

Evaluation of Cost Savings and Adherence to 3Rs With Exhaust Air Dust (EAD) Sampling for Colony Health Surveillance

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Introduction/Abstract

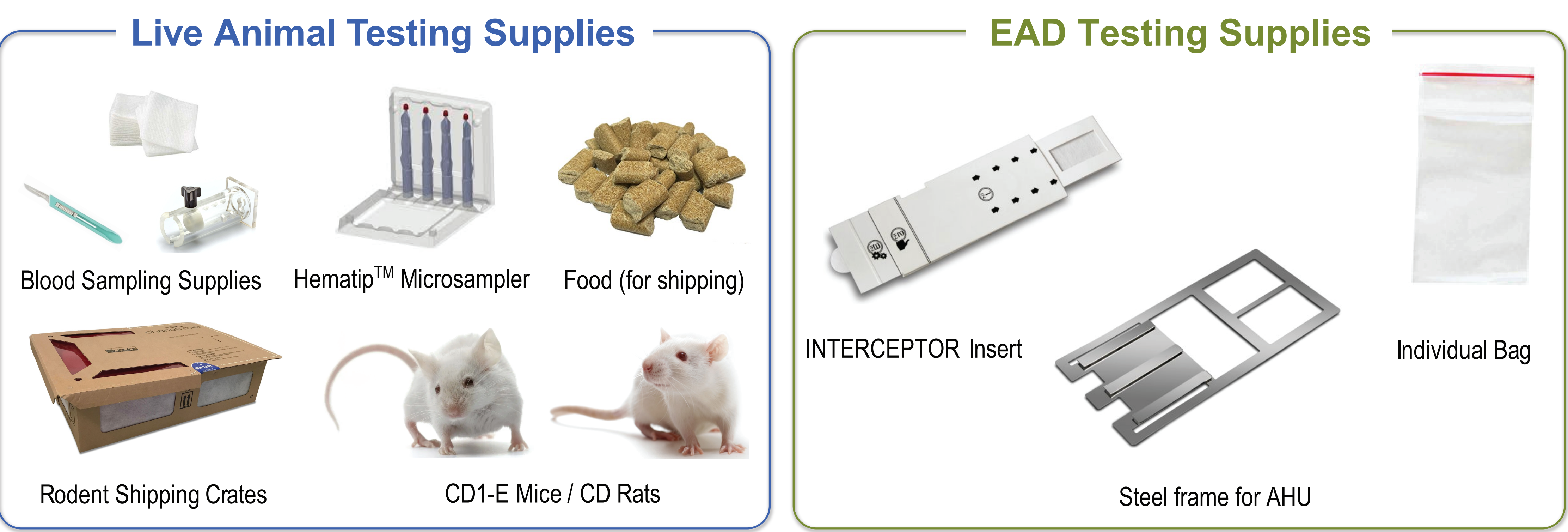
- In recent years, a new method of colony health surveillance has emerged to supplement or replace traditional live animal sentinel programs that use soiled bedding transfer. Exhaust air dust (EAD) monitoring involves sampling the exhaust prefilter of the air handling unit of individual ventilated caging (IVC) systems. The filters are then analyzed via polymerase chain reaction (PCR) testing to detect the presence of nucleic acids from commonly excluded rodent pathogens. This technology was deployed in a vivarium with the intent of replacing live sentinel animals for colony health surveillance. A 6-month pilot study was conducted to validate and compare the pathogen detection capability and cost-effectiveness of EAD surveillance technology to traditional live animal sentinel testing (including serology, PCR, and full body necropsy). Successful validation and cost savings of EAD monitoring would allow for the discontinuation of live animal sentinels used for colony health surveillance. EAD monitoring was found to be equally sensitive and specific with respect to pathogen-detecting capabilities when test panels were comparable. In addition, transitioning to EAD surveillance results in saving approximately 300 animals and \$20,000 annually in animals and material resources. In summary, the use of EAD technology appropriately monitors colony health, significantly champions the 3Rs initiative, and reduces labor and material resources for rodent colonies using IVC technology.

Animal Sentinels

- Sentinel animals (rats and mice) were ordered and housed two per cage; one sentinel cage per rack side.
 - CD1-E female mice: 22-28 days old, housed two per cage
 - CD female rats: 24-29 days old, housed two per cage
- Upon biweekly cage changes, a small amount of bedding from each cage on the respective rack side was donated into the new sentinel cage.
- Colony health was tested quarterly by shipping samples to Charles River Laboratories.

Exhaust Air Dust (EAD) Technology

- INTERCEPTOR filter inserts are placed in every active air handling unit (AHU) at the beginning of each quarter.
 - Room/rack ID and date the sampling began were recorded on each INTERCEPTOR
 - Colony health was tested quarterly by shipping samples to Charles River Laboratories for polymerase chain reaction (PCR) analysis.
- ### Room and Rack
- Rack air changes: 70-75 air changes per hour
 - Cage air speed: 0.05 meters per second
 - Tecniplast Blue Line individual ventilated caging (IVC) systems (most common in the facility).
 - Mouse cages: 542 cm²/84 in²
 - Rat cages: 800 cm²/124 in²
 - Tecniplast Green Line IVC caging systems used for larger, mature male rats.
 - 1862 cm²/288.61 in²



Experimental Design

- At the beginning of Q1 2019, INTERCEPTORs were placed in AHUs of animal housing rooms for mice and rats for a simultaneous comparison to rodent sentinels.
- On a quarterly basis, interceptors and rodent sentinels were sent out together for analysis.
- Tasks and total time for each method were tracked.

1st and 3rd Quarter Testing Process

Live Animal Sentinels	EAD Technology
<ul style="list-style-type: none">Gather all materials, documents, and tools neededCollect blood samples from each sentinel cage via tail tip using Hematips<ul style="list-style-type: none">Ear notch donor mouseRecord corresponding information on home cage and HematipShip samples to Charles River Laboratories for analysisIn the case of a positive result, blood sample from the 2nd mouse in sentinel cage will be sent out for analysis and confirmation	<ul style="list-style-type: none">Remove existing INTERCEPTOR from AHU<ul style="list-style-type: none">Individually bagged for shippingReplace with new INTERCEPTORShip INTERCEPTORs to Charles River Laboratories for analysis
Total Time Spent: 12 hours	Total Time Spent: 1-2 hours

2nd and 4th Quarter Testing Process

Live Animal Sentinels	EAD Technology
<ul style="list-style-type: none">Prepare shipping crates for live animal send-out<ul style="list-style-type: none">Food, hydrogel, enrichment, beddingUntested sentinel used for analysisAverage send-out: 60-65 animalsRecord corresponding information on shipping crate and home cageShip animals to Charles River Laboratories for analysisOrder new sentinel animal cohort and quarantined until confirmation of colony health<ul style="list-style-type: none">Once confirmed, remaining sentinels euthanized and replaced with new cohort	<ul style="list-style-type: none">Remove existing INTERCEPTOR from AHU<ul style="list-style-type: none">Individually bagged for shippingReplace with new INTERCEPTORShip INTERCEPTORs to Charles River Laboratories for analysis
Total Time Spent: 16-18 hours	Total Time Spent: 1-2 hours

Results

Cost Comparison of Representative Live Animal Sentinel Testing and Exhaust Air Dust Filter Testing With Comprehensive Surveillance Plus PRIA PCR Panel

Materials						
	Live Animal Sentinels	Amount (#)	Total Cost	EAD	Amount (#)	Total Cost
Initial supplies	n/a	n/a	\$0	Stainless steel frames: \$278 each	35	\$9,467
Semi-annual supplies	Mice and rats (\$14 each)	136 mice 18 rats	\$1904 (mice) \$275 (rats)	EAD filters (\$658/box)	4 boxes	\$2,634
	Hematips™	136	\$0 (complimentary)	n/a	n/a	\$0
	Shipping containers	~50	\$0 (complimentary)	n/a	n/a	\$0

Quarterly Testing (2019)

	Live Animal Sentinels	Amount (#)	Total Cost	EAD	Amount (#)	Total Cost
Mouse	Serology (Q3)	59	\$3,064	PRIA (Q3 & Q4)	21	\$8,772
	Whole body (Q4)	62	\$24,962			
Rat	Serology (Q3)	9	\$482	PRIA (Q3 & Q4)	5	\$1,924
	Whole body (Q4)	9	\$3,034			

Total Testing Costs*

	Live Animal Sentinels	EAD
Q3	\$5,708	\$12,013
Q4	\$27,996	\$12,013
Semi-annual	\$33,703	\$24,026

*Does not include cost of labor or steel frames for EAD

Savings

Animal #s savings	300 (annually)
Semi-annual cost savings	\$9,677
Annual cost savings	\$19,353

- Rodent restraint devices, blood collection materials (other than the Hematip™ microsamplers), shipping crates, and plastic bags were not included in the cost analysis of supplies. These materials are regularly on hand in the vivarium or were complimentary from the external diagnostic laboratory.
- Over a period of 6 months, without accounting for labor, the cost savings of performing the comprehensive Mouse and Rat Surveillance PRIA Plus panel testing on EAD filters when compared with the typical live animal sentinel testing panels is approximately \$9,700. This results in an annual cost savings of approximately \$20,000.
- When considering the initial cost of the steel frames, the cost savings for the 6-month period is reduced to \$210. However, the steel frames represent a one-time expense and will not require replacement unless the AHU model is altered. Thus, the cost savings for a year in which the program is implemented is approximately \$10,000.
- In addition to monetary savings, the animal savings per 6-month period is approximately 154 animals. Annually, this is a savings of approximately 300 animals. This has significant implications for the 3Rs initiative for which every animal research program strives.