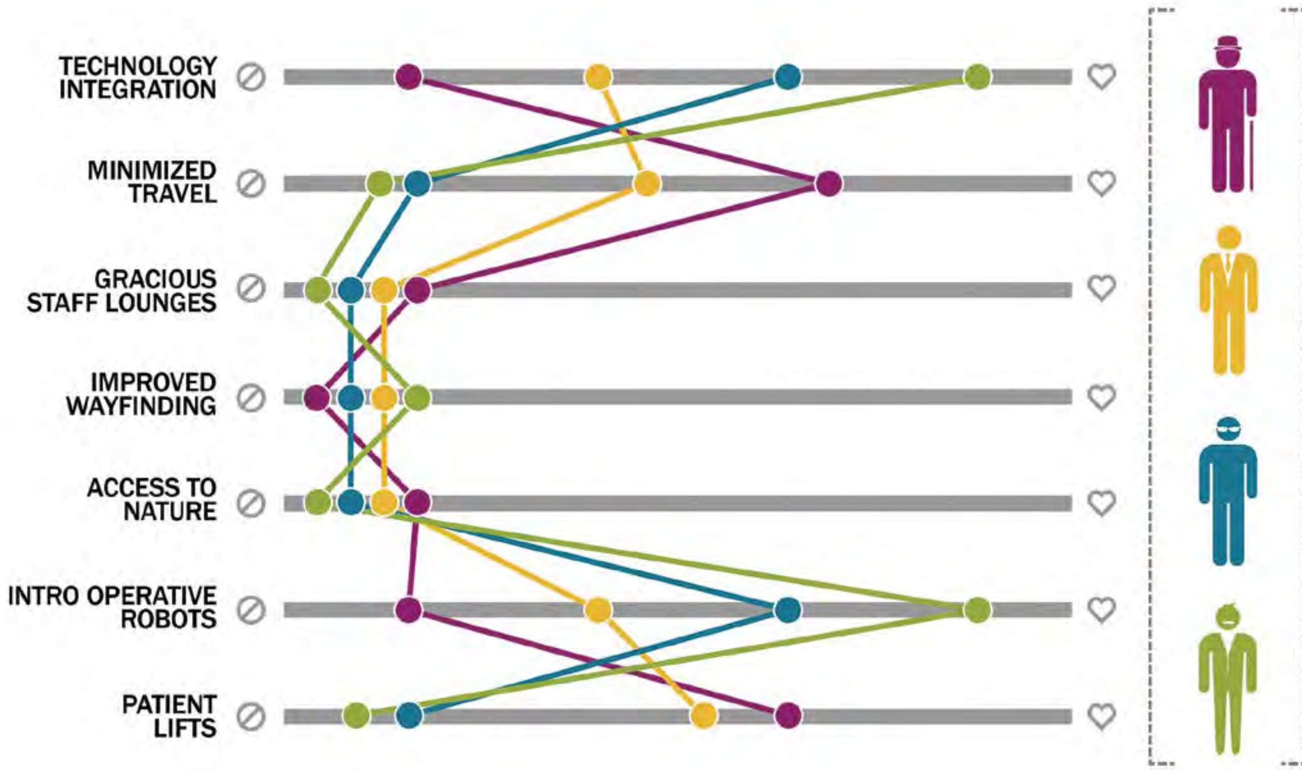

FIGURE 5: Generational Resonance

This entire hub is centrally located and allows easy access from both ends of the unit, and provides much needed areas for staff to access EMR records, test results, and sit physically together to collaborate on patient care. In addition to user group input, in 2009, the hospital and design team experimented with this type of configuration on a renovation of a two existing patient units in the 'C' Building. Many of the user group members have used these existing units as a living mock-up, and through their experiences have refined the current configuration.

To further encourage collaborative care and staff time at the bedside, the decentralized stations allow for two caregivers to gather outside of each patient room. These stations are equipped with technology to allow for continuous telemetry monitoring, visual inspection of patients, access to patient records, and typical charting options. These decentralized stations work in concert with, the central clinical hub and the team rooms with gathering space for interdisciplinary groups are provided on both ends of the unit. The team rooms are group gathering areas with robust technology which can retrieve information from patient files, recent surgery procedures, and access to outside resources to assure the best patient care.

In addition to the desire for minimizing travel distances, these various stations evolved around discussions and integration of electronic medical records into the clinical work flow, and the ever increasing reliance on changing technologies. One example of the diverse user group working together included, the IT department, the clinicians, and senior administration all participating in the same meetings to address how to accomplish the digital needs of the clinicians. The result includes spaces throughout the building are linked through a robust data backbone, to insure that on day one the infrastructure provides the right information on patients in an easily accessible way to the clinicians, and over time the systems are as adaptable as the clinicians themselves are to the changing digital landscape.

Design Results of Collaboration

As architects, the design team is trained to strive for excellence, but as architects for health we must also focus on what excellence means to the C-Suite, the clinical and support staff. For the Hospital's new facility, particular attention is given to the design and final layout as driven by the user group sessions and predicated on changes to healthcare delivery due in part to: EMR adoption, improved efficiencies, advances in technology, private patient rooms, decentralized nurse stations, team rooms, and new staff amenities.

Changes in technology, operational issues and healthcare delivery will continue at a rapid pace, and affect staff at all levels. Part of the design challenge is enhancing opportunities for speed and ease of adjustments over time. This project brought together all stakeholders from the supply chain, to the end users while preserving future change opportunities; utilizing prefabricated ceiling structures, connecting surgery video to the patient floor team rooms, and allowing flexibility within standardization extends the effective lifespan of the building.

Additional design opportunities that will allow the Hospital's multi-generational staff to excel include: minimized travel distances, team rooms, dual dedicated fiber optic backbones with pathway diversity, integration cabinets outside every OR and procedure room, intraoperative robots within the OR, patient lifts in every patient room, standardized support spaces, and technology charging stations within the decentralized nurse station. These physical changes affect the delivery of care differently for staff members dependent on their generational vantage point.

For those in the Baby Boom generation, shorter walking distances, decentralized nursing station, and patient lifts can physically ease the strains of the workday. For Gen X and Gen Y, access to the intraoperative robots and technology integration can serve to enhance their work environment. From an architectural and administrative standpoint, collaborative work areas begin to create physical space which can physically co-locate these disparate groups and bridge the gap between these two vantage points. All of these physical nuances help to create an environment for happier staff, which then provide better patient care and also drive HCAHP scores (Figure 6).

The goal of this inclusive design process was aggressive: to transform the disparate OR processes, consolidate programs from multiple buildings, introduce new patient and supply chain processes, and co-locate the surgery and procedural platforms in a single building with direct access to the ED and 150 new private Surgical Beds. This re-evaluation of the process and the institution from all vantage points generates a physical environment that motivates current and future caregivers, balances rising operational costs, and defines what excellence actually means in providing the best patient care delivery model.

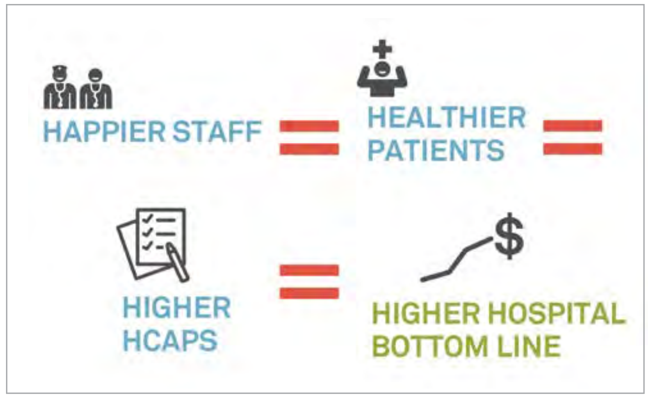

FIGURE 6: The Bottom Line

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Neonatal Intensive Care Unit (NICU) Room Type Design Trends

by YILIN SONG & MARDELLE McCUSKEY SHEPLEY, DARCH., FAIA

ABSTRACT

Since the first neonatal intensive care unit (NICU) in the world was established at the Yale-New Haven Hospital in 1960s, the number of NICUs has grown and the design has evolved. This study explores data regarding NICU room types and NICU room access to daylight.

An online survey was used that gathered information on: NICU hospital location, year of construction, numbers of rooms and beds per room, number of rooms with daylight and daylight sources. Subjects were recruited from a list of NICUs in the United States for which there was contact information. Eighty-eight medical directors completed the survey.

Based on the results, we conclude that the multiple-room configuration, which usually means an open-bay layout in NICU design, was the prominent room type before 1990. The average number of beds in NICUs with 2-3 beds per room is 2.71. The rapid expansion of SFRs and mixed SFRs, relative to 2-3 beds per room units since 1994 reveals the trend to reduce the number of beds per room and create a more individualized developmental care environment.

Regarding light, access to daylight via exterior windows is the most commonly used means. Existing SFR units have the advantage of providing more daylight than the other configurations; however, daylight is not a given in this configuration. The ratio of SFR rooms that have access to daylight is still lower than 85%, so the incorporation of daylight must be a design objective in and of itself.

ARTICLE

Neonatal Intensive Care Unit (NICU) Room Type Design Trends

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Introduction

Since the first neonatal intensive care unit (NICU) in the world was established at the Yale-New Haven Hospital in New Haven in 1965 (Historical Archives Advisory Committee, 2001), the number of NICUs has grown and the design has evolved. The demand for newborn intensive care has been increasing in the recent years; as a result, the number of NICU facilities in the United States expanded 20% from 1996 to 2011 (AAP, 1996, 2011) (see Figure 1). The physical environment of NICU departments has received more attention as well (Stevens et al., 2010). Several projects and studies emphasize the design trend of using private rooms instead of the traditional layout of open-bay rooms (Milford, Zapalo, & Davis, 2008; Feldman, 2009; Padbury, Van Vleet, & Lester, 2010; Bosch, Bledsoe, & Jenzarli, 2012).

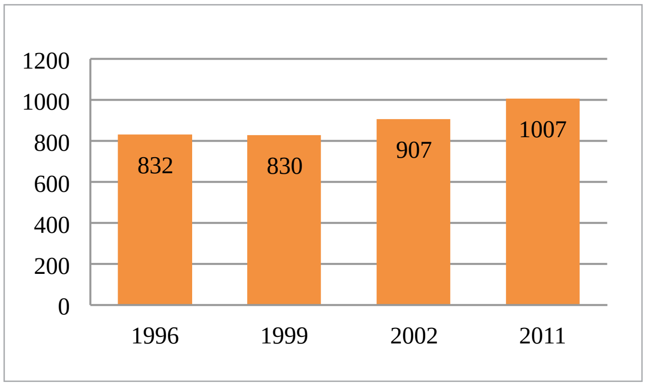


FIGURE 1: Number of NICU facilities in the United States, 1996–2011 (aap, 1996, 1999, 2002, 2011)

However, with the exception of the publication, *Design of Pediatric and Neonatal Critical Care* (Shepley, 2014), there has been little documentation of the transitions associated with different layouts in NICUs from either architectural design or medical facility perspectives. Another issue that has not been addressed is the historical role of natural light in NICUs. Although researchers have yet to demonstrate benefits of access to light for infants before 28 weeks of gestation, the importance of natural light in infant development and daily activities afterwards has been documented (e.g., Vandenberg, 2007; Rizzo, Rea, & White, 2010; Graven, 2011; White, R. D., Smith, J. A., & Shepley, M. M., 2013) and may have had a bearing on NICU design development. This paper addresses how NICU room types have changed over the last 50 years and when the change initially happened.

Method

This study explores two aspects of NICU rooms: one is data regarding NICU room types; the other is date regarding NICU room access to daylight and daylighting models.

An online survey was used for this investigation. The survey *NICU Room Type & Lighting Condition Questionnaire* collected (1) NICU physical environment information, such as the hospital location, built or renovated year, numbers of rooms and beds in each of the three room types (single family room (SFR), 2–3 baby beds per room, and more than 3 beds per room), and numbers of rooms with each type of daylighting condition (by exterior windows, by interior windows with daylight from exterior windows, by skylight and three combinations of any two types) and (2) staff evaluations regarding electric lighting and daylighting in NICUs. Figures 2 and 3 illustrated the typical floor plans of SFR and multiple-bed rooms. The questions regarding the physical environment were yes-no question or fill-in-the-blank; questions asking about subjective opinions were based on a seven-point Likert-scale.

The questionnaire was created using the online survey platform *Qualtrics.* The link to it was emailed to the nationwide NICU medical directors identified in *Newborn Intensive Care Units (NICUs) and Neonatologists of the USA & Canada Directory* (AAP, 2011) during March, 2014. Two reminder emails were sent

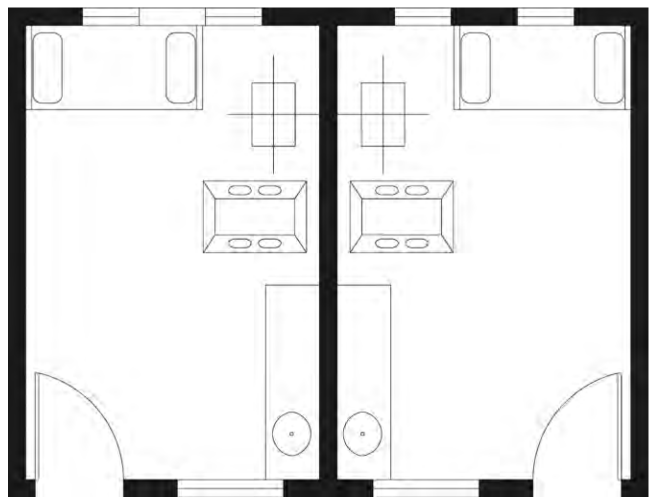


FIGURE 2: Typical floor plan of SFR NICU

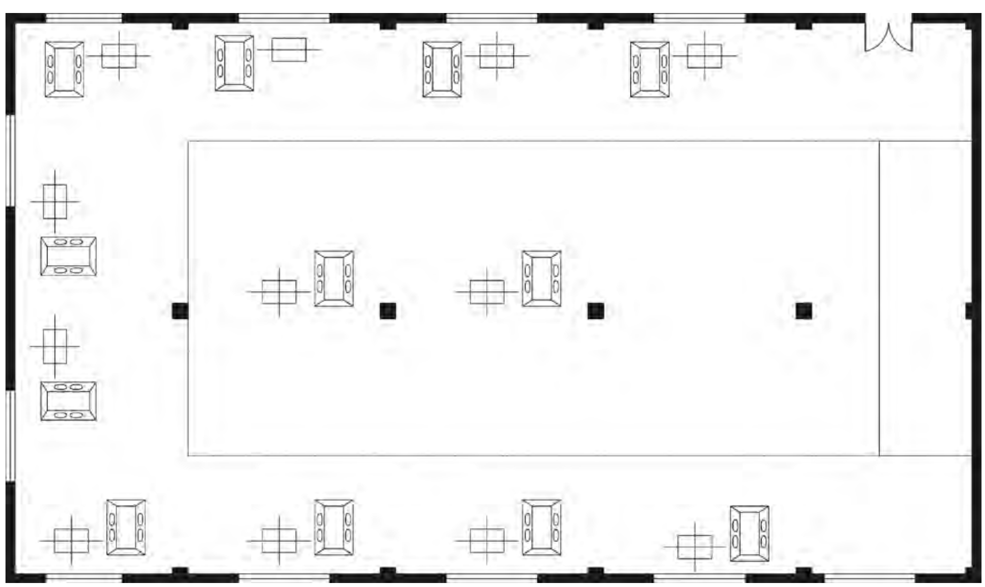


FIGURE 3: Typical floor plan of multiple-bed NICU rooms

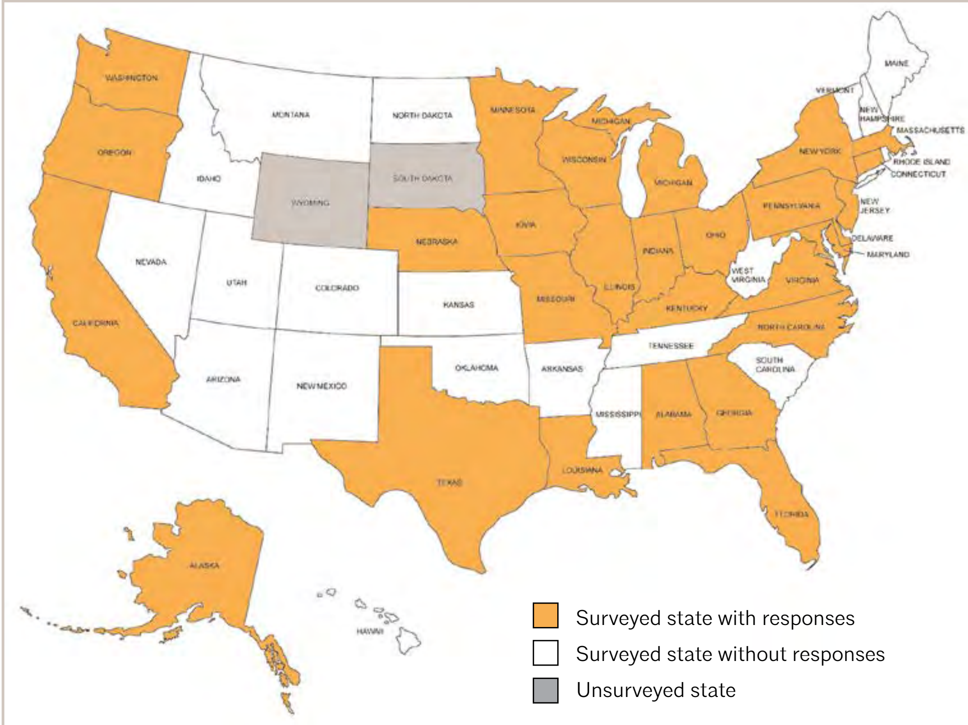


FIGURE 4: The states covered by the returned questionnaires

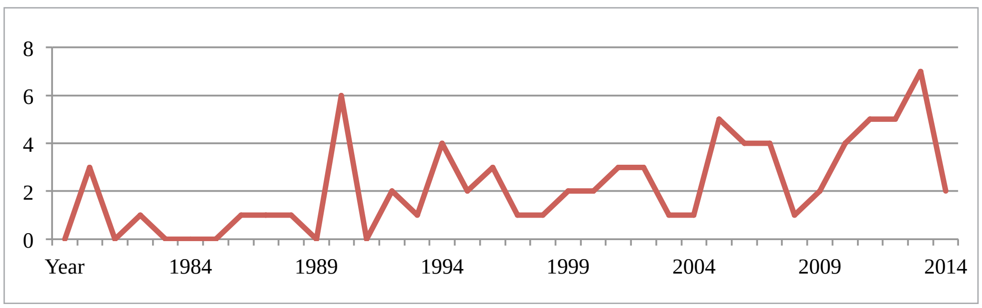


FIGURE 5: Number of NICU facilities by most recent year built or renovated

to enhance the return rate. The entire data collection process lasted for about 50 days to allow the medical directors enough time to respond. The study was approved by the Texas A&M University Institutional Review Board.

Results

The directory listed a total of 1,007 NICUs in the United States. Excluding seven hospitals in Puerto Rico and one naval hospital in Okinawa, Japan, information was provided for 589 out of 999 NICUs regarding the medical directors' email contact information. Four hundred and eighty-two of these were effective email addresses. Ninety-seven medical directors opened the link to the online survey and agreed to participate, and 89 among them finished the survey. If all the 482 medical directors with effective email address actually saw the invitation email, then the response rate was 20.1% (97/482), and the completion response rate was 18.5% (89/482).

The questionnaires were distributed to 49 states (which excluded Wyoming that, according to the Directory (AAP, 2011), did not have a hospital with an NICU and South Dakota which did not have an effective medical director email address). The 88 returned questionnaires covered 29 states (see Figure 4). For the NICUs that had been rebuilt or renovated, the most recent year of construction was used for the analysis.

The key findings from the survey responses regarding bed distribution were as follows:

- The most recently built or renovated NICUs spanned from 1980 until 2014 (see Figure 5). There was no SFR unit until 1994 and 2-3 beds per room units did not appear until as late as 1990. Figure 6 shows the

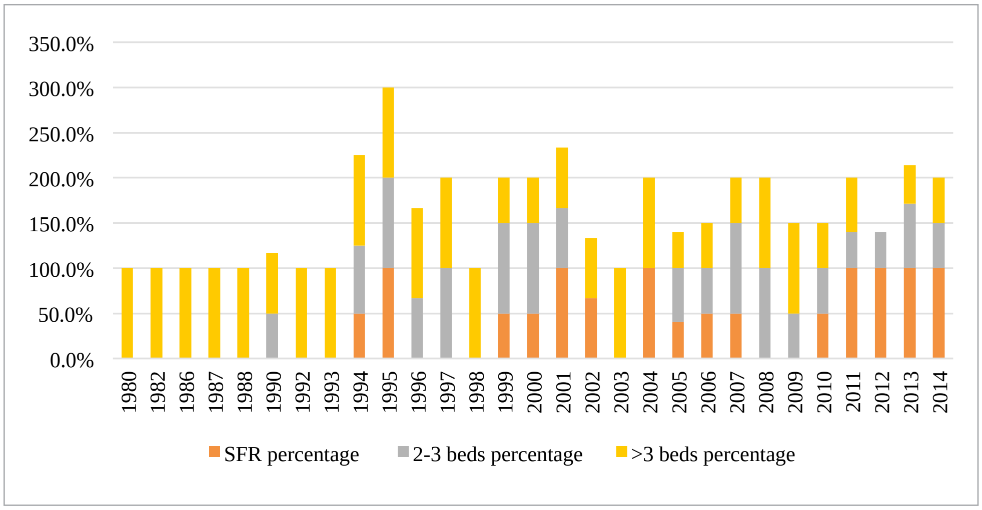


Figure 6: Occupation percentages of different NICU room types in hospitals by most recent year built or renovated

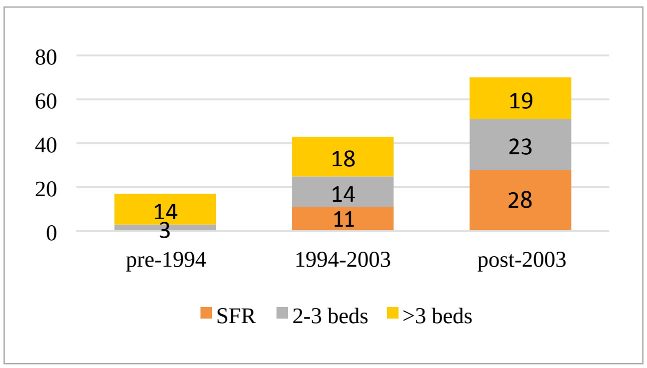


FIGURE 7: Number of hospitals by NICU room type by most recently built or renovated time period

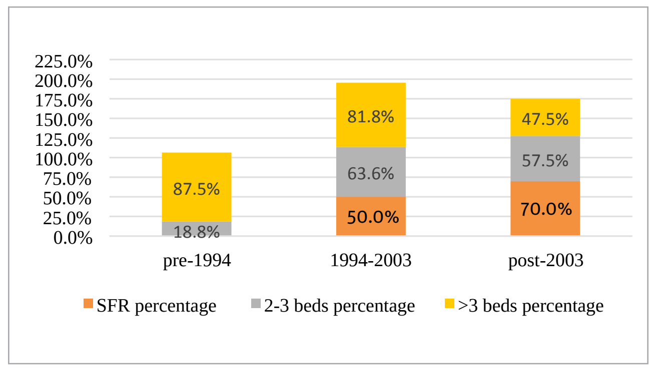
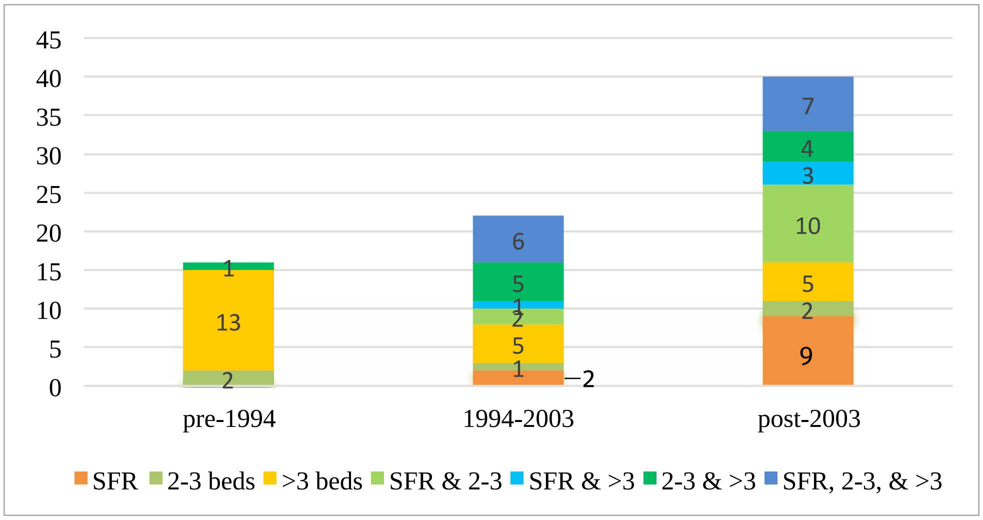


Figure 8: Occupation percentages of different NICU room types in hospitals by most recent built or renovated time period

proportion of NICU numbers in each room type out of the hospital numbers with NICUs. The totals exceed 100% due to units that have multiple types of rooms.

- If divided years into the periods of pre-1994, 1994-2003, and post-2003, as shown in Figure 7, we found the number of newly built/renovated NICUs with more than 3 beds to be relatively stable; however, the SFR units and the NICUs with 2-3 beds per room increased dramatically.
- Taking into account the co-existence of different room types in the same NICU, we calculated the proportion of NICUs in each room type relative to the hospital numbers with NICUs during each period. The results are shown in Figure 8. As in Figure 6, the totals exceed 100% due to units that have multiple types of rooms. We found that after the large increase (almost double) of mixed types during 1994 to 2003 compared to pre-1994, the use of mixed types in the same NICU decrease after 2003.
- Before 1994, the NICU room types were either 2-3 beds per room or more than 3 beds per room with the exception of one hospital with two room types. Since the SFR appeared, the mixed room types are various. If comparing the latter two periods, SFR and the mixed use of SFR and 2-3 beds per room are the fastest increasing while other types are stable (see Figure 9).
- The inner circle in Figure 10 shows the distribution of mixed and non-mixed NICU room types in hospitals, while the outer circle illustrates the specific distribution of each type. On the average, there are 2.71 beds per room for units with 2-3 beds per room and 6.89 beds per room for units with more than 3 beds per room.

FIGURE 9: Number of hospitals with mixed and non-mixed NICU room types by most recently built or renovated time period



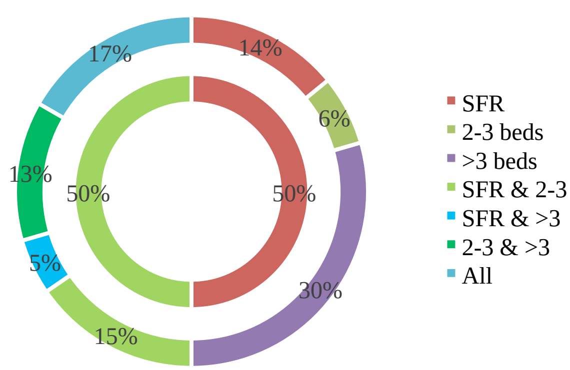


FIGURE 10: Distribution of hospitals with mixed and non-mixed NICU room types

The key findings from the survey responses regarding daylighting were as follows:

- Not all rooms in NICUs have access to daylighting even in the same NICU department. SFRs, however, have greater access; 58.5% of SFRs have all rooms access to daylight while less than a half of the 2-3 beds per room units have access and even less for units with more than 3 beds per room (see Table 1).
- The utilization of different daylighting models in NICUs is shown in Table 2. The majority of those rooms with daylight receive lighting directly from the exterior wall, but 40.1% have rooms with access to daylight via interior windows (including combination with other types).
- SFRs commonly have some rooms with access to daylight via exterior windows and some via interior windows. For the other two types, access to daylight both by exterior and interior windows is the second most common model.

Discussion

Based on these results, we conclude that the multiple-room configuration, which usually means an open-bay layout in NICU design, is the prominent room type before 1990. The construction of SFR units has increased since the unit was built mid-1990s and has subsequently increased in popularity.

We notice that the average number of beds in NICUs with 2–3 beds per room is 2.71. If we categorize the rooms into single, double, and multiple patient rooms, this type is closer to multiple-bed configurations. That also explains the low utilization of 2–3 beds per room and mixed types of 2–3 beds per room relative to 3+ beds per room configuration. The rapid expansion of SFRs and mixed SFRs and 2–3 beds per room units reveals the trend to reduce the number of beds per room and create a more personal care environment.

Regarding light, access to daylight via exterior windows is the most commonly used means. Existing SFR units have the advantage of providing more daylight than the other configurations; however, daylight is not a given. The ratio of beds of SFR rooms that have access to daylight is still lower than 85%, so the incorporation of daylight must be a design objective in and of itself.

Study limitations

There are three potential limitations to this study. Firstly, the limited number of responses may results in lack of ability to generalize the date to NICUs nationwide. Secondly, while medical directors are familiar with their NICU departments, they are not the designers of these facilities. When they report on the NICU physical environment, they may have different concepts and definitions of the room types and the lighting models. Thirdly, the questions listed in the survey are only a small part of the topic; and the response options might not cover all the possibilities. The room design is more complex than the short multiple-choice/fill-in-blank questionnaire could summarize.

Conclusion

Since the first SFR was built during mid-1990s, the overall trend has been to reduce the number of beds per room and enhance individualized and developmental care. Providing more rooms with access to daylight will need to be an additional focus of designers. As a life-defining place for infants, families, and caregivers (White, 2011), the NICU department requires continual improvement and research.

Acknowledgement

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TABLE 1: Basic conditions of NICUs access to daylighting

ROOM TYPE	AMOUNT	AVG. NUMBER OF BEDS/ ROOM	ALL ROOMS ACCESS TO DAYLIGHT	PERCENTAGE OF NICUS ACCESS TO DAYLIGHTING
SFR	41	1	24	58.5%
2–3 beds	41	2.71	18	43.9%
>3 beds	52	6.89	23	44.2%

TABLE 2: Distribution of daylighting models in NICUs by different room type

ROOM TYPE	EXTERIOR WINDOW	INTERIOR WINDOW	SOME EXTERIOR, SOME INTERIOR	BOTH EXTERIOR & INTERIOR	OTHER
SFR	20	6	11	6	2
2–3 beds	28	4	3	9	3
>3 beds	31	3	6	9	6
Total	**79**	**13**	**20**	**24**	**11**

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