# Academy Journal

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Academy of
Architecture for Health

an **AIA** Knowledge Community

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# Contents

## 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 health care architecture, planning, design, and construction. The goal is to promote awareness, educational exchange, and advancement of the overall project delivery process, building products, and medical progress that affect all involved in those fields.

## About AAH

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

AAH currently consists of approximately 7,000 members. Its mission is to provide knowledge which supports the design of healthy environments by creating education and networking opportunities for members of – and those touched by – the healthcare architectural profession.

Please visit our website at aia.org/aah for more about our activities. Please direct any inquiries to aah@aia.org.

# Letter from the editor

As we start the 22nd year of the *Academy Journal*, published by the AAH Knowledge Community, this edition includes two articles that support the enhancement of the built environment for health care.

As the official publication of the Academy, the Journal publishes articles of particular interest to AIA members and the public involved in the fields of health care architecture, planning, design, research, and construction. The goal has always been to expand and promote awareness, educational exchange, and advancement of the overall project delivery process, building products, and medical progress that affects all involved in those fields.

Articles are submitted to, and reviewed by, an experienced, nationally diverse editorial review committee (ERC) of medical and architectural professionals. Over the years, the committee has reviewed hundreds of submissions, responded to writers' inquiries, and encouraged and assisted writers in achieving publication. In its over 20-year history, the Journal has provided valuable opportunities for new and seasoned authors from the architecture and health care professions, including architects, physicians, nurses, other health care providers, academics, research scientists, and students from the US and foreign countries.

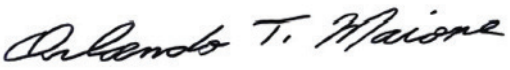
Published articles have explored a broad range of medical topics, including research trends, the future of health care architecture, cardiac care, future and evolving technology, patient rooms and patient safety, lighting design for health care, psychology, workplace design, cancer care environments, emergency care, women's and children's care, and various health care project delivery methods.

We encourage graduates who have received health care research scholarships and others involved with research within the health care architecture field to submit their research to the Journal for publication consideration. We'll continue to develop a cross-referenced article index and a broader base of writers and readers. The deadline for the 2020 call for papers is May 29, 2020.

Since the late 1990s, this free publication has expanded to include worldwide distribution. And we are proud to report that as our readership continues to grow, it also expands internationally. Readers have viewed the Journal online from the US, Canada, Europe, the Caribbean, Asia, Africa, India, and Saudi Arabia, just to name a few. The Journal is available to the 94,000 AIA members and the public on the AIA website at aia.org/aah.

My special thanks to 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 2019 ERC: Donald L. Myers, AIA, NCARB (VA); Angela Mazzi, AIA, ACHA, EDAC (OH); Sharon Woodworth, FAIA, FACHA (CA) and Regan Henry, RA, PhD, LEED AP, LSSBB (OH).

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



Orlando T. Maione, FAIA, FACHA, NCARB
Editor, *Academy Journal*
November 2019

# Building is Only Half of the Battle: Multi-level interventions to impact change

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## ABSTRACT

Design interventions influence how one feels, behaves, interacts with others, and perceives their organization's culture and values. However, social ecological models demonstrate something we all intuitively know as true: The success of any design project depends on organizational and culture change occurring in concert with physical changes to the environment. Models of this system help us understand the multiple factors impacting design strategies' success. These models can also help design teams develop the partnerships and integrated approaches needed to impact systemic change. This article provides examples of how to apply interventions at each of these levels of the system. By understanding the existing attributes of the social ecology surrounding a built environment design project, one can better anticipate the success of certain interventions over others and potentially foster conversations with the client about moving the needle on all fronts to maximize their capital investment.


Sam recalled years ago he had stated that he'd never return to the hospital. As he approached the doors, he looked up at the plastic sign marked "Entry" and was struck by how much things have changed now that Grace needed him. Last week, she'd been complaining about chest pain. This week, he was on his fourth visit. As he navigated through the sterile halls, he felt the familiar mix of panic, hope, and claustrophobia settling in.

In Grace's room, her nurse Dan was checking vitals when he was paged by one of his other patients. He rushed out of the room, calling into the hall, "Can I get a little help? Patient lift in room 22." Dan was greeted with silence and quickly realized he'd be doing this alone. Sam and Grace shared a look of concern, feeling powerless and wondering what would happen if the next emergency was theirs.

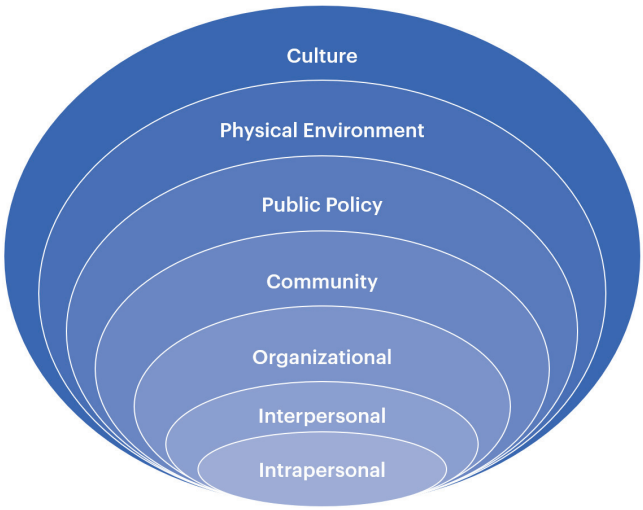
Unfortunately, these experiences are not unique. They're created by a commonly used but broken system; however, they are avoidable. The factors that determine the success of health care improvement efforts depend in part on the quality of any physical design intervention (e.g., the design of patient rooms, staff workstations, departmental adjacencies). They are also largely influenced by the individuals, organizational norms, culture, and political climate. Fostering systemic change requires understanding the whole system. Whether through training, environmental changes, or organization-wide protocols, identifying and addressing all the changes happening within the system can feel like a maze with no roadmap. Models can help us see a complex system in more understandable parts.

## Modeling the social ecology

Social ecological models (SEMs) show how the social, physical, and often abstract parts of one's environment are interconnected. These models have been used since the 1970s by Cornell professor Urie Bronfenbrenner to explain the person-environment interaction and make changes to the environment that support the individual.

Although researchers have historically used these models to focus on human health and development, applying them to health care environments can offer insights into understanding the system-wide changes needed to accomplish health care goals. The Simons-Morton, McLeroy, & Wendel (2012) model (see Figure 1) offers a widely encompassing SEM, organized into seven interconnected types of environments, or levels. These levels start at the individual and radiate out to include intrapersonal (i.e., within one's self), interpersonal (i.e., with others), organizational, community, public policy, physical environment, and culture. By examining and understanding each level, one can design interventions to improve the system and thereby the conditions for the individuals.

FIGURE 1




This figure is based on Simons-Morton et al. (2012). By understanding the interconnected layers of one's environment, more targeted and thoughtful interventions can be created to systemically impact patient safety. Each of these layers is interdependent with the other layers.

## Ecology of change: Levels of influence

*The Intrapersonal level* defines the attributes that come from the individual person. This can include the individual's genes, biological or psychological factors, demographics, family situation, cultural background, education or knowledge, and more (Simons-Morton et al., 2012). For example, a nurse's level of stress, training, years of experience, and sufficiency of sleep can impact their ability to provide safe care.

*The Interpersonal level* addresses how the individual is influenced by others, including close ties such as friends and family, as well as larger social networks. Interpersonal influences can be either purposeful or unintentional. For example, nurse Dan may have learned poor handwashing behaviors by watching others—an unintended consequence; or he may have been instructed by his peers to wash his hands—a purposeful social influence.

*The Organizational level* of the model is a setting where the individual attends work, educational, social, or religious activities. Organizations often require membership, participation, or belonging, and are typically related to a place, such as a workplace or school building. Organizations tend to have defined social and procedural norms (e.g., safe patient handling practices or team huddles) that can be influenced by the resources provided (e.g., continuing education offerings).

*The Community* level represents a setting or a place where healthy behaviors take place or are learned, such as a neighborhood. It can also be a social network or system—digital or physical. In many instances, such as a hospital setting, community and organizational levels overlap, where communities can be defined by organizational boundaries. The level of leadership, citizen participation, community values, resources, skills, power, and strength of social networks can facilitate change at the community level.

*The Public Policy level* includes policies, laws, and incentives made throughout the spectrum of local, state, and federal. These policies can range from funding for sidewalks to the 2010 Patient Protection and Accountable Care Act, which changed how our medical care, preventative services, and national health insurance is incentivized. Public policy often drives the incentives for health care practice through mandating national standards, public reporting, and reimbursement (Shin & Singh, 2016).

*The Physical Environment level* is a location for interaction, patient care, community, physical activity, and exchange. There are multiple methods in which the physical environment can impact health, including a medium for disease transmission, a cause of stress (e.g., noise, density), a source of danger (e.g., lead paint, slippery floors), enabler of health behavior (e.g., patient lifts, hand-rails, walking trails), and a health resource (e.g., gym proximity, patient record access) (Simons-Morton et al., 2012). The next section, Designing for Success, expands on the physical environment's interaction with each of these levels.

*The Culture level* is defined as a "shared system of learned norms, beliefs, values, and behaviors that differ across populations defined by region, nationality, ethnicity, or religions" (Simons Morton et all, 2012, p.60; Hruschka & Hadley, 2008). Most health care organizations define their explicit culture in their vision and mission statements; however, national and international practice standards influence local culture. Understanding the culture in which one is working can allow them to create more targeted and effective interventions. By transforming the environment at other levels, one often aims to influence the cultural values and norms.

## Designing for success: Integration of social ecological thinking

Design interventions influence how one feels, behaves, interacts with others, and perceives their organization's culture and values. However, social ecological models demonstrate something we all intuitively know as true: The success of any design project depends on organizational and culture change occurring in concert with physical changes to the environment. SEMs help us understand the multiple factors impacting the success of design strategies and can help design teams develop the partnerships and integrated approaches needed to impact systemic change. Examples of how to apply interventions at each of these levels is shown in Table 1. By understanding the existing attributes of the social ecology surrounding a built environment design project, one can better anticipate the success of certain interventions over others and potentially foster conversations with the client about moving the needle on all fronts to maximize their capital investment.

The physical environment is the ecological layer that designers have the most influence over. On each of the interconnected levels, the physical environment plays a role in promoting or hampering health, wellbeing, and safety. From the way a single individual feels in it to how they connect with others or view their community – the place embodies more than can be contained in walls. The physical environment impacts an individual's mental and physical health in many ways. For example, impacts to air quality, exposure to natural light, nature, or noise can lead to physical and emotional stress. Interpersonal relationships can be impacted by providing spaces for people to gather and interact naturally with their colleagues. Similarly, programs within facilities impact the organizational and community structures, along with the interrelationships and shared space between departments. The public policy has a direct impact on the physical environment by determining types of buildings and setting guidelines for safety and zoning. Lastly, the culture of health is impacted by what behaviors and attitudes a building or community cultivates: Are there easy walking paths or other spaces for celebrating health and the patient journey? Or is the space windowless and difficult to navigate? These small changes can make a large difference in the way a space feels and the culture it embodies.

## A brighter future

Imagine Sam's first visit to the hospital he had once written off. How would he respond if he pulled his car under a covered walk and was greeted by a valet who directed him to the main entry? Imagine Sam's reaction when he made his way through the tree-lined path into the hospital. Envision how he is welcomed into the sunlit lobby where the sound of a piano can be heard playing nearby, and a greeter smiles at him and offers help. Visualize too, that nurse Dan can easily see colleagues as he works, and with one quick call a fellow nurse nearby assists the patient in transferring to a ceiling lift.

Both realities are possible by making operational, physical, and cultural changes. We can help our clients create environments that foster health, mental, and physical well-being for patients, their families, and the staff that make their care possible.

TABLE I

| SEM LEVEL | ATTRIBUTE EXAMPLES | DESIGN INTERVENTION EXAMPLES | OPEARATIONAL INTERVENTION EXAMPLES |
|---|---|---|---|
| Intrapersonal  | ▪ Education, training, skills, & knowledge<br>▪ Age, weight, race, & strength<br>▪ Personality, mood, & mental workload<br>▪ Years of experience, experience with specific duties | ▪ Natural light and views of nature improve mood and fatigue<br>▪ Noise levels impact staff distraction and patient sleep quality | ▪ Skill-based training<br>▪ Inter-professional simulation training |
| Interpersonal  | ▪ Team size, members, and experience working together<br>▪ Social hierarchy<br>▪ Team support behaviors (e.g., social, task-based)<br>▪ Social learning and team norms<br>▪ Team size and experience working together | ▪ Visibility and proximity between staff can increase communication, teamwork, and reduce feelings of isolation<br>▪ Dedicated team space enables interprofessional models of practice | ▪ Inter-professional simulation training<br>▪ Caregiver buddy support system<br>▪ Team training<br>▪ Virtual communication technology<br>▪ Regular huddles and debriefs |
| Community & Organization  | ▪ Hospital culture & safety culture<br>▪ Leadership, management, staffing<br>▪ Incentive structure, financing<br>▪ Patient population and risk level | ▪ Design of patient spaces influences family visiting<br>▪ Unit layouts and room numbers determine possible nursing ratios | ▪ Increasing nurse to patient staffing ratios<br>▪ Organizational commitment to safety |
| Public Policy  | ▪ Regulatory and Allocative Tools<br>▪ Policies for zoning<br>▪ Mandatory overtime rules<br>▪ State adopted guidelines for design standards | ▪ The Facility Guidelines Institute (FGI) and other building codes determine minimum room sizes and program<br>▪ Certificates of need determine the number of patient rooms that can be provided | ▪ The PPACA legislation that implemented VBP and has changed incentives for hospital facilities by allocating funding to reward/penalize hospitals<br>▪ Regulations that mandate public reporting of patient outcomes |
| Physical Environment  | ▪ Size, spatial properties, physical resources<br>▪ Location, adjacency of spaces<br>▪ Aesthetics, sound, visibility, comfort<br>▪ Ease in cleanability<br>▪ Accessibility of supplies, resources | ▪ Strong environmental design strategies can be created using an evidence-based design approach informed by client engagement | ▪ Location of hand washing sinks or disinfectant dispensers to be in highly visible standardized locations that are easily accessible in path of travel<br>▪ Improving proximity and accessibility between care team members<br>▪ Provide shared workspace for team |
| Culture  | ▪ Beliefs, values, behaviors<br>▪ Influenced by religion, nation, geography, etc. | ▪ Creating shared spaces for physicians, allied health and nursing can help create a culture of interprofessional collaboration | ▪ The education of care staff about the rates of patient harm, and strategies that focus on improving quality |

**Table 1.** Outline of attributes and interventions at each level. Attributes encompass what is innately a part of each level, some may be fixed (e.g., age), and others are adaptable (e.g., training). Interventions can be made at every level to impact attributes and benefit the system.

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# Sound and Space: Acoustical design strategies for health care staff spaces

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## ABSTRACT

As health care design embraces the creation of collaborative spaces, there are unintended consequences that designers need to deal with: Noise. Work environments should be designed not just for appearance, but with consideration for all the senses, especially hearing. As health care planners we emphasize planning adjacencies, patient/staff flow inside the building, applying lean concepts to the design process and working holistically on patient and staff experience. Sound ambience plays a major role in patients' healing process and enhancing the staff work efficiency. Research indicates that good acoustics design can (Ampt., Harris and Maxwell, 2008):

- improve patient comfort, privacy, and dignity
- assist in providing essential sleep patterns to aid the healing process
- improve staff comfort, privacy, efficiency, and accuracy

Specific environmental design strategies should be used to improve the acoustical environment of health care settings. According to the Advisory Board, high hospital noise levels hinder patient recovery. Ambient noise levels as well as peak levels have a serious effect on patients' sleeping patterns, pain perception, blood pressure, and emotional exhaustion (Advisory board, Jan. 11, 2012). Noise-induced stress is contagious for those who work long shifts in noisy environments. Nurses have reported exhaustion, burnout, and irritability. In addition, interfering and distracting sounds have been shown to contribute to medical and nursing errors (Susan E. Mazer, "Creating a culture of safety: reducing hospital noise").

This article will discuss how health care designers can consider in acoustics at the planning level to help elevate the staff work experience. Design elements will provide staff with quiet focus areas, one to one communication spaces, multiple group work interaction, and social spaces. It will also describe the required sound levels for different types of work settings.


## Sound and staff in health care

Noise can be a potential source of stress for hospital and medical staff and may interfere with their ability to work effectively. Several studies by institutions like the Advisory Board and The Center for Health Design have identified that noise is strongly related to stress and annoyance among nursing staff, and high levels of noise interfere with their work.

Staff work areas, especially nurse workstations, are high-paced environments. Nurses are running in and out carrying multiple conversations at once. There's background equipment noise from printers, alarms, pages, phones ringing, HVAC noise, and more. As noise builds, so do the stress levels of nurses. According to The Center for Health Design, noise induced stress has also been related to:

- increased perceived work pressure
- increased fatigue
- emotional exhaustion and burnout
- difficulty in communication, possibly leading to errors

Additionally, the Joint Commission also documents noise as a potential risk factor related to medical and nursing errors, concluding that ambient sound environments should not exceed 50 dB, a level that would prohibit clinicians from clearly understanding each other (Susan E Mazer, "Increase Patient Safety by creating a Quieter Hospital Environment").

**Decibel (dB)**
The decibel (dB) is a logarithmic unit used to measure sound level.

**A weighted Decibel dB(A)**
A-weighted decibels, abbreviated dBA, is an expression of the relative loudness of sounds in air as perceived by the human ear.

Classifying the staff work zone in different sound ambience categories, based on the level of staff collaboration, will give them the necessary environment to enhance their performance.

| Zone | Character | Type of staff space | Recommended maximum design sound level dB (A) | Comparative examples of Noise levels | Recommended Reverberation time, sec |
|---|---|---|---|---|---|
| Very Quiet | Focused work, less communication | Dictation space<br>Physician offices<br>Meds Area<br>Triage | 40 | Library ambience | 0.4-0.7 |
| Quiet- small scale | One to one communication | Team huddle spaces<br>Meeting room | 45 | Quiet suburb | 0.4-0.6 |
| Relatively Noisy space | Multiple interaction | Nurse station | 50 | Refrigerator | 0.4-0.7 |

Source: Recommended sound level based on the space character- AZ/NZS 2107:2000 Acoustics for sound environment

There are two aspects of sound measurements:

- The frequency of the sound
- The intensity of the sound

The decibel scale is logarithmic: A small increase in decibel level is a big increase in noise level. For example, an increase of only 3 dB doubles the noise level for the human ear and halves the time a person should be exposed to it once harmful levels are reached.

According to World Health Organization 30-40 dB (sound of a whisper) is ideal for patient occupied spaces in hospitals. For any intellectual and focused work, ideally the room should have a sound ambience of 40-45 dB (sound of birds calls or a quiet suburb).

The nursing station based on the acoustical standards shouldn't exceed 50 dB (conversation sound level). Initial readings for hospital nurse stations (Connor Alison, Ortiz Elizabeth 2009) revealed 78 dB (traffic noise)—very close to be in a noisy environment. The recommended level is 40-45 dB for a nurse station.

A difference of 28 to 33 dB between the desired and the actual environment clearly shows that health care designers need to do more to account for acoustics.

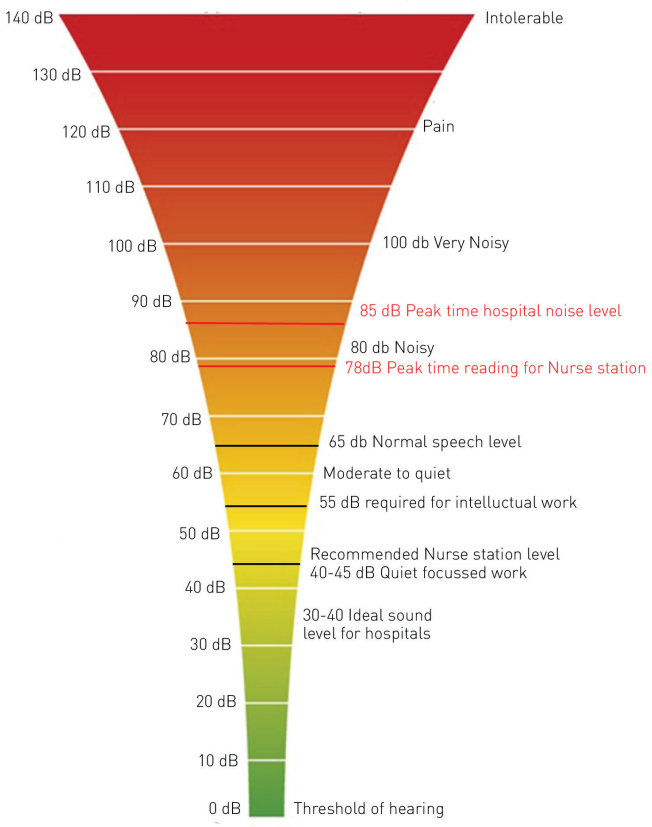
It is also important to identify what sound sources should be enhanced (the conversation of nurses and physicians), what should be attenuated (rings, printers, and other equipment being absorbed into space) and what should be completely blocked (HVAC). If a designer knows how they want to respond to a sound source, they can select an appropriate material treatment to reflect, absorb, or block that sound source. Strategically locating these sound-absorbing or reflecting surfaces can provide a healthy acoustical environment.

## Sound design strategies for architectural planning

The rattling of an air diffuser, the laughter of colleagues gathered around the water cooler, the printer's noise, the loud elevator ping – collectively these become major distractions and make sound attenuation a priority. As described earlier in this article, there are three types of work zones:

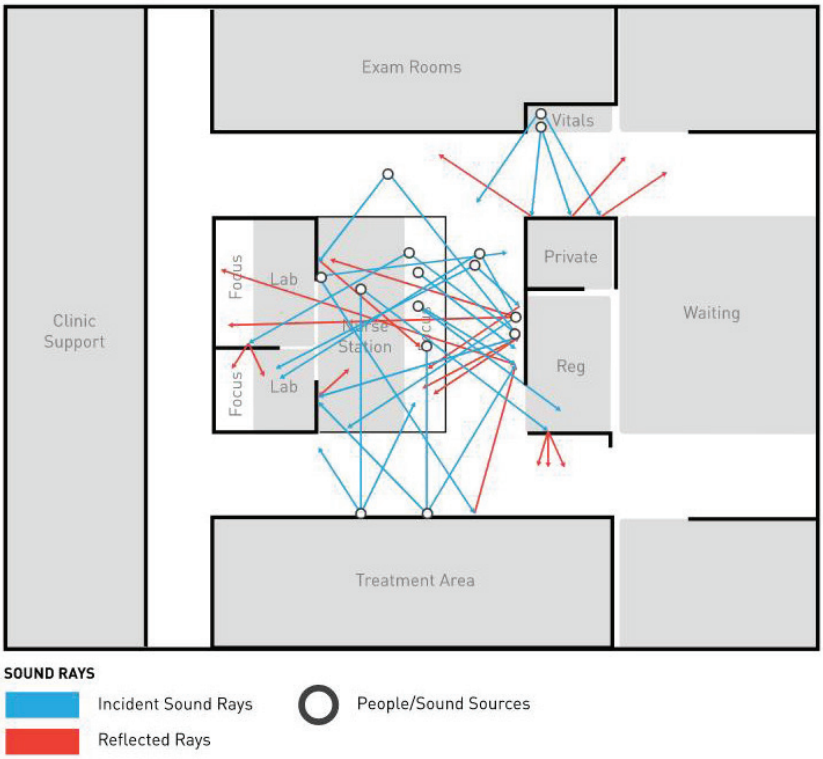
- Quiet and focused zone
- One to one conversation/collaboration zone
- Multiple conversations/collaboration zone

IMAGE 1




Noise levels in health care settings IC: Institution of Occupation safety and health

IMAGE 2




Scenario 1.A Centrally placed focused work area with no wall enclosure

In this **scenario 1.A** (Before) – A centrally located shared staff area with no wall enclosure is surrounded by the treatment space and back-of-house clinical support. Three focused zones include the nurse station, meds space, and lab, all placed centrally together. This planning situation creates an environment where the focused work zones are exposed to a lot of noise from the corridors and from surrounding exam room traffic. These focused work zones are exposed to a variety of sound sources (equipment noise, patient and staff talking). This type of work setting is also concerning from a HIPPA standpoint because private patient information is potentially audible to surrounding traffic. The medication room and lab are each accessible from the nurse station for efficiency reasons, but that poses a possibility of distraction while working. Further, the distractions might affect staff's ability to make sound medical judgements. Inappropriate sound levels increases the likelihood of medical errors.

**Scenario 1.B** (After layering in acoustical considerations in planning) – This centrally shared staff area with wall enclosure is surrounded by the treatment space and back-of-house clinical support. It depicts how we can create a better environment by having the same planning adjacencies but treating the space differently with walls that have the proper class of absorption or blocking. Strategic placement of an appropriate sound transmission class (STC) wall helps block the sound coming from the nurse station and surrounding areas.

STC stands for Sound Transmission Class. STC ratings average how much sound is stopped by walls or other considered surfaces. A wall with a STC 30 rating would block 30 dB of noise. A higher absorption wall will help contain the sound in the space and provide more privacy.

Creating an enclosure to the nurse station with an appropriate STC wall blocks sound, providing staff with privacy and helping them focus on their work. The incident sound energy from the source gets quickly absorbed or blocked rather than reflected. This scenario shows how an acoustical layer of planning makes a difference and creates a comfortable environment for staff.

**Scenario 2:** This centrally shared staff area has separate patient and staff circulation paths and exam pods situated in between. This is an example of a large-scale staff area that has strategically located different work zones in an open plan. In this open staff work area, the focused zones are located back of the house in the plan to provide privacy, visually and acoustically for the individual user. The focused zones are provided with higher STC walls to block sound from the surroundings and to prevent sound infiltrating the open work area. Higher STC ratings would be 60 and above. Double 5/8" drywall on either side of a steel stud wall with insulation and 1 load of Green Glue on both sides will provide STC 60, providing the capability to block loud conversations. A single layer of 1/2" drywall on each side, wood studs, and no insulation (typical interior wall) would provide an STC of 33 dB, providing poor insulation. In other words, loud conversations can be clearly heard and understood. A four-inch CMU wall will provide an STC of 44 which performs basic, meaning loud speeches can be heard but not understood. Additionally, to STC walls, each of the collaborative open nurse work areas would have absorptive ceiling clouds to keep the sound in their specific zone. These absorptive ceiling clouds would have a higher absorption coefficient of 0.8 to 0.9 (absorbing 80–90% of incident sound energy) to keep the sound contained within a zone in an open area. Clinical support areas have higher absorption walls on the staff work side to absorb sound and higher STC rated walls on the exam room side to prevent the sound from penetrating the exam room. On a planning level, this clinical module breaks the patient and staff circulation into different paths that helps give more acoustical and visual privacy to the staff work area. This scenario depicts strategic placement of focused work areas, circulation patterns, and appropriate acoustical wall treatment – achieving the notion of privacy in an open environment.

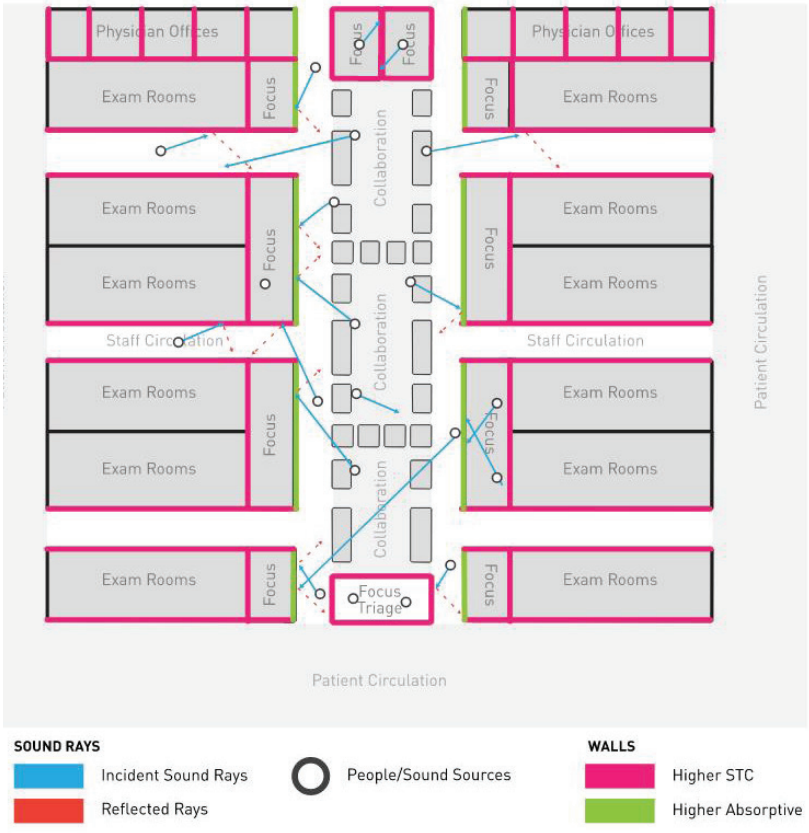
## Conclusion

Sound is critically important in health care settings in order to reduce medical errors and staff burnout. Health care designers can add considerable value to the design by planning for ambient sound mitigation. Strategic location of surfaces that absorb, reflect, and block noise will provide a more comforting staff work environment and enhance their work performance.

IMAGE 3


Scenario 1.B Centrally placed focused work area with wall enclosure

IMAGE 4




Scenario 2 Centrally shared staff area with separate patient and staff circulation paths

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# Call for papers

AIA Academy of Architecture for Health Journal submission deadline: May 29, 2020

You are invited to submit articles, innovative project case studies, completed research projects, and monographs in the field of health care design. In addition to the architectural profession, all other disciplines involved in health care—doctors, nurses, administrators, etc.—are encouraged to submit.

Articles should be timely; preview new trends; and address industry wide topics, issues of relevance, and emerging technology in the health care system. No book reviews, please.

The Academy of Architecture for Health is an interactive and multidisciplinary organization. Submissions selected for publication will reflect the diversity of its programs, the specialized commitments of its membership, and the quality of composition befitting a learned journal that is accessed and read worldwide.

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