Glass Half Full: Hydrating Mice Without Water

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INTRODUCTION

Food, water, and clean cages make up the three-legged stool of rodent husbandry, as all are essential. Recently, we were faced with a significant dilemma that would undermine this balance, as our facility was challenged with an unavoidable water outage that would affect thousands of cages that are dependent on an automatic watering system.

BACKGROUND:

The original distribution piping installed in our Research Building in 2004 was polypropylene, with joints fused using a new technology at that time called electrofusion. Soon after the facility opened, leaks were detected. After years of repeated leaks and numerous repairs, it became clear that the piping needed to be replaced. Recently, a new installation process using socket fusion welded joints was used to install new polyvinylidene fluoride (PVDF) pipe. For most of the replacement process, the animal facility was not affected; new pipe was simply run parallel to the original pipe. However, to make final connections, pressure test, and sanitize the entire system, water that services our animal facility's automated watering system would have to be completely suspended for a minimum of 3-4 days.

PROBLEM:

Due to the impending water outage, we needed to find an alternative means to supply water to nearly 20,000 cages of mice for a minimum of 3 days duration. This would entail several steps:

- Selecting a water replacement
- Developing a management plan
- Planning logistics of water replacement
- Designating personnel roles and duties during the period of water replacement
- Training personnel
- Communicating to research community
- Ensuring animal health and hydration
- Restoration

APPROACH: MATERIALS AND METHODS

WATER REPLACEMENT OPTIONS

We determined that there were 4 logical options for water replacement. We eliminated pre-filled water bottles, carboys, and water pouches due to lack of availability, impracticality, and expense, respectively. Our remaining option was water gels.

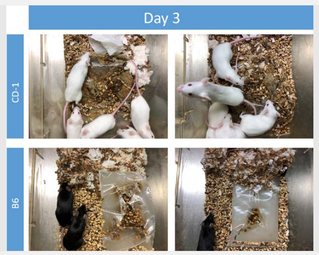
GELS

There were two gel options available: HydroGel® and Gel 'B'. Both gel types contain 98% water, making them essentially equivalent to water. Moreover, both *theoretically* provide enough water to meet the needs of mice for 5-6 days. However, we needed to determine the duration of gels in the 'real-life' setting of a rodent cage. For instance, would there be premature desiccation or loss of gel secondary to various factors such as air exchanges, influx of bedding, and/or differences in rodent strains?

HydroGel®

STRAIN DIFFERENCES

In order to assess gels for cage application, consumption, duration in a ventilated cage environment, visualization characteristics, and mouse health, we ran a trial on CD-1, C57Bl/6 and nude training mice, following IACUC notification. We found that for both gels, there was a strain difference in acclimation to gel use; C57Bl/6 mice had greater difficulty in accessing the pouches cut with a routine "X" pattern; thus, we cut a complete flap off to facilitate use. It also became clear that visualization would be difficult due to mouse placement of bedding and enrichment materials into the pouches. Nevertheless, HydroGel® was slightly preferred due to ease of cutting, and slightly longer duration of gel.



GEL APPLICATION

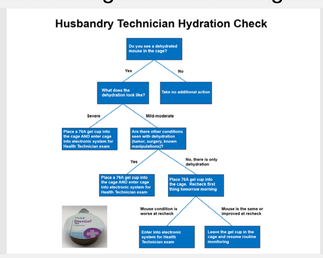
We then ran a timed trial to determine the most efficient method of application. Application by an individual required 26 seconds per cage; two-person teams required 14 seconds. Based upon this data, we determined that we could apply all gels in a 6-8 hour period, not accounting for personnel breaks and unforeseen obstacles.

TRAINING

We trained personnel in gel preparation and application, box cutter use and safety, gel visualization, and dehydration identification.

HEALTH AND HYDRATION

Identification and treatment of dehydration was our paramount concern. Because the gel pouches would become covered with debris quickly, technicians needed to rely less on the observation of gel and instead upon the assessment of hydration. In our facility, gel is the treatment of choice for dehydration on a day to day basis; and, placing water bottles would not necessarily be the treatment of choice for failure of gels. Therefore, we selected the use of DietGel®76A gel cups, which offer nutrition and fluid replacement for this purpose. Our final management plan for dehydration was provided to technicians in an algorithm for training and reference.



WATER BOTTLES

We made the determination that some cages required water bottles. This included our GEM facility, NSG breeders, rodents used in behavior research, hamsters, and cages requiring medicated water. Lastly, any researcher or lab that requested water bottles, for any reason, was provided with bottles. Ultimately, 2160 cages received water bottles. Final number of cages that received gels was 18,000.

COMMUNICATION

Leadership met with all personnel daily during the outage to address concerns. An email informing the research community of the impending water outage was distributed one month in advance. Information was disseminated via meetings, hallway monitors and on flyers posted in the facility.

OUTAGE ROLL-OUT

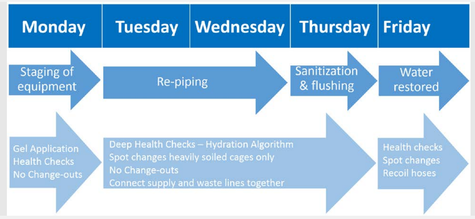
Pre-outage: Half of routine change-outs scheduled for the week of the outage were performed on the prior week.

Monday: Gels were placed; no change-outs.

Tuesday/Wednesday/Thursday: Intensive health checks were performed. Hydration algorithm was followed. Spot changes of heavily soiled cages were performed late in the day after health checks. Recoil hoses were disconnected from racks. Supply and waste lines were connected together.

Friday: Intensive health checks followed by spot changes were performed. Recoil hoses were reconnected to racks. Watering valves were toggled to ensure normal water flow had resumed.

Post-outage: All routine and delayed change-outs were performed. Routine health checks resumed. Gel pouches were removed at the room level. Water was tested.



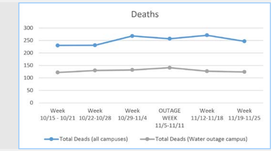
DATA COLLECTION

To evaluate our process and apply lessons learned to future events of this magnitude and scope, we collected data on dehydration cases, treatments, deaths, gel pouches applied/replaced, and water bottles used. Technologists were interviewed for feedback. Husbandry technicians and the research community were administered a survey. Lastly, cost and labor analyses were performed.

Results

DEHYDRATION RATE was determined based upon the application of DietGel®76A gel cups and/or water bottles. Total number of cages with these provisions was 539 of 18,000, yielding a 3% rate of perceived dehydration.

DEATHS prior to, during, and after the outage were assessed for trends. No notable increases in deaths were noted.



QUESTIONAIRES provided valuable anonymous feedback from personnel and research labs, yielding a 72% and ~18% response, respectively.

COST ANALYSIS showed that the total cost for water outage management was $102,777.

Water substitute	
Gels	$100,500
76A gel cups	$40
General Supplies	
Utility blades	$191.20
Gloves, cut-resistant	$187.60
Labor (not including overtime)	$1,858.68
Total	$102.777.48

*Gels: we ordered 2 times the number of cages in the facility plus 10%: 41,050 pouches

LABOR ANALYSIS demonstrated that 67.7 hours of overtime was required in advance of the outage. The gel application process was successfully completed in 8 business hours.

Conclusion

Ultimately, due to meticulous planning and preparation, comprehensive training, thorough health checks, and continuous communication with our research community, we successfully navigated a water outage with minimal impact to our mouse population, and have developed a model for use at other institutions. Water gels have proven to be effective for future water outages, and for disaster planning. Improvements would include pre-placement of water bottles with select breeders, weanlings, and nude mice.

ACKNOWLEDGMENTS