# Learning From Others: A Case Report From the Anesthesia Incident Reporting System

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Review of unusual patient care experiences is a cornerstone of medical education. Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to the Anesthesia Incident Reporting System (AIRS) and authors a discussion of the safety and human factors challenges involved. Real-life case histories often include multiple clinical decisions, only some of which can be discussed in the space available. Absence of commentary should not be construed as agreement with the clinical decisions described. Feedback regarding this article can be sent by email to **airs@asahq.org**. Report incidents or download the AIRS mobile app at **www.aqiairs.org**.

## Case 2019-2: The Sound of Music

*A patient was undergoing an open reduction and internal fixation of a fracture under general endotracheal anesthesia. The surgeons were playing loud music on a wireless speaker that was positioned directly behind me. In between songs, I noticed that the high-pressure alarm was sounding because the endotracheal tube was kinked. I didn't hear the alarm because the music was so loud.*

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*After an uneventful surgical procedure, I extubated the patient. Before transferring the patient, I gave a total of 0.8 mg hydromorphone over 10 minutes for pain. We then transported the patient to the PACU. Over the next 10 minutes, I gave an additional 0.4 mg hydromorphone for pain. The resident and I observed the patient for five minutes, until the patient was pain free. He was breathing spontaneously and his $SpO_2$ was 100%. A few minutes later, we were called back because the patient was apneic. The pulse oximeter probe was off the patient's finger, but nobody heard the alarm to indicate that it was malfunctioning. We aroused the patient with verbal and tactile stimulation and gave him supplemental oxygen. There were no sequalae. Further investigation revealed that the "$SpO_2$ Probe Off" alarm settings defaulted to alarm volume of 5/10 (barely audible) and intermittent alerts every 30 seconds.*

## Discussion

In both of these cases, the anesthesia provider was unable to perceive an alarm that indicated a potentially life-threatening condition. In each case, the problem was the same (the provider was unaware of the alarm), but the root cause was different. In the first case, a loud, distracting environment caused by music rendered the alarm inaudible. In the second case, the alarm volume had been set too low for anyone to hear. Both of these situations highlight important aspects of human performance and merit discussion.

Although music makes the O.R. environment less stressful for both patients and health care providers[1] (and has even been used to time CPR[2]), the assumption is that the music is played at a level consistent with a patient care environment, not a rock concert. Nearly everyone who has worked in an O.R. has experienced the situation described in the first report. The O.R. is a noisy place, and it can often be difficult to hear critical alarms or conversations. One study found that neurosurgery and orthopedic surgery had the highest noise levels in the O.R., with an average sound pressure level of 66 dB.[3] Peak sound levels during these procedures exceeded 100 dB more than 40 percent of the time. Cardiac surgical procedures are somewhat quieter but also include brief periods of extremely high peak sound levels. The highest peak levels observed were over 120 dB![3] Of course, noise can include conversations, surgical equipment and alarms, but who hasn't been subjected to loud music in an O.R.?

Not surprisingly, a noisy environment can impair an anesthesia provider's ability to hear critical alarms.[4] Surgical drills and saws can mask alarms and make it difficult for anesthesia personnel to differentiate between them.[5] Working in a loud, noisy O.R. has also been shown to increase anesthesia residents' perceived task load and fatigue.[6] O.R. noise (especially music) impairs surgeons' ability to process auditory cues. Understanding verbal communication becomes more difficult when the information conveyed is unexpected or when the number or complexity of tasks that must be performed is increased.[7] All of this noise adds to an already distracting environment. In one study, anesthesiologists dealt with an average of almost 10 interruptions per hour, including individuals walking into and out of the room, telephone calls and pages.[8]

Turning off or turning down the volume on excessive alarms is a logical response to unnecessary or incorrect alarms (e.g., an alarm indicating that demographic information has not yet been entered into a monitor). Unfortunately, when an unneeded alarm is turned down, the volume for necessary alarms may be inadvertently decreased as well. The anesthesia provider in the second report was unable to hear the alarm because somebody in the post-anesthesia care unit had set the volume too low. Alarm fatigue describes a situation in which a clinician either fails to respond to an alarm or his/her response time is increased because of an excessive number of alarms. Factors that contribute to the development of alarm fatigue include false alarms, nuisance alarms (which indicate a violation of alarm limits that is not clinically significant) and technical alarms, which indicate that equipment needs attention.[9] In this case, the alarm indicating that the pulse oximeter was malfunctioning was turned so low as to make it inaudible, and this led to a near-miss in which the patient became apneic and hypoxic. The Anesthesia Patient Safety Foundation has discussed the need for technology training at a conference and written an excellent summary in their newsletter: **www.apsf.org/article/apsf-convenes-conference-on-technology-training**.

Another contributing factor might have been inattentional deafness, which is a failure to hear otherwise audible sounds under high-workload conditions.[10,11] This is a real phenomenon and not something that we can fix by saying, "Pay attention!" Functional MRI studies demonstrate there is reduced connectivity to auditory processing areas in the brain during high visual task loads.[10] Although we do not know what else was happening when the patient became apneic, the PACU is almost always a hectic place, so it's not unreasonable to assume that the care team was busy with other tasks. There is no easy solution, other than to make sure that all alarms can be heard by the people responsible for managing them and to design equipment so that alarms have a high positive predictive value and unnecessary alarms are minimized.

It is probably unrealistic to ask surgeons who like to dance to the music to whisper in the sounds of silence. Music may improve surgeons' performance and (assuming everybody's tastes are similar) can make the environment much more pleasant. One interesting study in a simulated O.R. found that increasing noise levels did not affect anesthesiologists' ability to detect alarms, but the results of that study might also be affected by the specific type of alarms that were evaluated.[12] Even so, it makes sense to keep the volume to a reasonable level so that people can speak in a normal conversational tone and no one on the patient care team misses an important cue. We should also check the volume settings of critical alarms to be certain that we can hear them above the ambient noise levels and add this check to our preoperative anesthesia equipment and pre-PACU sign-out safety checklists.

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