

Under construction: how to deal with noise and vibration in the animal facility?

Many animal facilities have experienced problems caused by excessive noise or vibrations, and what happened at Great Eastern University will sound familiar to many readers. While planning for the construction of a new building, the school's architects and engineers informed the vivarium leadership that there would be noise and vibrations caused by some necessary blasting, but they intended to cover the blasting sites with very heavy synthetic blankets to lessen the impact on other school areas, including the vivarium. The director of the vivarium, Dr. Ken Manning, thanked them for their concern and requested they install appropriate equipment in the vivarium to monitor vibration and noise and thereby allow a comparison with pertinent studies reported in the biomedical literature. This was agreed to by the engineers and Manning proceeded to inform animal-using investigators of the school's plans. Some of

the investigators who had mouse breeding colonies were apprehensive, but they felt they had no choice but to curtail some of their breeding and take a wait-and-see approach.

Soon after the blasting started it became obvious that the vibrations and noise exceeded levels considered to be 'safe' for mouse breeding and certain other studies. Manning brought this to the attention of the IACUC and the construction team, but he was told by the latter that nothing could be done to alleviate the problem. Manning asked why recording equipment had been installed if no remedies were available, but he only received sympathy without any help. The IACUC chairman went to the Institutional Official and informed her that animals were being stressed and research was being compromised, because about one in three breeding colonies was reported to be experiencing a dramatically decreased number of pups per litter along

with increased cannibalization. And, he added, this was negatively affecting the budgets of the researchers. Yet, he received only sympathy and a suggestion to work the problem out with the investigators and the construction team.

Does unalleviated stress, such as described above, need to be reported to the federal Office of Laboratory Animal Welfare (OLAW) because it occurred without IACUC approval? If the problem occurs at an AAALAC-accredited institution must it be reported to AAALAC? Do you have suggestions on how to mitigate this problem if it occurred at your organization? □

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To report or not to report? Regulations win, despite the unavoidable nature of renovations

This scenario is a great example of the growing pains felt by many institutions, as their units manage ongoing growth of both infrastructure and research programs—often in very close proximity to each other.

Upon initial review of the scenario, we were undecided on the necessity for reporting, given the volume of construction noise at the institution, combined with published data that show noise and vibration associated with large scale construction projects decrease reproductive efficiency in mouse colonies by decreasing live birth rates and increasing the number of stillborn pups.^{1,2} We questioned whether this issue is so prevalent and expected in a growing program that it could be considered an example of situations not normally required to be reported, as suggested in OLAW Notice NOT-OD-05-034: "death or failures of neonates to thrive when husbandry and veterinary medical oversight of dams and litters was appropriate."³

However, upon closer review of both the PHS Policy⁴ and the Institutional Animal Care and Use Committee Guidebook⁵, we must recognize that, due to the unalleviated stress and deviation from standards of care, there is strong regulatory support for the situation to be self-reported to OLAW.

Specifically, in the US Government *Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training*⁴, Principle IV states that "proper use of animals including the avoidance or minimization of discomfort, distress, and pain when consistent with sound scientific practices, is imperative." Additionally, according to Principle VII, the provisions of the "living conditions of animals should be appropriate for their species and contribute to their health and comfort." Based on the number of breeding colonies that were having issues after the construction started, it is clear that the two Principles above were no longer being met for these animals.

Furthermore, the *Guide for the Care and Use of Laboratory Animals*⁶ states that excessive vibration has been associated with biochemical and reproductive changes in laboratory animals and can become an uncontrollable variable for research experiments. It is clear, as stated above, that the conditions for housing of the mice no longer meet the requirements of the PHS Policy or the Guide. The housing conditions due to the construction noise are also referenced in the scenario as "negatively affecting the budgets of the researchers." If the researchers' budgets are also being impacted by the renovations, it would further support the requirement to report to OLAW/funding agency.

Institutions with an approved PHS Assurance must have the IACUC report situations or actions taken in the following instances:

1. Any serious or continuing non-compliance with the PHS Policy⁴

2. Any serious deviation from the provisions of the Guide, and⁴
3. Any suspension of any activity by the IACUC⁴

Assuming the Institution is AAALAC International-accredited, and depending upon how their Program Description is worded, they may also be required to report serious issues relating to the animal care and use program, such as investigations by the USDA or OLAW, or other serious incidents or concerns that negatively affect animal well-being.⁵

Potential mitigation strategies could include the following:

1. Prior to onset of construction work, relocate animals to buildings further

2. Attempt insulation of animal housing spaces and areas surrounding construction noise to reduce effects, such as using noise barriers made from composite materials and designed to improve the attenuation of noise transmission by windows. For example, Rasmussen, S. et al. installed noise barriers consisting of two layers of 5/8-in. thick exterior sheathing on metal studs with mineral wool insulation on the outside surface of all windows facing the construction site. Their data shows that, “with the exception of a few construction activities, such as breaking through

walls to connect the new building to the old, the composite barriers provided adequate sound attenuation of exterior construction noise. For the breakthroughs, supplementary noise barriers were installed inside the building to minimize noise transmission to the nearest housing rooms.”¹ Additionally, this group reported that “exterior to interior sound transmission studies with and without the window barriers confirmed the high level of sound attenuation achieved. In addition, attenuation was much greater for high-frequency noise than low-frequency noise, suggesting that ultrasonic noise produced outside will have virtually no effect on the rodent colonies inside the building.”¹

In closing, while the authors of this response recognize that construction noise may be unavoidable as programs grow, the inevitable effect it has on rodent colonies is reason enough to support the report of potentially compromised animal welfare to federal regulatory bodies and AAALAC International. “The underlying foundation of the PHS Policy is one of institutional self-evaluation, self-monitoring, and self-reporting.”³ Institutional leaders should consider the self-report process a way to formalize its self-evaluation and develop its ability to mitigate and respond when faced with this unfortunately common situation. □

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A WORD FROM OLAW

In response to the issues posed in this scenario, the National Institutes of Health - Office of Laboratory Animal Welfare (NIH-OLAW) provides the following clarification:

In this scenario, mouse breeding colonies experienced unalleviated stress from excessive vibrations and noise during adjacent new building construction resulting in decreased litter sizes and cannibalization. Whether to report the situation to OLAW and what mitigation should be considered are the key questions in this case.

Regarding the unalleviated stress caused by the blasting, the PHS Policy requires that the living conditions of animals contribute to their health, and the *Guide* expects facilities to minimize the production of unnecessary noise and vibration^{1,2}. Because there is demonstrated harm to the mice as indicated by visible stress and breeding issues, the situation is a programmatic failure. For institutions with an approved Animal Welfare Assurance with OLAW, the incident is reportable whether the research is supported with NIH funds or not³. If there is a question about whether to report or not, contacting OLAW for guidance is recommended. In addition, because the IACUC and the Institutional Official have failed to implement measures to mitigate the problem, despite repeated concerns raised by the veterinarian, there is programmatic noncompliance by the institution in not fulfilling its responsibilities as agreed to in the Assurance⁴.

Concerning prevention and mitigation strategies, the institution may consider having a written agreement in place in advance with the contractor to immediately halt blasting activities when vibration in the vivarium reaches certain limits. The suspension of blasting allows researchers to wean litters, adjust or stop breeding and move animals to locations that are less subject to blast vibrations. The vibration sensors are useless unless prompt action is taken when parameters are exceeded. An additional mitigation strategy is to arrange cooperative agreements with other institutions in advance of the construction to temporarily house vulnerable colonies. □

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Construction effects on laboratory animals: Communication is key

Unalleviated stress is an intentional component of several animal models used to induce a stress response, which is then examined during the course of a study. The stress response occurs by using a standardized method of inducement for a defined period of time and is IACUC-approved. At Great Eastern University, however, animals that were already on studies were affected by construction occurring in a nearby location on campus. The use of heavy construction equipment often results in loud noise and vibration. If close enough in proximity, the animals can detect this noise and vibration, which often promotes decreased breeding efficiency, abortion, cannibalism, and aggression. These effects, in turn, can lead to problems with establishing breeding schemes, the loss of data, and project delays.

If the affected animals at Great Eastern University are funded by an NIH grant or if the Great Eastern University's entire animal care and use program is covered by their Assurance, then the University is to report this matter to NIH OLAW. We agree that the event is 'unalleviated stress,' but we would also characterize this as an unanticipated adverse animal event, especially given the outcome of increased cannibalism.

We note that the adverse consequences were likely preventable, had the appropriate

conversations and then subsequent proactive measures occurred well in advance of the construction project activities. Great Eastern University appeared to be taking the right steps by installing equipment to monitor vibration and noise for comparison before and during construction. The device was used to record time periods without construction activity as well as measure levels of construction-related noise and vibration around the animal facility, detecting levels above what is considered 'safe' for mouse breeding and other studies. The initial plan to use very heavy synthetic blankets to dampen the noise and vibration seemed tenable. But if the construction site were to be composed mostly of solid rock, such as limestone, then the blanket would have minimal effect on dampening vibrations produced in the ground and conducted through the solid rock to the vivarium site.

Once effects on the animals were determined, a solution could have been to place anti-vibration pads, which go under cage racks to dampen vibrations and can help to mitigate this disturbance before and after construction projects are underway. Animal studies being conducted near the site could then be monitored before and after anti-vibration pad placement, looking for abnormalities that might

develop in the control groups (especially in behavioral studies).

We further recommend that Dr. Manning and the IACUC Chairperson enlist the aid of the Institutional Official (IO) in establishing a sub-committee to consider the impact of construction projects, as well as preventative measures, moving forward. In addition to Manning and the IACUC Chairperson, it is essential that membership of the sub-committee include Facility Operations, Building Management, and a veterinarian, if Manning is not a DVM. Additional stakeholders may be added as the sub-committee deems useful (e.g., subject matter experts, Vice Provost of Research). This sub-committee should meet with regular frequency, perhaps quarterly, to discuss any project potentially having an effect on animals held in the vivarium.

Last and in regards to AAALAC International, we recommend reporting this incident, as outlined in their [FAQ # C7](#). □

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