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 Physician offices Meds Area Triage	40	Library ambience	0.4-0.7
Quiet- small scale	One to one communication	Team huddle spaces 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.

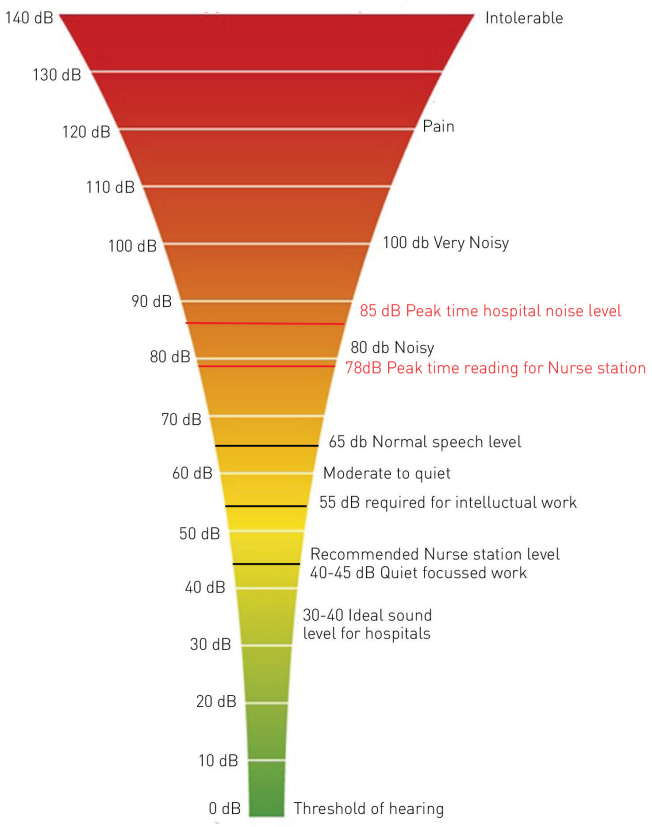
It is also important to identify what sound sources should be enhanced (the conversation of nurses and physicians), what should be attenuated (rings, printers, and other equipment being absorbed into space) and what should be completely blocked (HVAC). If a designer knows how they want to respond to 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:

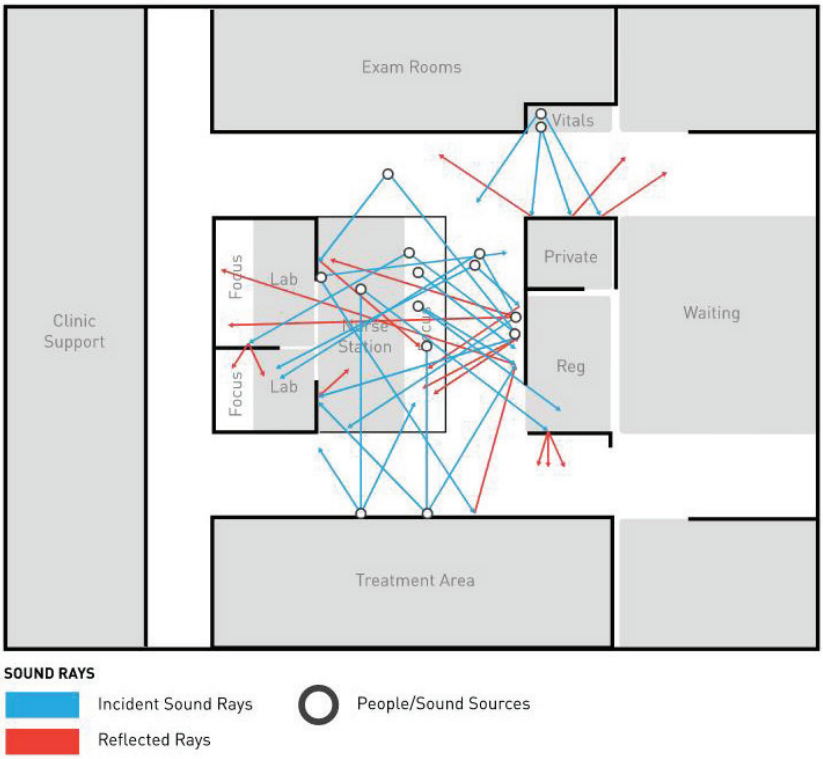
- Quiet and focused zone
- One to one conversation/collaboration zone
- Multiple conversations/collaboration zone

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.

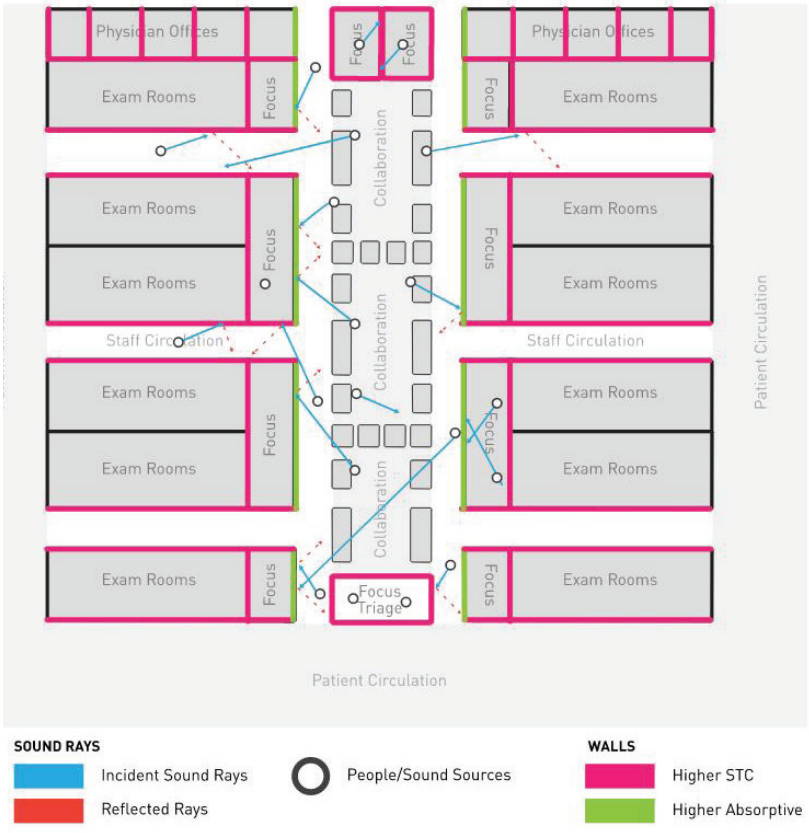
Conclusion

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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