

## Rodent Shelter: improving the post-operative care of rodents

### Overall aim

1. The aim of this Challenge is to develop an easy-to-use shelter for rodents to provide warmth and a means to monitor the animals to improve post-operative care.

### Duration

2. Up to two years.

### Budget

3. Up to £150k.

### Sponsors

4. Sponsors define the Challenges in collaboration with the NC3Rs to set out the business case and 3Rs benefits, with a view to using the product developed. Sponsors are required to provide in-kind contributions to help solve the Challenge.
5. The Sponsors for this Challenge are AstraZeneca and the University of Gothenburg.

### Background

6. Rodents undergo surgical procedures in studies investigating disease mechanisms, the efficacy and safety of new treatments and to enable monitoring of physiological parameters such as heart rate and blood pressure. Post-operative care is critical to minimise pain and distress and aid recovery. This includes providing analgesia, a source of warmth and shelter, palatable food and close regular observations of animal behaviour and vital signs.
7. Following surgery, most rodents are returned to their social groups as soon as they are sufficiently recovered. In some circumstances it can be necessary to single house animals for a short period of time to mitigate against damage to sutures, wounds and implants by cage mates. When rodents are singly housed directly after surgery, enrichment items are often removed to avoid injuries and enable better monitoring. The post-operative housing environment is important as it can influence

recovery in mice [1] and may induce stress. For example, a change in bedding material can affect post-surgery blood pressure [2, 3].

8. Rodents have a large surface area to body weight ratio, which means they lose body heat rapidly and are susceptible to hypothermia. Following anaesthesia and surgical procedures, their ability to regulate their body temperature is reduced. Providing thermal support during this time is critical to mitigate against the risk of hypothermia and aid the animal's recovery [4-8]. Warmth is often provided by externally powered heat pads placed under the cage. However, these cannot be used for cages kept in racks (e.g. individually ventilated cages and large rat cages such as high houses or double decker cages). There is a need for an easy-to-use solution for providing shelter and warmth in any cage type for post-operative care.

## The Challenge

9. The aim of this Challenge is to develop an easy-to-use and affordable shelter that provides warmth and can be placed in any type of cage post-surgery to improve the post-operative care of rodents. The shelter should be equipped with controllable heat to keep the rodent warm and made of a transparent material to aid visual monitoring while avoiding disturbing the animal.
10. The shelter should be equipped with sensors for real-time non-invasive telemetry to monitor vital signs and indirect parameters of stress and/or pain such as heart rate, respiratory rate and body temperature. Mice and rats are prey species and can mask behavioural indicators of pain and suffering in the presence of humans who they perceive as potential predators [9]. Automated monitoring would remove the effects of human intervention and permit monitoring during the dark cycle.
11. The addition of a wireless alert to a mobile device, for example, if the heart or respiratory rate goes above or below pre-defined frequencies which might indicate pain or suffering, would enable timely welfare intervention. The potential for an automated feedback loop to adjust the heat source to the animal's body temperature within the device would also be desirable. While advanced automated rodent home cage monitoring systems are available, they are not tailored to the purpose of this Challenge.

## 3Rs benefits

12. Annually at AstraZeneca, over 200 rodents undergo surgical procedures and require post-operative care. The development of a small, easy-to-use, warming shelter would improve post-operative recovery, monitoring and pain management, as well as scientific outcomes. Improved recovery could also enable:
  - A reduction in rodent use, especially for advanced surgical models, where extra animals are added due to the uncertainty around post-operative recovery.

- Returning animals to their social groups more quickly, minimising the time spent singly-housed.
13. The shelter would have broad applicability across the bioscience sector where surgical animals are used including academia, contract research organisations and the pharmaceutical industry. It could also be used for non-surgical models such as cold sensitive strains (e.g. BTBR ob/ob mice and nude mice) and for mice required to be single housed for specific measurements such as food intake or in cases of male mice incompatibility. Additionally, the shelter could be used by veterinary clinics in the care of small animal pets, where there is increasing demand for veterinary care and surgical intervention.

## Key deliverables

14. This Challenge has essential and desirable deliverables. The essential deliverables are a shelter with basic features (i.e. shelter with a controllable heat source made of a transparent material for monitoring purposes) that is affordable for widespread use. The desirable deliverables describe an additional modular component that can be added onto the basic shelter inside the cage for automated monitoring of the animals when they are in the shelter.
15. The **essential deliverables** are that the shelter should:
- Be appropriate for both mice and rats. The shelter should be of different sizes for mice and rats and fit into any standard cage type.
  - Provide a controllable heat source for warmth, which should be wireless with a battery time of at least 24 hours.
  - Be easy to decontaminate (e.g. be dishwasher safe, autoclavable or by other means of decontamination).
  - Be non-toxic and protected against chewing and biting damage.
  - Be accepted and used by mice and rats in their home environment.
  - Enable visual monitoring through the material but be opaque enough for the animal to not be disturbed.
  - Be affordable to enable widespread uptake.
16. The **desirable deliverables** are intended to deliver an optional add on for automated monitoring of animals when in the shelter. The desirable deliverables are:
- The remote and non-invasive monitoring of heart rate, respiratory rate and body temperature.
  - The recording and wireless transmission of real-time measurements to provide an alert if the health parameters change from pre-defined levels to enable timely welfare interventions.

- The level of warmth provided by the heat source should automatically compensate for any increases or decreases in the animal's body temperature.
- The ability to obtain individual animal data when they are group-housed in their home cage. The approach used to individually identify animals should be minimally invasive and readily available (e.g. microchip/tracer techniques).

## In-kind contributions

17. The Challenge will be supported through the provision of in-kind support from the Sponsors. The in-kind support offered includes:

- Time and expertise, including veterinary advice.
- In-house testing of ideas and prototypes in several surgical models in various strains of both rats and mice at AstraZeneca.

## References

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