**1st Laboratory Animal Analytics Conference**

**Presentation Abstracts**

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***Hosted by:***

 ***Center for Comparative Medicine (CCM), Massachusetts General Hospital***

***Office of Animal Resources (OAR), Harvard University Faculty of Arts and Sciences***

***Vivarium Operations Excellence Network (VOEN)***

**Session A: Operational Equipment and Supply Management**

 **1. Low and High Tech Options for IVC Rack Inventory Management**

 Authors: **Steve Niemi,** Ethan Hildebrand, Jason Jorgenson, Office of Animal Resources, Harvard University Faculty of Arts and Sciences, Cambridge MA. sniemi@fas.harvard.edu

Abstract: Individually ventilated cage (IVC) rodent cage racks require regular sanitation for good vivarium management as well as to meet expectations by various oversight bodies. In addition, because of their significant cost and bulk, it is wise to monitor the number and location of idle IVC racks so unnecessary capital purchases are avoided and expensive storage space is conserved. Our program involves 222 IVC racks, 176 of which are in current use in support of average daily census of ~9,500 mouse and rat cages maintained in 50 rooms in three buildings. Racks that house animals are washed in a rack washer and autoclaved at least once yearly (more often in conjunction for extinguishing outbreaks of excluded pathogens). This sanitation schedule is monitored by our IACUC and possibly reviewed by pertinent extramural parties (AAALAC, City of Cambridge Commissioner for Laboratory Animals, USDA for non-*Mus* species). Therefore, it’s important to have a reliable system to identify racks approaching their scheduled cleaning, and documenting when it was performed. We affix a dated tag to each rack and enter that information in an Excel spreadsheet that is updated after each cleaning. But that “system” requires checking rack tags visually to confirm compliance. So we explored digital alternatives that automatically detect individual racks and track their location, the reports of which would be reviewed by anyone anytime anywhere. Two digital possibilities were considered: one leveraged our existing RFID cage census platform in that racks would be counted as “cages” in the rooms they occupied, but required customized software and hardware; the other involved a simple Wi-Fi-based tracking system sold as a retail product to the public. A comparison of features and drawbacks relevant to vivarium operations (e.g., cost, ease of use, durability, security) for all three approaches will be presented along with our conclusions

**2. Data Based Determination of Optimal Micro Isolator Top Change Interval for Rat and Mice Across Five Types of Ventilation Systems**

Authors: **Zachary Freeman** DVM PhD DACLAM, Assistant Professor, Unit for Laboratory Animal Medicine, Michigan Medicine, University of Michigan, freemanz@umich.edu

Abstract: Currently the *Guide for the Care and Use of Laboratory Animals* recommends sanitizing cage components including micro isolator (MI) tops at a minimum frequency of every 2 weeks. Previously published data demonstrated that mouse MI top microbial loads do not increase until time frames greater than 2 weeks and MI top changes may be delayed up to six months. It remains unclear how microbial loads differ on mouse versus rat MI tops as well as across different ventilation systems. We hypothesized MI top microbial loads were altered by ventilation system and higher in tops from rat compared to mouse cages. We used RODAC contact plates to determine bacterial load (colony forming units, CFU) on MI tops at serial time points (0, 14, 30, 60 ,90 and 120 days) on mouse and rat cages from the same rack type with one of five different ventilation systems. MI tops were determined to have sufficiently elevated bacterial loads to necessitate changing based on either statistically significant increases in CFU compared to the day 0 and 14 values or values greater than 50 CFU. MI tops from rat cages had significant elevations of bacterial counts at 14 days that were also greater than the 50 CFU cutoff regardless of ventilation system. MI tops from mouse cages had longer intervals with acceptable CFU that were dependent on the ventilation system. Four of five ventilation systems had acceptable bacterial loads on mouse MI tops for at least 90 days while the remaining system required MI top changing at 30 days. In conclusion, the species of animal and the type of ventilation system utilized greatly alter the accumulation of bacteria on MI tops used to house laboratory animals.

**3. Comparing Two Disinfectants Through A Price Analysis**

Author: **Evan Hutto,** M.S. RLATg, Animal Facility Supervisor, Division of Animal Resources, Georgia State University. ehutto3@gsu.edu

Abstract: Recently Georgia State University’s program underwent a change of disinfectant used throughout the rodent facilities. The switch was made from a chlorine dioxide compound that was prepared weekly with a short shelf life after reconstitution to a ready to use hydrogen peroxide solution that has an expiration date of two years extending from the mill date at the factory. In performing an initial price analysis between the two, the chlorine dioxide was the significantly cheaper option per bottle, giving it a larger advantage in the comparison. In order to thoroughly investigate which product would be the best fit for GSU we began to investigate additional factors that contribute to the overall cost of each disinfectant. One of the largest contributing factors that was focused on was labor cost. Aside from the chemical differences between the two, the labor associated with the different products was one of the most obvious differences. When calculating the cost of the labor for the chlorine dioxide compared to the ready to use hydrogen peroxide solution, the price gap between the two was greatly reduced. After analyzing cost for comparison, we began to look at other figures that do not necessarily have monetary value associated with them. These considerations ranged from but were not limited to: confidence in the products, the effects of the product on the equipment and personnel as well as convenience. After expanding the definition of price analysis from beyond the base price of a product the analysis became much more complex, but ultimately allowed GSU to choose the best course of action for the program.

**4: Optimizing RFID Cage Census Frequency**

Authors: **Ethan Hildebrand**, Jason Jorgenson, Steve Niemi, Office of Animal Resources, Harvard University Faculty of Arts and Sciences, Cambridge MA; Rupesh Patel, Allentown, Inc., Allentown NJ.; ehildebrand@fas.harvard.edu

Abstract: Rodent cage census is a fundamental component of cost recovery in academic vivaria; cage numbers are counted on a regular basis so animal user grants can be charged per diems. In June 2015 we switched from counting cages by hand weekly to counting cages daily via commercial radio frequency identification (RFID) technology (WiCom Sensus, Allentown, Inc.). Cage cards embedded with unique RFID tags are either read by antennae fixed on the ceiling above racks or by a hand-held scanner. Since its launch, each rodent housing room has been scanned once daily between 6:00 and 8:00 am to minimize interference by and with investigators who usually arrive later in the day. However, this scanning schedule doesn’t capture new animals received and housed later in the day that still generate expenses that day. Conversely, animals euthanized or transported to labs shortly after the daily cage census is taken represent reduced costs after their cages were counted for a full day. Thus, the question arose: is there an optimum time during the workday to take cage census that provides a better balance between old cages leaving and new cages appearing? In addition, what times of day are more or less likely to be disturbed by activity in each housing room that could inconvenience researchers or skew results if antennae don’t have a clear field for scanning? A data gathering project was initiated in the WiCom Development (“Dev”) environment (versus the Production or “Prod” environment) to scan rooms with installed antennae every two hours starting at 5:00 am and ending at 5:00 pm, for a total of seven scans per day. Dev census data were collected over a three-week period and will be presented with conclusions and discussion.

**Session B: Clinical Care and Compliance Management**

**5. Improved lab animal operations and quality of care at WVU**

Author: **Ida M Washington,** DVM, PhD, DACLAM, Director and Attending Veterinarian, Office of Laboratory Animal Resources, West Virginia University, Morgantown, WV; ida.washington@gmail.com

Abstract: We addressed operational inefficiencies at WVU in 2017, producing improved animal care, time savings, and reduced costs. Inefficiencies included slow reporting of clinical cases, excessive room entries per day, and high use of personal protective equipment (PPE). Clinical cases were previously reported by Animal Care Technicians (ACTs) to Veterinary Technicians (VTs) 1-3 hr after discovery by distant phone, with frequent inaccuracies or omissions. To address this, ACTs were provided iPod Touches and now email cage card pictures and brief clinical descriptions to VTs immediately as cases are discovered. The result is fast and accurate reporting of cases and rapid response by VTs, saving time and improving animal care. Housing rooms were previously entered an excessive 4X/weekday and 2X/weekend day by ACTs, and ~3X/wk by other staff (VTs, supervisors), thus ~27 entries (6.75hr)/rm/wk. PPE cost ($1.12/entry) was $30.24/rm/wk, or $907.20/wk for main facility (30 rms). Housing rooms are now entered 1X/day by ACTs and ~3X/wk by other staff, thus 10 entries (2.5hr)/rm/wk (63% time savings). PPE cost became $11.20/rm/wk, or $336.00/wk for main facility (63% cost reduction). Cross contamination risk between rooms was also reduced, improving housing quality. PPE required for room entry was previously a disposable gown, gloves, facemask, booties, and bouffant (total $1.12), all discarded at room exit. Current risk-based PPE standards include facemask and booties for room entry, gown and gloves to handle cages, additional Tyvek sleeves to change cages. Gloves and sleeves are discarded at exit, facemasks and booties are worn until dirty, and gowns are re-used within rooms for ≤1 wk. PPE cost is now $6.02/rm/wk, or $180.60/wk for main facility (total 80% cost reduction). In summary, a modest investment in electronic devices improved reporting efficiency and animal care, and revised room entry standards and PPE usage produced large time savings and cost reductions at WVU

**6. Integrating *Free tech* to Improve Vivarium Efficiency**

Author: **Colleen Thurman** DVM, MS; Veterinary Resident in Laboratory Animal Medicine at NYU/Regeneron, Office of Veterinary Resources, 665 Broadway Suite 804 New York, NY 10012; colleen.thurman@nyu.edu

Abstract: Technology and communication are both integral to the operation of the modern vivarium. Technology and software can improve communication and efficiency, but that potential may be untapped without an organized and creative approach. This presentation will cover three distinct problems in the vivarium 1) Communication of Surgical Plans and Sample Submission, 2) Calculation of animal numbers in IACUC protocols, and 3) Excessive email communication. In the first case, we have successfully implemented Google Forms to collect data about upcoming surgeries and submitted samples from labs. In the second case, an Excel sheet was created to help check animal number calculations for personnel writing IACUC protocols, especially large breeding protocols. This tool is used but not mandated, and we have seen some improvement in protocol calculations and fewer rewrites. Our third problem was excessive email communication, which we attempted to mitigate using a chat-based program called Slack. Slack allows people to be assigned to channels and keep a running conversation thread. We intended to use it for conversations about topics such as enrichment, housing room disturbances, ongoing clinical cases, or non-emergent facilities issues. The purpose was to limit email communication to important or new cases and issues. Unfortunately, adoption was a problem, and it was difficult to distinguish cases that were best to use Slack versus email. We have reverted to email at this time, but we may try something similar in the future once our record keeping is mobile. Overall, taking information technology approaches to solving communication and organization issues has made some of our operations more efficient, particularly with respect to veterinary man hours, but not every idea catches on. We will continue to make these types of adjustments to improve overall efficiency as problems present themselves.

**7: Evidence-Based Behavioral Management (Hutchinson)**

Authors: **Eric K Hutchinson**, Sara P Flemming, Research Animal Resources, Johns Hopkins University

Baltimore

Abstract: The data collected as part of behavioral management programs for laboratory animals increases with seemingly every new regulation or guideline.  The analysis of these data and application to management decisions remains less common.  This presentation will focus on several case studies where data collection procedures were instituted or improved, or where already collected data were analyzed, ultimately driving behavioral management decisions.  As one example, we developed a new scoring system for self-injurious wounds in nonhuman primates that could be accomplished quickly at cageside with high reliability and high fidelity to the “gold standard” behavioral observation.  We then applied this sytem widely to better assess the effectiveness of treatments for SIB.  In another case, previously collected socialization data was analyzed to demonstrate the relative success rates of different demographics of nonhuman primates, and which demographics most contributed to “failed” socializations.  This analysis redirected the focus of effort toward socializations that were more difficult but longer lasting.  As another illustration, we analyzed already collected alopecia scores from nonhuman primates housed in indoor-outdoor enclosures to determine whether there is a seasonal effect on the animals’ evident hair loss.  This analysis helped respond to inquiries from regulators regarding the possible significance of this alopecia.  These and other case studies will be presented as an argument that basic data collection is an imperative component of behavioral management programs, and that analysis of this data may allow for evidence-based decision making where published guidance is scarce.

**8. Comparison of Sire Conception Rates in Rhesus Macaque (Macaca mulatta) Males Between Two Harem Breeding Arrangements (Flemming)**

Authors: **S. P. Flemming**, E. K. Hutchinson and R. J. Adams, Johns Hopkins School of Medicine, Baltimore, MD

Abstract: Johns Hopkins University established an SPF Indian-origin rhesus macaque breeding colony in the early 1990’s to provide the University with a source of nonhuman primates to aide in human and animal medical advancements. Traditionally, stable matrilines were kept intact as breeding groups to avoid increases in intragroup aggression and injury; however, a shortage of breeding males often resulted in harems being combined, and in some instances, harems went without access to a breeding male during the breeding season. In order to avoid combining harems while allowing all females access to a breeding male, we established the practice of alternating males between two harems throughout the breeding season. Currently, seven males have alternated between harems for at least one breeding season. This procedure allows more females access to breeding males, thus increasing overall birth rates while eliminating the practice of merging unrelated harems. Most importantly, “sire conception rates” (SCR) are not negatively impacted. Each male’s SCR is calculated based on the number of offspring produced compared to the number of sexually mature females each male has access to during the corresponding breeding season. The SCR for each male from one to three years during single-harem breeding seasons is then compared to his SCR for one to four years during alternating harem breeding seasons. The mean SCR during single-harem breeding seasons is 75.4% and 67% during alternating harem breeding seasons, a statistically insignificant difference (t (6) = -1.73, p=0.13). SCR was stable across both conditions despite males having an average of 4.7 additional females during the alternating harem breeding seasons, which resulted in an average of 2.9 additional births. Our data shows that alternating males between harems throughout the breeding season is an effective breeding management tool when faced with limited male stock.

**Session C: Human Resourcing and Operational Management**

**9. Scheduling Work at Yale Animal Resources Center (Yale)**

Author: **Hilary Vojtek**, M.S. RLATg, Manager of Husbandry Operations, Yale Animal Resources Center, Yale University, New Haven CT. Hilary.Vojtek@yale.edu

Abstract: At a time when our census was increasing by double digit percentages for many years, our method for scheduling quickly became inadequate. The husbandry technicians’ schedules were inherently unfair in the manner that work was divided. We had challenges understanding how much work a technician should be able to complete and also with rescheduling work when employees had planned or unplanned time off. Oftentimes, employees would return to work after a couple of days off to find their rooms had only been checked in their absence, leaving them with tremendous amounts of cage change work to complete in a shortened week. In addition, managers did not have a full understanding of what tasks were completed each day. To better understand our workload, we decided to gather process metrics times on all activities for every technician over a month. Employees timed themselves and turned in worksheets with their daily information. This information was analyzed, grouped and averaged. The resulting data became the foundation for process metric schedules based on the average time it takes to complete each task, such as checking cages, changing cages, weaning/separating, room maintenance times, special assigned tasks, etc. We trialed the new schedules in one facility, then moved to other areas as the kinks were worked out. From a manager’s perspective the schedules work very well; they now know what work is completed each day. Some technicians loved the changes, others were less enthusiastic. Since every technician is assigned work to complete each day, they no longer have the flexibility to decide what tasks to accomplish each day. The schedule for each husbandry technician is now constructed equitably based on the same set of standards, and work is completed per our defined schedule even when staff have time off. We completely changed the way we schedule work and created a Scheduler position to manage the workflow. We developed a macro-driven Excel file to maintain and manipulate our schedules. Over time, we’ve developed better ways to gather the data to change our process metrics times as the work changes or as we add new species or tasks.

**10. Balancing Cage Husbandry Duties amongst Animal Technicians**

Author: : **Jason Jorgenson**, Ethan Hildebrand, Steve Niemi, Office of Animal Resources, Harvard University Faculty of Arts and Sciences, Cambridge MA; Rupesh Patel, Allentown, Inc., Allentown NJ; jorgenson@mcb.harvard.edu

Abstract: Our program assigns animal care technicians to combinations of specific rodent housing rooms to encourage familiarity with animal model peculiarities and investigators’ needs in those rooms. Assignments are by supervisors made based largely on cage census data with the intent to spread the load fairly between husbandry staff so each technician is responsible for the same approximate number of cages; assignments are reviewed along with census figures and adjusted as needed. But feedback from technicians indicated that some felt certain rooms involved more work than others, regardless of the number of cages in those rooms. For example, a room housing many diabetic rodents with polyuria requires more spot changes than usual. Similarly, a room that loses 5 cages while gaining 5 cages has a smaller workload than a room that consistently loses 100 cages while gaining another 100 per week. In response to these concerns and seeking better ways to ensure balanced and fair assignments, our RFID cage census platform was engaged to detect and quantify higher versus lower degrees of cage “churn”, i.e., the number of cages that leave versus appear in a given week, even while the total number of cages may remain relatively constant. Another benefit of documenting room churn rates could be to inform operations support (cage wash) more accurately as to how many soiled cages will need processing and how many new setups are needed per room. Thus, a data gathering project was initiated in the WiCom Development (“Dev”) environment (versus the Production or “Prod” environment) to scan rooms with installed antennae every two hours starting at 5:00 am and ending at 5:00 pm (seven scans/day) to detect cage comings and goings. Dev census data were collected over a three-week period and will be presented with conclusion and discussion.

**11. Optimizing Mouse Cage Change Intervals Using Continuous Home Cage Monitoring Systems.**

Author: **John J Hasenau** DVM, DACLAM , Principal , Lab Animal Consultants; labanimalconsultants@charter.net

Abstract: With varying rodent cage populations and the inherent nature of having different cage functions (holding , breeding and testing), monitoring and management methods; to optimize individual cage change outs have not been practical or efficient. Even with consistent populations there has been significant individual variability in cage changes, while there are abundant resource allocations that are associated with each cage change. Standard rodent cage changing intervals have historically been based on set maximum time intervals or visual SOP limits (percentage of soiled bedding) established by the institution. Manual systems of tracking cage change outs and cage soiling acceptance levels have required large resource input on a daily basis. Introduction of continuous automated home cage monitoring systems has allowed opportunities to re-evaluate cage change intervals by individual cage, with the potentials to decrease cage disruptions and improve animal welfare study impacts while conserving resources (staff, utilities and expendables). In this discussion we will look at the use of extremely low Electromagnetic Field (EMF) evaluations of automated home cage monitoring and the predictability of cage change intervals. Data collected from institutions utilizing a similar continuous automated home cage monitoring system (EMF based) will be presented. The initial learning component phase of the systems, as well as, the continuous machine learning phases will be emphasized . Data outputs from these facilities with realized reductions in cage change outs will be shown. Resource impact savings in areas of staff, utilities and expendables will also be detailed. In conclusion, we will review the application of automated continuous home cage monitoring for animal welfare/management and to establish predictable cage change intervals

**12. Analytic Decisions on Durable or Disposable Plastic Caging Systems**

Author: **Leopoldo Zauner**, Corporate Marketing Director, Tecniplast SPA, Italy, Leopoldo.Zauner@Tecniplast.it

Abstract: The following case study describes a decision making process to evaluate the impact of utilizing either a reusable  (Durable) or single use (Disposable) ventilated caging system in a new multi-species facility being constructed for the Mario Negri Institute for Pharmacological Research, located in Bergamo, Italy. The basis of the decision making process was the development and comparison of the following key performance indicators; economic sustainability, operational functionality and efficiency, and environmental impact. It was assumed there was no obvious difference in animal welfare between the two systems and so this was not considered in the evaluation. The facility has a capacity of 2000 mouse cages, which were the focus of the study. Facility operating protocols dictated the need for changing the complete cage with each cage change, the use of water bottles, and that bedding is added to cages onsite. It was determined a minimum amount of cage processing would be required to support other species and that all materials entering the facility would require chemical decontamination.The location of the facility limited the availability of options for recycling Disposable caging and local regulations requires the handling of caging as hazardous waste. Equipment, space, and operating costs for each system were developed into cash flow statements and an incremental cash flow comparison developed. A review of the operational impacts related to material handling flows, cage change operations, and biosecurity were conducted. An environmental assessment of each scenario was conducted using a Life Cycle Assessment (LCA) process conforming to ISO14040 and ISO14044. Economic indicators demonstrated short-term  gains with the use of Disposable caging due to reductions in initial capital costs. Higher long-term operational costs associated with Disposable caging reduced initial capital savings and in Year 4, the two systems were at a breakeven point with further cumulative losses in subsequent years. Operational impact analysis demonstrated no significant space savings or labor savings and additional operational complexities were associated with the frequent delivery and entry of materials to the facility. Results of the environmental impact analysis demonstrated Durable cages produced 50% of the carbon footprint over its entire useful life when compared with Disposable caging. With Durable caging scoring higher on all three key performance indicators it was concluded that Durable caging provided the best solution to the specific functional and operational characteristics of the new facility.

**13. Workforce Resourcing and Management: Hiring, Engagement and Retention Metrics Tracking**

Authors: **Gibbons, Clifford,** Peter Chelton, Laurie Ingram, Jason Fuller, Lori Palley and Donna Jarrell; Center for Comparative Medicine, Massachusetts General Hospital, Charlestown, MA; cgibbons1@mgh.harvard.edu

Abstract: Determining and ensuring the number of total FTEs needed for front-line animal care and researcher support requires: 1) A full understanding and validation of number of FTEs per facility; 2) Predicting and responding to anticipated attrition; and 3) Focusing efforts to fully train and retain the best employees. At CCM we collect data to help us meet these needs, we will share our metrics used to respond to attrition and employee retention efforts during this presentation. Currently, we monitor the lead time from when a candidate applies for a position to when we fill an open role with a trained FTE. We track the number of candidates required to interview; use predictive numbers to ensure we have enough candidates that will eventually accept employment offers; and then ensure they meet performance standards by tracking progress during on-boarding. Our ability to on-board new staff in an average of ~60 days helps us to maximize and standardize filling open positions. We also track the tenure of the employees and have hypothesized that we can extend this tenure by focusing on engaging employees in all aspects of the workplace as defined by the Gallup Survey on Employee Engagement. Early annual “Engagement Factor” metrics (to be shared) suggest that some human resource-based initiatives conducted over the past two years have increased the “Engagement Factor” for the front-line staff in a statistically significant way. It is yet to be determined how this will impact front-line staff tenure long term. However, it is hoped that tenures will increase as the engagement factor increases, supporting the theory that employees who feel engaged and valued express that through their loyalty to the organization.