Get Smart About Home-Cage Monitoring

Improving Research Reproducibility and Outcomes with Home-Cage Monitoring 24/7

All scientific disciplines grapple with the standardization of methods and ensuring the reproducibility of results. Perhaps nowhere is research standardization and reproducibility more challenging than when dealing with lab animals such as genetically modified rodents, an invaluable tool for studying the influence of genes on development, behavior, and disease.

Getting a handle on mouse research standardization and reproducibility is some of the benefits gained from the Home-Cage Monitoring system developed by Tecniplast, a leading global producer of high-tech animal facilities with a comprehensive product portfolio unified by vivaria logistics products, monitoring and analysis platforms. With digital housing solutions that remotely monitor mouse cages changes 24/7, enhance the threshold in animal welfare as well user experience and management. Thus, Tecniplast is moving the vivarium into a new digital era.

An exciting webinar “Home-Cage Monitoring 24/7: Improving research reproducibility and outcomes,” hosted by Human Gene Therapy (Mary Ann Liebert Inc. Publishers) and sponsored by Tecniplast, highlights how environmental factors, lab animal facilities, and husbandry practices are highly variable and often overlooked as contributors to experimental variation, as well as how this information is rarely shared or requested.

“Even if you use the same strain, age, and condition, you can have completely different results because of environmental factors. Trying to address this question is a hard one,” says Dr. Stefano Gaburro, Scientific Director of Digilab Solutions at Tecniplast.

The guest speakers in the webinar emphasize the value of monitoring laboratory mouse activity and behavior—a crucial yet underappreciated aspect of biomedical research— and consider practical options to achieve better research reporting and reproducibility while reducing stress in lab mice.

Animal data can now be recorded 24/7 with new home-cage monitoring systems called the Digital Ventilated Cage (DVC), representing an important milestone for experimental research. By using digital technology, the DVC offers standardization for the improvement of animal welfare, facility operations, and research.

During the webinar, participants learned about recording animal data using the DVC for sensitive, high-throughput, and longitudinal valuations to ensure more rigorous reporting.

Specific examples were presented on the practical applications of this digital transformation in home-cage monitoring, within a unit and across an organization.

Feeling the Biorhythm

Brun Ulfhake, MD PhD, Senior Professor at the Karolinska Institute in Sweden, presented “Biorhythms of home-cage activity in barrier bred and maintained laboratory mice (C56Bl/6J male and female, NMRI) using DVC.”

Using digital ventilated cages that collect information and data directly from the home cage without stressing laboratory animals, Dr. Ulfhake shows that home-cage activity data clusters around certain frequencies, such as those that correspond to circadian rhythms and weekly cage changes.

“Some rhythms have been established to be triggered by external signals, such as light, while others are imposed by regulatory events in care and use of the animals, such as cage-change,” says Dr. Ulfhake. “While clustering of activity at different frequencies reproduces well across cages and sex, cages are not synchronized in time except when externally triggered by a cage-change or light ON/OFF.”

In addition to high-frequency activity patterns, at 2–3 months, Dr. Ulfhake shows slow oscillation in animals’ activity correlating with feeding patterns and the magnitude of behavioral response to stimuli as lights on.

Ulfhake says that non-intrusive recordings of mice home-cage activity will improve our understanding of spontaneous home-cage behaviors of the lab mouse and how it varies across day-and-night and over time across the years as they age. “Automated home-cages can aid in characterizing behavioral responses to care and use procedures, assist in experimental design, and may be used to screen behavioral phenotypes of different genotypes,” he suggests.

Dealing with Discrepancies

Mathias Leblanc DVM PhD, Senior Director of the Animal Resources Department at the Salk Institute in La Jolla, CA, and a Staff Scientist in the Gene Expression Laboratory, discussed “Evaluation of the effect of bedding and environmental enrichment on mouse activity patterns through the use of automated home-cage monitoring.”

Dr. LeBlanc showed that automated home cage monitoring provides a unique opportunity to assess animal activity and behavior with minimal disturbances from human activities, in which he explores how bedding and environmental enrichment causes considerable variation in activity levels—a significant confounding research variable.

“Housing conditions in mice has been shaped by economics, ergonomics, biosecurity, and standardization considerations, sometimes at the detriment of the animal welfare,” says Dr. LeBlanc. This has major consequences including reproducibility issues within institutions or even within a lab, especially in neuroscience and neurobehavioral testing.

“We see a lot of discrepancy between studies that may be due to many factors, such as husbandry, mouse models, or background strains. It is a serious issue that we have to address as a scientific community,” says Dr. LeBlanc.

Both presenters agreed that we are still in the infancy of home-cage monitoring and still have much to learn about how best to use this technique and understand the mice that live in the cage.

Using instruments like the DVC for undisrupted and non-intrusive data collections will enable scientists using mice models for research to build libraries on the strain, substring, sex, and age-associated home-cage behaviors that can be very useful for future husbandry and research efforts.

“Perhaps 5–10 years from now,” Dr. Ulfhake speculates in closing, “we can collect data from tens of thousands of cages across the world on different strains, and build up databases of behaviors, nocturnal activities, seasonal variations, etc. It is a very interesting era to be a behaviorist.”

Find out more about the historical concerns and contemporary issues going forward in home-cage monitoring for mouse research by watching the webinar on demand: https://www.workcast.com/register?cpak=8917513340246234

Tecniplast, a leading company in the lab animal industry since 1949, designs, manufactures and distributes equipment for vivaria.