

Creating a Culture of Safety

Reducing Hospital Noise

Susan E. Mazer, PhD

About the Author



Susan E. Mazer, PhD, is the president and chief executive officer of Healing HealthCare Systems, a

company based in Reno, NV, that produces The C.A.R.E. Channel and other products and services to help healthcare organizations create healing environments. E-mail: smazer@healinghealth.com.

Editor's Note: In 2006, Susan E. Mazer wrote an article for BI&T that examined the impact of hospital noise on patient safety. Six years later, Mazer takes a fresh look at the issue

In comparing the state of healthcare in the 19th century with that of the 21st century, it is clear that the uncontrollable and seemingly unmanageable ways that noise penetrates the hospital environment has changed for the worse. Florence Nightingale, whose environmental theory became the original basis for professionalizing nursing care, described noise as “that which damages the patient.”¹ At that time, the noise to which Nightingale referred included squeaking floors, brushing crinolines, appropriate and inappropriate conversations—

any sound that resulted in feelings of “apprehension, uncertainty, waiting, expectation, fear or surprise.”² Today, hospital noise has been studied according to its physiological and psychological outcomes: increased respiratory

rates, heightened blood pressure, increased heart rates, and increased stress.^{3,4}

While some improvements have been made in acoustic treatment of corridors and rooms,^{5,6} they are not industry wide nor are they hospital wide. Generally, the improvements have been made in one unit of a hospital, clinical area, or clinic. Meanwhile, negative

auditory factors have multiplied: growing populations, higher patient acuity levels, increased pressures on staff to perform, and the introduction of more technologies.

Some new technologies have replaced older ones: Overhead paging has been traded in for mobile technologies, and the irritating broadcast of announcements has been replaced by the near-constant use (in corridors and rooms) of cellphones or other individual communication technologies. Each new technology has its own environmental impact, requires its own utilization policy, and introduces new risks as well as benefits. The studies to date have merged the technological sounds into the generic auditory environment and the outcomes remain the same: Hospital noise is pandemic.

The auditory environment of the 21st century hospital is substantially louder, more complex, and more difficult to control than that of Nightingale's time. Intensive care unit (ICU) psychosis or delirium has been directly linked to environmental stressors—noise, sleep deprivation, and social isolation, being primary.⁷ The costs related to sleep deprivation, agitation, stress, and lower pain thresholds that are a result of ambient hospital noise are measured in additional medication, length of stay, and subsequent complications.

Defining the Patient Experience

Consumer assessments of healthcare providers and systems (HCAHPS) scores have included the environment of care as a significant

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indicator as to what happens to patients. Among the 27 questions in the HCAHPS survey, two deal with the environment from the patient perspective.⁸ The first focuses on the cleanliness of the patient's bathroom. The second—and the one that has consistently been given the lowest score—is: “How often do you experience quiet around your room at night?”

This question has many implications, with noise at night being the primary cause of sleep deprivation.^{9,10}

According to *The American Heritage Dictionary of the English Language, Fourth Edition*, the noun “sound” is defined as “vibrations transmitted through an elastic solid or a liquid or gas, with frequencies in the approximate range of 20 to 20,000 hertz, capable of being detected by human organs of hearing.”¹¹

This definition, however, has little to do with the experience of a sound and its qualitative impact, which is relative to the capacity and circumstances of the listener. The context in which noise occurs and ultimately the meaning attributed to it becomes a contextual experience for the patient, one distinctly subjective which is informed by the character of the sound. The individual nature of this perception, however, contributes to its potential physiological impact.

There is a plethora of articles and research available regarding noise as a human and technological outcome and a consequence of living beyond the industrial and digital revolutions. Noise is an adverse auditory event; it is neither benign nor considered neutral. At the same time, the impact of hospital noise can vary and what is noise to a patient may be critical information to a nurse about another patient (such as an alarm). The studies listed below have shown that the impact of noise on patients, families, and staff is hardly positive.

- 2006 Mayo Clinic study found that noise was the major cause of sleep disturbance.¹⁰
- HCAHPS scores noise as the number one complaint, consistently receiving the lowest ratings.¹²
- Hospital noise slows healing during a hospitalization.^{13,14}
- Noise increases the perception of pain while heightening anxiety and stress.⁹
- Noisy environments contribute to communication errors.¹⁴
- Noisy environments contribute to “learned-helplessness.”¹⁵



The modern hospital environment is full of noise—beeps and alarms from devices, paging systems, telephones, conversations, the movement of equipment, and more—a fact that can often prove stressful for patients and staff alike.

- Noise contributes to medical and nursing errors.^{16,17}

Medical Alarm Fatigue

The AAMI Medical Device Alarms Summit in October 2011 focused on one aspect of hospital noise—the challenge posed by the cacophony of medical alarms. In addition to the consequences of non-actionable alarms on the staff, the environmental impact spreads throughout the whole unit. For the patient whose bedside monitor alarm triggers for any reason, sleep deprivation or agitation results.¹⁸

A stunning statistic to consider comes from a Stanford University study that revealed that only 3.6% of cardiac alarm conditions indicated critical events. Further, the number of cardiac monitor alarm events in a two-month period within six units and 154 beds, totaled 318,000 alarms.¹⁹ If we take these numbers as the average number of alarms per bed, we are looking at 2,065 alarms per bed over two months, with 2,000 of these being non-critical. The microenvironment of the patient, then, becomes his or her bed and the alarm.

Understanding the Risks

Ambient noise is the primary cause of sleep deprivation and disturbance for patients, which

causes confusion and can result in increased medication and restraint use.^{9,20-23} It increases their anxiety and decreases their confidence in the clinical competence of the staff.⁵

Furthermore, noise-induced stress is contagious, impacting family members who eventually wind up at the nurses' station complaining about a variety of issues worsened by the extraneous noise. Sudden noises, such as a dropped tray or slammed door, often cause a "startle reflex" in patients, resulting in physiological responses such as facial grimacing,

muscular flexion, increased blood pressure, higher respiratory rate, increased heart rate and vaso-constriction^{24,25} Ventilated or semiconscious patients still hear sounds around them, and the startle reflex is especially risky for them due to their high acuity and

severely impaired ability to adapt or respond. As Nightingale said, the sick suffer "in a greater proportion than the well from precisely the same causes."¹

Patients exposed to continuous extraneous noise can also experience altered memory, increased agitation, less tolerance for pain, and feelings of isolation.²⁴ These environmentally generated symptoms are often medicated or otherwise treated in ways unrelated to their cause.

What Happens to Staff

Those who work long shifts in noisy environments, day in and day out, have experiences similar to patients. Nurses report exhaustion, burnout, depression and irritability. In addition, interfering and distracting sounds have been shown to contribute to medical and nursing errors.²⁶ The Joint Commission (TJC) also mentions noise as a potential risk factor related to medical and nursing errors, stating that the ambient sound environments should not exceed the level that would prohibit clinicians from clearly understanding each other.²⁷ The exact sound pressure level or volume that would be appropriate is not absolute; rather, it

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is relative to the activities that are going on and other environmental factors.

The *AORN Journal* (a publication of the Association of Operating Room Nurses) reported a surgical episode in which the music was so loud that the surgeon's directions to the anesthesiologist regarding heparin levels were misunderstood by 8,000 units—the surgeon requesting 10,000 units and the anesthesiologist hearing 2,000 units.²⁶ Thus, beyond annoyance, within the sound environment lie potential safety risks that are often unidentified or ignored.

How Many Decibels Does it Take To Make Noise?

While cited in almost every article about hospital noise, recommendations from the Environmental Protection Agency and World Health Organization, which call for volume levels of ambient noise to remain between 35 dB and 45dB, have been rendered irrelevant. First, they are ignored and unenforceable. Second, they measure noise levels solely by sound pressure levels. A more meaningful description—"environmental psychologists define sound as noise recognized by a listener"²⁸—in a paper by D.S. Pope considers the perception of the listener who ultimately responds to the sound.

Further, on a qualitative level, Pope goes further, claiming that lowering the volume of an annoying sound does not solve the problem or remove an annoyance. In addition, she identified both the psychological and physiological impact of sound.

A review of the literature by Ulrich and Zimring²⁹ indicates that many studies have found the primary sources of hospital noise to be paging systems, alarms, bedrails, telephones, ice machines, pneumatic tubes, carts, and medical alarms at the bedside. Each of these factors is common to hospital environments and is part of normal hospital operations. However, for the patient, they are at the minimum, annoying and, at the extreme, damaging. The actual volume level of each of these sound predators is less relevant than context in which they are heard. For example,

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an alarm is not perceived as benign, rather, an alarm is alarming, and a response that is hostile to the recovery process.

Review, Repair, Replace

In many cases, the auditory impact of mechanical equipment can be reduced with relatively minor modifications or repairs: changing wheels, applying padding, repairing or replacing door bumpers, using thicker carpeting, and installing effective acoustic ceiling tiles. The decibel level of the pneumatic tube system which was prominent in the critical-care unit at Atlanta's Northside Hospital was brought down to 50 dB (more than 400% quieter) by the careful use of padding. (This was a project the author was involved in 2002.)

More importantly, new equipment purchases should be based not only on function and price, but also on auditory impact. While this is not currently or prominently noted, it must become a requisite specification.

Descriptive specifications related to operational environments are needed, such as:

- Location of the device during use (e.g. bedside, clinic, special area)
- Auditory impact to operator
- Auditory impact to patient (if applicable)
- Transient and continuous auditory measures while operational (e.g. ice machine, refrigerator, water cooler, anesthesia gases, surgical saws, lasers)

Any other sounds that would indicate malfunction of equipment should also be noted and evaluated for their impact on patients and users. Perceptible measures, not only empirical measures, must be related to the situation. This means that if a piece of equipment sounds noisy or disturbing to the patient or user, there should be no debate. If it sounds inappropriately loud, it is inappropriately loud. If it seems annoying to you, it definitely is to the patient.

TJC standards state that the noise level should not exceed that which permits clear and unimpeded communication. In keeping with this, hospital compliance standards must be established according to the environment of use and circumstance, not merely a sound level meter.

While research has shown that noise is a risk factor to patients and staff, stringent auditory impact standards for medical equipment have not been established or enforced. In reviewing

equipment for safety and functionality, healthcare technology management (HTM) professionals are well positioned to take the next step in improving their organizations' healthcare environments. By working with facilities managers and clinicians, HTM staff can help to establish local standards that meet the needs and culture of the organization, and to include in requests for proposals and bids.

National standards apply to the sound environment as a whole, but they have not been heeded.^{31,4} Neither have they kept up with the increasing number of new types of healthcare settings and the plethora of new equipment used in them. Therefore, only new standards set by users controlling purchasing decisions can ultimately change the way manufacturers develop new equipment.

Steps You Can Take

AAMI's *Clinical Alarms: 2011 Summit* publication³² cited specific steps healthcare facilities could take to address the issue. They include:

1. Test acoustics on clinical floors: environmental noise impacts patient and staff well-being and patient safety. For example: Implement existing standards and guidelines: IEC-ISO 60601-1-8; the AHA's 2010 FGI Guidelines; The Joint Commission's *Planning, Design and Construction of Health Care Facilities* (Second edition, 2009).
2. Implement an alarm system configuration policy based on clinical evidence. Don't just accept default alarm preset configurations, but configure alarms according to the patient. Also eliminate no-action alarm conditions. Change single-use sensors more frequently to reduce nuisance alarm conditions. Data suggests 24 hours for ECG; conduct testing for SpO₂. (except in pediatric units).

Also, when it comes to the broader issue of noise, pay attention to patient satisfaction surveys and HCAHPS scores. Patients can be your best source of problem solving. These steps will immediately improve the auditory environment for both patients and staff, and will reduce risks related to clinical alarm fatigue.

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Creating a Culture of Quiet

Creating a therapeutic environment of care requires participation and skill from all departments. From clinical engineers and biomedical equipment technicians, to medical device manufacturers, facilities managers, and purchasing agents, all parties must make efforts to contribute to quieter and therefore safer environments. Furthermore, because the use of technology is heard throughout the patient experience, minimizing the auditory impact of requisite medical equipment will lead to enormous strides in patient care. The hospital environment will never achieve an absolute “quiet,” nor should it, as it is active, complex, and constantly in motion. However, a culture of quiet is one that is in balance with all this activity, has compensated for what cannot be avoided, and has made intentional and conscious decisions that contribute to comfort and care for the patient and family.

The relationship between patient safety and hospital noise is not a straight line. Rather, it is the distraction, interruption, stress, confusion, and challenge to clear communication caused by noise that leads directly to safety issues.

To the patient, the noise in the environment, whether experienced as loud and distracting or, in the late night, is a series of unpredictable, erratic sounds, resulting in heightened expectation, anxiety, and uncertainty. If Nightingale, who considered any noise as damaging to the patient, were to comment on the noncritical alarms and other avoidable disturbances, she would undoubtedly quote herself when she wrote that, “Unnecessary noise is the cruelest absence of care.”¹ ■

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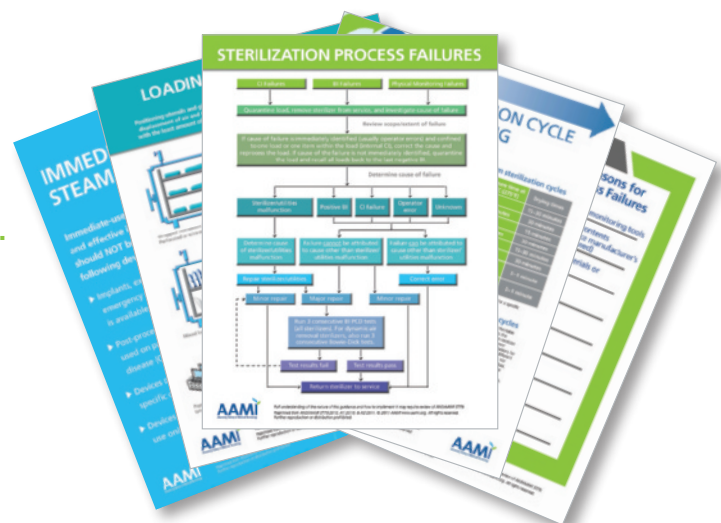
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