A State-of-the-Art Review of Healthcare Acoustics

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Acoustical consultants and noise control engineers who have not worked on a healthcare project in the past few years need to know about recent changes that have increased the expectations of architects, healthcare executives, caregivers, and patients for better acoustic quality in their facilities.

Loud noises in hospitals have been shown to adversely affect patient and staff physiological conditions, including heart rate, blood pressure, respiration rate, skin conductance and muscle tension.[1] Noise decreases the duration and quality of the patient's natural sleep cycles and inhibits recovery. Conversely, when the areas around patient rooms are quiet, occupants sleep better. Restorative sleep decreases the need for pain medication, reduces patient fall risk, lowers average length of stays and improves medical outcomes. In this new era of healthcare, acoustic performance is a top priority, not only in existing facilities, but also for every renovation, expansion and replacement facility currently on the drawing boards.

Changing Demographics and Economics. A biannual benchmarking study conducted by the Beryl Institute in 2013 showed more than 70% of healthcare professionals cited patient satisfaction as one of their top priorities during the next three years.[2] Further, the study said noise reduction was their top priority for improving patient satisfaction. To understand these findings, one must understand the series of events that has unfolded in the United States over the last five to 10 years.

As baby boomers enter the phase of their lives where greater healthcare is likely to be required, and as obesity-related medical problems continue to increase, a deficit between Medicare revenues and spending was projected. In response, the 2005 *Deficit Reduction Act* authorized the Centers for Medicare and Medicaid Services (CMS) to implement its value-based purchasing (VBP) program. This program withholds 1% (incrementally increasing to 2% by 2017) of hospital financial reimbursements for care of Medicare patients. Those hospitals with higher quality and performance receive not only the 1% originally withheld, but also up to an additional 1% that was withheld from lower-performing hospitals.

Thirty percent of a hospital's VBP score comes from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey given to inpatients.[3] This survey assesses consumer satisfaction with aspects of care, such as doctor and nurse communication, pain management and quietness. As of October 2012, financial reimbursements to hospitals are getting adjusted up or down, due in part to facility

Patient room.

Procedure room.

acoustics.

In the HCAHPS survey, the question, "How often was the area around your room quiet at night: always, usually, sometimes or never?" consistently scores the lowest. The current national top box score (*i.e.,* "always") scores only 61% compared to an average of 74% for all other metrics. The frequency at which discharge instructions are provided to patients has a top box score of 85%.

A high score on the quiet-at-night question is not easily achieved in existing hospitals. A study conducted by ROCKFON's *Making Hospitals Quiet* program and the Beryl Institute in 2012 showed only 12% of 241 hospitals trying to reduce noise in existing facilities judged their progress as "good" or "great."[4]

A high score is not easy to achieve in newly constructed hospitals either. More than 50 new (ground-up) hospitals that opened between 2007 and 2013 have an average quiet-at-night score of 63%, only 2% better than the current U.S. average for all facilities combined. Similarly, more than 25 hospitals that opened between 2011 and 2013 also have an average score of 63%.

The value-based purchasing program does not allow for even one low HCAHPS outlier. Many hospitals are seeing their overall reimbursement rates held down by their quiet-at-night scores even if scores for the other metrics might be above achievement thresholds. This is why healthcare executives and administrators are now focused on the acoustics of their facilities.

Enter Evidence-Based Design. Evidence-based design (EBD) is the process of basing design decisions about the built environment on credible research to achieve the best possible outcomes. A growing body of evidence attests to the fact that the physical environment influences safety, patient stress, staff effectiveness and quality of care provided in healthcare settings.

In a 2007 Center for Health Design whitepaper,[5] *Sound Control for Improved Outcomes in Healthcare Settings*, the authors provide key EBD considerations for improving the acoustical environment. They include:

- Installing high-performance (*i.e.*, high-noise-reduction coefficient) acoustic ceiling panel systems to reduce noise (and associated perceptions), as well as to have a positive impact on outcomes such as improved speech intelligibility and reduced perceived work pressure among staff.[6-10]
- Providing patient examination rooms and treatment areas with walls that extend full height to prevent voices and noise from transmitting through the ceilings.
- Providing single-patient rooms so they are less noisy, are perceived by patients as being more private, and permit more effective and confidential communication between staff and patients.
- Removing or reducing loud noise sources on hospital units and educating staff about the impact of noise on patients as well as themselves.

Furthermore, a 2008 whitepaper[11] by the Center for Health Design and the Georgia Institute of Technology – *The Business Case for Building Better Hospitals through Evidence-based Design* – specified a list of eight priority design recommendations based on the strength of the evidence available and the impact on safety, quality and cost. Three of these eight recommendations are acoustics-based:

- Install high-performance sound-absorbing ceiling panels to decrease patient and staff stress, reduce patient sleep deprivation and increase patient satisfaction.
- Use music as a positive distraction during procedures to reduce stress, pain and medication use.
- Conduct a noise audit and implement a noise reduction plan.

Clearly, the research provides evidence that acoustical conditions within healthcare facilities relate to accuracy, privacy, safety and ultimately, quality of care.

Roadmap to Guidelines, Standards and Governing Bodies. When designing to comply with the acoustic requirements in the various standards and guidelines for healthcare facilities, it helps to understand which document is the core source for acoustic performance criteria and design recommendations, and which other documents draw their content, in part or whole, from that core document.

The Acoustics Research Council (ARC) represents several hundred members of the leading acoustical societies in the U.S., including those from the Acoustical Society of America (ASA), the Institute of Noise Control Engineering of the USA (INCE-USA), and the National Council of Acousti-

cal Consultants (NCAC). Since 2005, ARC has been responsible for developing the core document on acoustical performance criteria in healthcare facilities. Technically, the "current" version at the time that this article is being written is the 2010 *Sound & Vibration Design Guidelines for Health Care Facilities* (v2.0), which is on a four-year revision cycle. The next, expanded and updated version (v3.0) of this core document, which is already substantially completed, will be published later in 2014.[12]

This core document is a minimum design requirement to ensure satisfactory acoustics and privacy in healthcare facilities of all types. It is not intended to provide best or optimal recommendations.

The main organization that references parts of this core acoustics document is the Facility Guidelines Institute (FGI). Founded in 1998 to provide continuity in the revision process of what were originally minimum construction standards from the Department of Health and Human Services, FGI has produced the *Guidelines for Design and Construction of Health Care Facilities.* The 2010 edition is used in some form by 42 states.[13]

The FGI Acoustics Working Group has become synonymous with ARC. Its efforts resulted in the acoustics sections of the 2010 version of FGI's guidelines, the first edition in its 60-year history to contain comprehensive minimum criteria for acoustics in healthcare facilities. It recently revised the acoustics sections in the 2010 version.

Revisions to FGI's guidelines also occur on a four-year cycle. The current 2014 version is now available for hardcopy or e-book purchase. The full guidelines also are available for online viewing at no charge. To purchase a copy or to view them for free online, visit FGI's website.[14] The opportunity to propose revisions to the 2014 version for possible inclusion into the 2018 version should be in the summer or fall of 2015.

In previous editions, only one guideline covered all types of healthcare facilities. In 2014, FGI's guidelines are split into two separate volumes. Some of the content in the new volume existed in the previous versions, but it was split off, expanded, and made into a stand-alone version in 2014.

- *Guidelines for Design and Construction of Hospitals and Outpatient Facilities* (Volume 1), which covers hospitals and outpatient facilities.
- *Guidelines for Design and Construction of Residential, Health, Care, and Support Facilities* (Volume 2), which will cover residential healthcare facilities such as assisted living, hospices and nursing homes, along with related support facilities, such as wellness centers, adult daycare facilities and outpatient rehabilitation therapy facilities.

Both volumes of the FGI guidelines contain a variety of the more traditional acoustical design criteria relating to isolation of noise from the exterior and adjacent interior spaces, sound absorption of interior surfaces, background noise generated by

Post-op, step-down multipatient room.

building systems, speech privacy and vibration. However, the volume for *Residential, Health, Care, and Support Facilities* has some newer acoustics concepts such as access to nature sounds, quiet rooms and the use of positive auditory distractions. (More on this topic is found later in this article.)

The Joint Commission (JC) is the not-for-profit organization that accredits and certifies more than 20,000 healthcare organizations and programs in the U.S. The JC does not mandate use of FGI's guidelines if another state or national standard is being applied to the project. For example, the Veterans Administration and Department of Defense have developed their own guidelines. Beginning in January 2011, JC simply references the 2010 edition of FGI's guidelines in its accreditation manuals.

CMS does not demand compliance with FGI's guidelines either, but it does require compliance with an established standard and local building codes and requirements. Therefore, since many states call for compliance with the FGI guidelines, or some version, it makes them a back-door requirement for the JC and CMS in those jurisdictions.

The acoustic requirements in the 2010 version of FGI's guidelines and its reference document, *Sound and Vibration Design Guidelines for Health Care Facilities*, are the basis for the acoustic requirements in the current version of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) for Healthcare rating system (V. 2009 & V. 4). Two LEED points are available for acoustic performance.

Similarly, the acoustic requirements in the latest version of the Green Guide for Health Care GGHC (V. 2.2, 2007) are adopted from the 2006 version of the *Sound & Vibration Design Guidelines for Health Care Facilities*. It previously was titled the American Institute of Architects' (AIA's) and American Hospital Association's *Draft Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities.* GGHG, like LEED, has two points available for proper design of the acoustic environment (EQ 9.1 and EQ 9.2). At some point in the future, LEED and GGHG may reference a more recent version of FGI's guidelines. Until then, it may be the case that the 2010 version of FGI's guidelines continues to be used.

New Criteria for Acoustic Success. In the past, the acoustic success of a healthcare facility was judged largely by whether noise was present or not. Noise was bad, and quiet was good. Still, silence is not the goal, for it makes high-acuity patients feel isolated. Nurse call rates increase. Just because sound pressure level decreases, does not necessarily mean that patient perception of quietness will increase.

A sonically sterile environment is a tremendous loss of opportunity. The new era of healthcare acoustics is not just about eliminating bad noises, but also about employing good sounds for their beneficial attributes. Auditory landmarks are now being used to aid wayfinding. The soft sounds of a baby cooing can lead expectant parents toward obstetrics. Positive auditory distractions, especially those that are interactive, can distract patients from their pain and loved ones from their stress.

Nature sounds, whether real or recorded, are an important part of reaping the benefits of having access to the natural world. Certain types of music can return worsened physiological conditions back to normalcy faster than manmade noise or silence.

Many of these newer types of acoustic concepts that ultimately soundscape the auditory component of healthcare environments already are starting to appear in guidelines for designers (*e.g.*, FGI's 2014 volume for *Residential, Health, Care, and Support Facilities*). In response, the ASA's Technical Committee on Architectural Acoustics now has a Healthcare Acoustics Subcommittee, and its members will be working to better quantify a sound field from the patient's perspective and qualify whether holistically good sounds combined with unavoidable bad noises help or hinder recovery.

In the future, the acoustic success of healthcare facilities will be judged by how the total auditory experience contributes to recovery and satisfaction for patients, accuracy and stress relief in caregivers, and maximization of financial reimbursements.

References

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3. Visit www.hcahpsonline.org/home.aspx.
4. Visit www.theberylinstitute.site-ym.com/store/view_product.asp?id=1101753.
5. The article, by Anjali Joseph (Center for Health Design) and Roger Ulrich (Center for Health Systems and Design, Texas A&M University) can be read at www.healthdesign.org/sites/default/files/Sound%20Control.pdf.
6. The listed studies have shown that installing high-performance acoustic ceiling panel systems reduce noise propagation, creates the perception of a quieter environment, and improves speech intelligibility to enhance accuracy of staff communications.[7-10]
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11. The article, by Blair Sadler *et al.* (The Center for Health Design and Georgia Institute of Technology) can be read at www.healthdesign.org/chd/research/business-case-building-better-hospitals-through-evidence-based-design?page=6\.
12. Visit www.speechprivacy.org/joomla//index.php?option=com_content&task=view&id=33&Itemid=46 for the 2010 version and to obtain the 2014 version when it is available.
13. Some states have adopted the whole document, and a few of those automatically update to the current edition (*i.e.* 2014) when it was published. Other states only use part of the document, often the "General Hospitals" chapter, to regulate facilities and only use the rest as a reference. Many states reference an earlier edition. Some states also modify language in FGI's guidelines to address their own specific issues. (Other states write their own code with little input from FGI's guidelines.) To find out what is most applicable for a project, the designer should contact the pertinent state agency (often the Department of Health) or e-mail info@fgiguidelines.org.
14. Visit www.fgiguidelines.org/.

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