

University of Missouri Veterinary Medical Diagnostic Laboratory (VMDL) Annual Report – 2021

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Summary

In 2021, the VMDL processed approximately 55,756 accessions and performed more than 162,000 laboratory tests, which represent a 6.8% and a 9.3% annual increase in accessions and laboratory tests, respectively. The VMDL provided diagnostic service to veterinarians and owners from 102 MO counties/independent cities and 43 US states and Canadian provinces. In 2021, the VMDL retained NAHLN Level 1 Lab and FDA Vet-LRN Tier 1 Lab status.

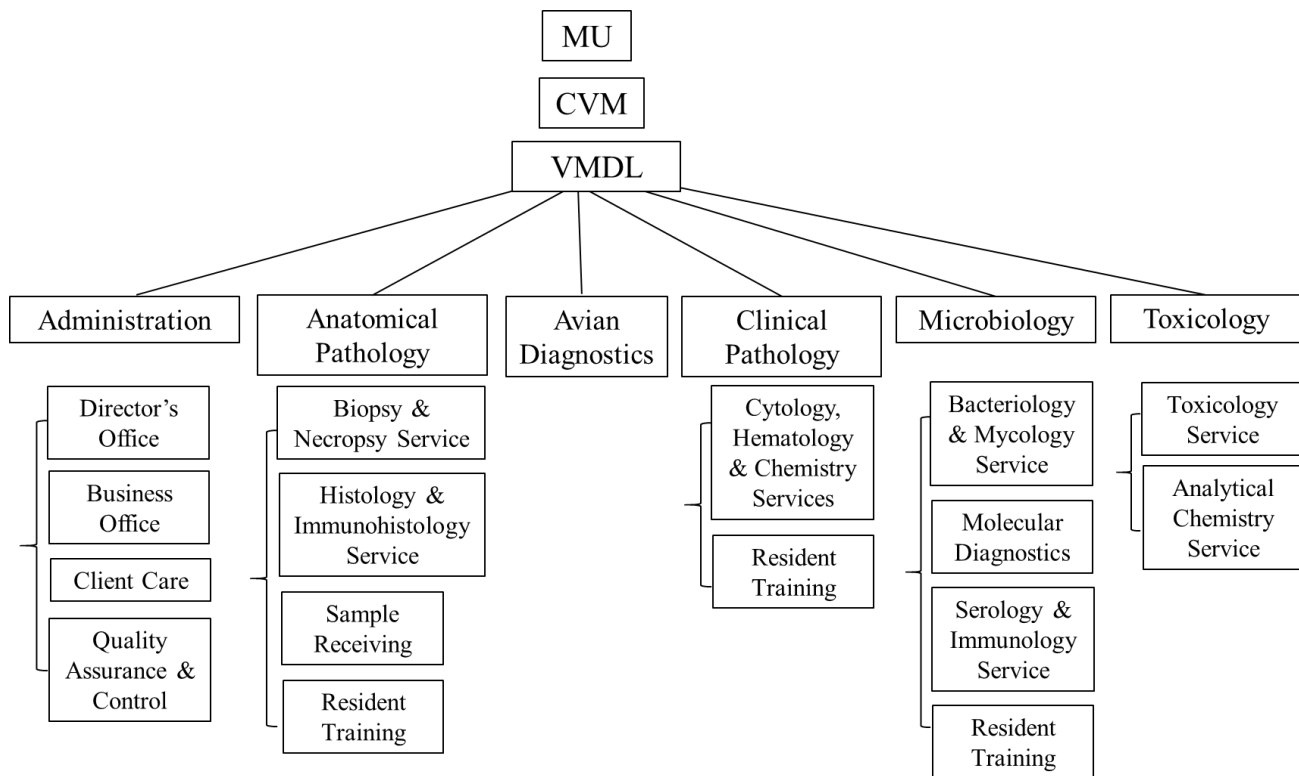
The faculty taught (or co-taught) 37 DVM, graduate and undergraduate courses and 20 clinical/diagnostic rounds. The faculty led and participated in 29 funded research projects, including 16 new or active and 13 completed projects. The faculty and staff published 24 peer-reviewed research and diagnostic papers, submitted an additional 7 papers, and presented 13 conference posters and oral presentations. The faculty and staff actively participated in extension and outreach events and diversity, equity, and inclusion programs. In addition, the faculty and staff provided leadership service to many national and state organizations and programs, attended international, national, and state conferences and trainings.

Introduction

The University of Missouri Veterinary Medical Diagnostic Laboratory (VMDL) is one of two clinical units in the College of Veterinary Medicine. The VMDL is Missouri’s only full-service diagnostic lab for all animal species and is also the only lab in the state accredited by the American Association of Veterinary Laboratory Diagnosticians (AAVLD). The faculty and staff are committed to excellence in diagnostic service, teaching, and research. The VMDL provides relevant, timely, and cost-effective diagnostic services to its clients and maintains a positive learning environment for the students.

The 2021 VMDL Annual Report outlines the major diagnostic, teaching, research, and organizational service activities. To track diagnostic caseload for professional DVM education and better service to the state of Missouri, 5-year data are presented. Owing to the recent improvement on data mining method, the diagnostic data for years 2017 to 2020 are more accurate and slightly different than those included in previous annual reports.

VMDL Organizational Structure



Anatomical Pathology – Dr. Gayle Johnson

Avian Diagnostics – Dr. Dan Shaw/Dr. Jeff Mitchell

Business Office – Mr. Kirk Thompson

Client Service/Sample Receiving – Dr. Lauren Delaney

Clinical Pathology – Dr. Angela Royal/ Ms. Cheryl Rojas

Director's Office – Ms. Rachel Newton

Histology/Immunohistochemistry – Dr. Dae-Young Kim/Ms. Candace Kassel

Microbiology – Dr. Tamara Gull/Mr. Jesse Bowman

Molecular Diagnostics – Dr. Solomon (Wole) Odemuyiwa/Ms. Debra Sharpe

Quality Assurance – Mr. Eric Mathis/Mr. Brian Nodine

Serology/Immunology – Dr. Michael Zhang

Toxicology/Analytical Chemistry – Dr. Tim Evans/Dr. Xiangwei Du

VMDL Client Outreach Programs

Online Portal is available for clients to check results and charges in real-time.

FedEx Billable Stamps enables inexpensive next day delivery

Columbia area sample courier service is available

After-hours sample drop-off (a refrigerator is available at the VHC Small Animal Emergency Clinic)

VMDL attendance at regional VMA meetings

External Advisory Board

Mission Statement

To advise VMDL management on policies, development strategies, services, and collaborations with pertinent private, state, national and international organizations

Advisory Board Membership

The Advisory Board consists of 11 members representing Missouri Department of Agriculture, Missouri Department of Conservation, commodity groups, private practice, animal health industry, and the University of Missouri Veterinary Health Center.

Advisory Board Members

Steve Strubberg, DVM, Missouri State Veterinarian

Terry Gosch, DVM, USDA Area Veterinarian in Charge

Sherri Russell, DVM, Missouri Wildlife Veterinarian

Clark Fobian, DVM, Sedalia, MO, Past President AVMA

Bruce Addison, MS, President, Addison Biological Laboratory, Inc.

Tony Martin, DVM, Director of Animal Health Division, MFA, Inc.

Don Nikodim, Executive Vice President, Missouri Pork Association

Chuck Massengill, DVM, Missouri Cattlemen’s Association

Joan Coates, DVM, MS, DACVIM-Neurology, MU VHC Interim Director

John Middleton, DVM, PhD, ACVIM MU VHC Food Animal Service

Philip Johnson, BVSc, MS, MRCVS, ACVIM, MU VHC Equine Service

Diagnostic Service Activities

Table 1. Five Year VMDL (Main Lab and Clinical Pathology) Accessions*

Year	Total Accessions	Main Lab	Clin Path	Source (%) and Type			
				VHC/Main Lab (%)	VHC/Clin Path (%)	VHC/Total (%)	Non- VHC/Total (%)
2017	45,680	25,598	20,082	3,879 (15.15%)	19,170 (95.46%)	23,049 (50.45%)	22,631 (49.55%)
2018	48,560	27,741	20,819	4,160 (15.00%)	20,046 (96.29%)	24,206 (49.85%)	24,354 (50.15%)
2019	51,830	27,142	24,688	4353 (16.04%)	23,954 (97.03%)	28,307 (54.62%)	23,523 (45.39%)
2020	52,214	27,189	25,025	4,264 (15.68%)	23,768 (94.98%)	28,032 (53.69%)	24,182 (46.31%)
2021	55,756	29,015	26,741	4,340 (17.59)	26,043 (97.39%)	30,383 (54.59%)	25,373 (45.51%)

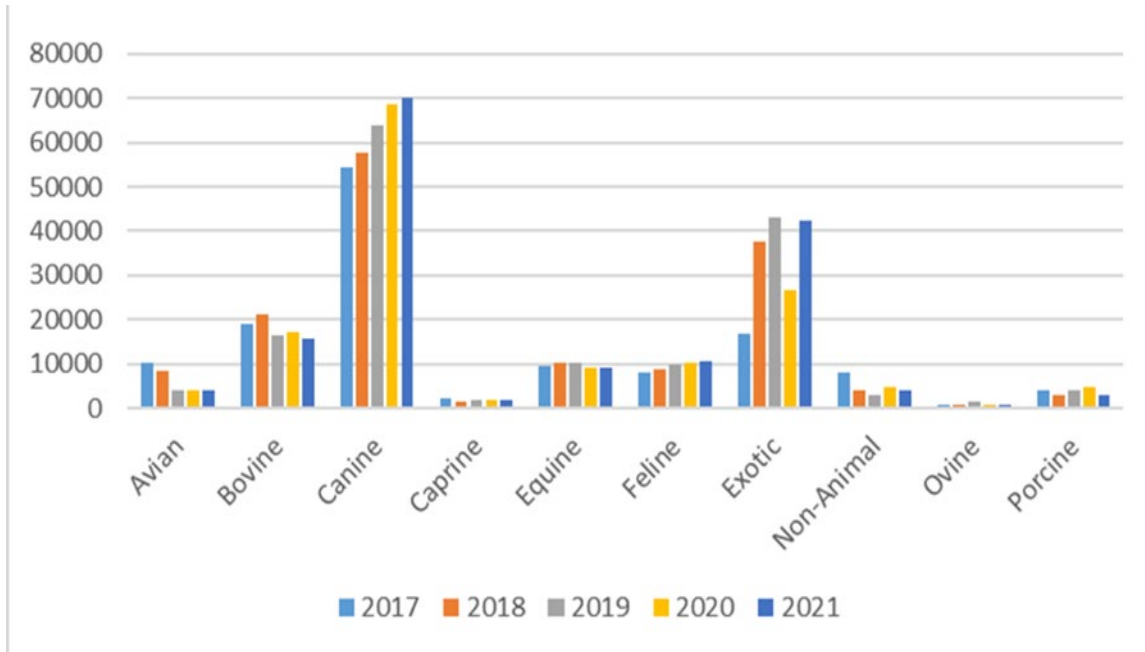
*A Main Lab accession may include multiple samples whereas each Clinical Pathology accession represents one test performed on one sample. VHC cases accounted for approximately 18% and 97% of main lab and clinical pathology accessions, respectively. From 2020 to 2021, total accessions increased 6.8%.

Table 2. Five Year VMDL (Main Lab and Clin Path) Tests by Animal Species

Year	Avian	Bovine	Canine	Caprine	Equine	Feline	Exotic /Wild	Non- Animal	Ovine	Porcine	Total
2017	10,327	19,126	54,401	22,86	9,391	8,205	16,861	8,191	718	4,147	133,653
2018	8,493	21,086	57,719	1,448	10,224	8,896	37,461	4,229	701	2,868	15,3125
2019	4,136	16,590	64,001	1,967	10,234	9,918	42,994	2,919	1,399	3,877	158,035
2020	4,164	17,029	68,744	1,835	9,191	10,347	26,541	4,672	838	4,887	148,248

2021 4,228 15,798 70,261 1,690 9,161 10,666 42,247 4,118 784 3,069 162,022

Figure 1. Distribution of Diagnostic Tests by Animal Species



Year	Avian Dx.	Ana Path	Histo/IHC	Clin Path	Bacti /Myc.	Mol. Dx.	Serology /Immuno	Tox/Ana Chem	Total (% Change)
2017	5,415	12,157	40,537	28,249	16,727	10,911	21,634	5,421	141,051 (N/A)
2018	4,411	12,882	40,376	29,126	15,246	9,872	38,515	3,890	154,318 (9.41%)
2019	1,604	12,934	42,373	31,797	13,761	8,548	46,646	3,335	160,998 (4.33%)
2020	1,822	13,051	45,270	35,206	13,720	7,717	27,539	3,222	147,547 (-8.35%)
2021	1,586	15,294	44,227	37,151	13,625	8,537	43,364	2,787	166,571 (10.16%)

Table 3. Five Year VMDL (Main Lab and Clin Path) Tests by Section

Table 4. Distribution of VMDL Accessions in 102 MO Counties/Independent City

County	Accession #	County	Accession #	County	Accession #
Boone	35,538	Buchanan	140	Cedar	45
Saint Louis	1,502	Pettis	132	Ste. Genevieve	44
Saint Charles	846	Oregon	124	Platte	43
Greene	823	Cooper	122	Linn	40
Jackson	683	Howard	122	Bollinger	34
Cole	679	Lawrence	112	Carroll	32
Callaway	642	Miller	107	Montgomery	32
Franklin	530	Texas	107	Lewis	31
Christian	458	Saline	102	Dallas	29
Johnson	442	Polk	100	Stoddard	29
Jefferson	418	Pulaski	100	Atchison	24
Not Specified	389	Putnam	100	Clay	21
Cape Girardeau	345	Shelby	99	Dent	21
St. Louis City	316	Scott	94	Benton	19
Webster	266	Taney	94	Mississippi	17
Phelps	260	Macon	89	Maries	15
Camden	258	Pike	89	Perry	15
Butler	249	Nodaway	83	Chariton	11
St. Francois	211	Caldwell	73	Barton	10
Jasper	207	Grundy	71	Sullivan	9
Randolph	207	Knox	68	Andrew	7
Newton	206	Audrain	64	Shannon	7
Cass	200	Laclede	61	Clark	6
Marion	199	Wright	61	Scotland	5
Gasconade	198	Osage	58	Dade	4
Lafayette	195	Bates	56	Harrison	4
McDonald	195	Crawford	56	Dekalb	3
Lincoln	192	Dunklin	56	Gentry	3
Livingston	192	Vernon	52	Clinton	2
Monroe	192	Henry	51	Ozark	2
Howell	183	Warren	51	Ripley	2
Ray	177	Madison	49	Douglas	1
Barry	153	Adair	47	Mercer	1
Moniteau	149	Morgan	46	Stone	1

Table 5. Distribution of VMDL Accessions Outside Missouri

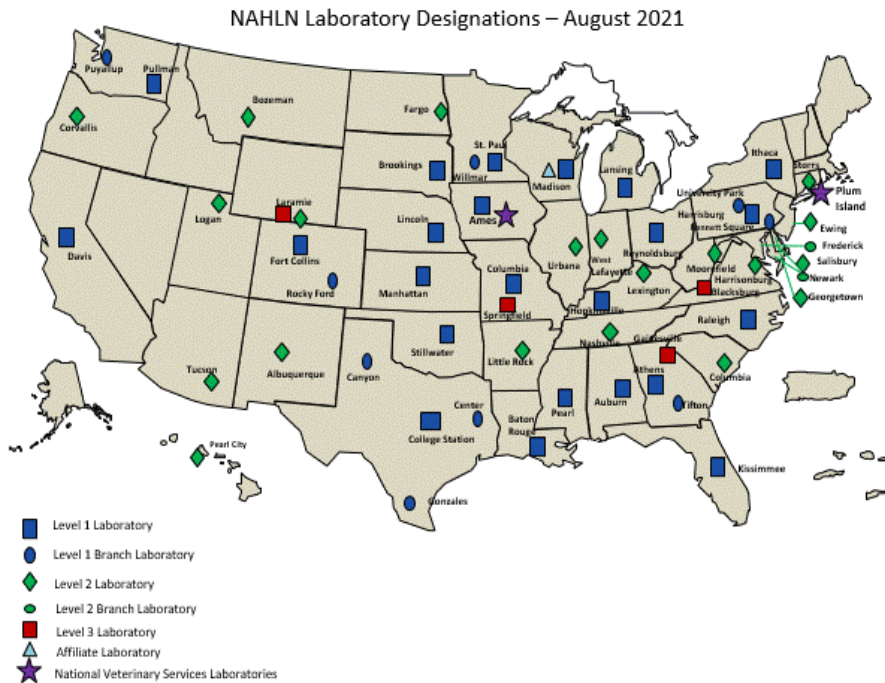
State	Accession #	State	Accession #	State	Accession #
Illinois	1,045	Arizona	28	New Mexico	4
Arkansas	927	Pennsylvania	28	Georgia	3
Oklahoma	521	Manitoba	24	Maine	3
Florida	448	Massachusetts	24	Wyoming	3
N. Carolina	378	New Jersey	24	Alaska	2
Kansas	233	Texas	19	Ontario	2
California	185	South Carolina	18	Oregon	2
Iowa	104	Nebraska	14	Michigan	1
Minnesota	95	Delaware	13	Hawaii	1
Colorado	87	Alabama	12	Nevada	1
New York	73	Washington	10	North Dakota	1
Montana	50	Tennessee	9	Ohio	1
Indiana	41	Kentucky	6	Rhode Island	1
Virginia	40	Wisconsin	6	Utah	1
Michigan	36	Florida	5	Vermont	1
S. Dakota	30	Connecticut	4	West Virginia	1
Puerto Rico	29	Maryland	4		

Table 6. External Proficiency Tests

Bacteriology/Mycology	Molecular Diagnostics
Contagious Equine Metritis Culture	African Swine Fever rPCR
<i>Listeria</i> and <i>Salmonella</i> in Raw Dog Food	Classical Swine Fever Virus rRT-PCR
<i>Salmonella</i> Group D Culture and Serology	Foot-and-Mouth Disease Virus rRT-PCR
Clinical Pathology	Mycoplasma gallisepticum PCR
Chemistry-Routine	Mycoplasma synoviae PCR
Hematology	Swine Influenza Virus rRT-PCR
Microscopy	SARS-CoV-2 rRT-PCR
Urinalysis	Serology/Immunology
Foreign Animal Disease Data Transmission	Bluetongue ELISA
APMV/vNDV Electronic Messaging	Bovine Leukemia Virus ELISA
ASF Electronic Messaging	Brucellosis Serology
CSF Electronic Messaging	Chronic Wasting Disease ELISA
FMD Electronic Messaging	Equine Infectious Anemia ELISA
IAV-A Electronic Messaging	Johne's ELISA
IAV-S Electronic Messaging	Pseudorabies Virus gB & gI ELISA
Pseudorabies Electronic Messaging	Toxicology
Molecular Diagnostics	Aflatoxin in Feedstuffs HPLC
Avian Influenza Virus rRT-PCR	Aflatoxin M1 in Tissues HPLC
Avian Paramyxovirus -1/END Virus rRT-PCR	Deoxynivalenol in Feedstuffs HPLC
	Fumonisin in Feedstuffs HPLC

VMDL Participation in National Programs

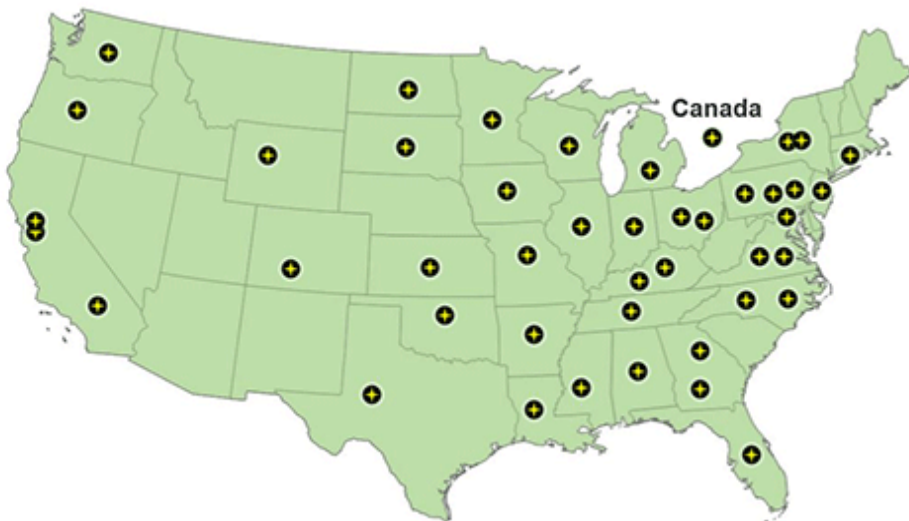
Figure 3. Level I Lab of National Animal Health Laboratory Network (NAHLN)



Please refer to lab list for testing capabilities.

August 24, 2021

Figure 4. Tier I Member of FDA Veterinary Laboratory Investigation and Response Network (Vet-LIRN)



Teaching Activities

Didactic and Laboratory Courses (N = 37; Bold: Coordinated by VMDL Faculty)

AS 140/2140	Companion Animals
AS 325/4977	Horse Production
BioMed 3200	Comparative Hematology
BioMED 3310	Biomedical Pathophysiology Online
BioMed 4100	Veterinary Clinical Chemistry, Online
BioMed 4110/V_PBIO 7110	Veterinary Cytology
BioMED 4120	Principles of Toxicology Online (Undergraduate Level)
LAB_AN 9437	Lab Animal Pathology
MMI 8050	Mechanisms of Microbial Pathogenesis
P_Health 8150	Human Health and the Environment
V_BSCI 5507	Veterinary Pharmacology
V_BSCI 5508	Veterinary Pharmacology
V_BSCI 5509	Veterinary Toxicology
V_M_S 6400	Food Animal Medicine & Surgery I
V_M_S 6420	Equine Medicine and Surgery I
V_M_S 6987	Problem-Based Learning Clinic Preparation
V_M_S 6996	Advanced Dermatology
V_M_S 8036	Advanced Physiology of Dog and Cat
V_M_S 8401	Topics in Veterinary Clinical Sciences
V_M_S 8402	Seminar in Veterinary Clinical Sciences
V_M_S 8402 B	Seminar in Veterinary Clinical Sciences
V_M_S 8402 D	Clinicopathologic Case Conference (CPC)
V_M_S 8415	Advanced Veterinary Neurology
V_M_S 8485	Problems in Veterinary Clinical Science
V_PBIO 5552	Veterinary Bacteriology 1
V_PBIO 5553	Veterinary Bacteriology 2
V_PBIO 5554	Veterinary Virology
V_PBIO 5575	General Veterinary Pathology
V_PBIO 5576	Veterinary Systemic and Special Pathology I
V_PBIO 5577	Veterinary Systemic and Special Pathology II
V_PBIO 5578	Veterinary Clinical Pathology

V_PBIO 6647	Diagnostic Pathology and Special Species Medicine I
V_PBIO 6679	Diagnostic Pathology and Special Species Medicine II
V_PBIO 7120	Principles of Toxicology Online (Graduate Level)
V_PBIO 8434	Advanced Clinical Pathology
V_PBIO 8435	Advanced Microscopy in Veterinary Clinical Pathology
V_PBIO 9090	Area Veterinary Pathobiology Dissertation Research

Clinical and Diagnostic Rounds and Seminars (N = 20)

Chemistry Rounds
Comparative Orthopaedic Laboratory (COL) journal club
Cytology Rounds
Dermatology Rounds
Equine Journal Club
Food for Thought Rounds
Food Animal/ Equine Clinical Case Rounds
Food Animal Journal Club
Gross Pathology Rounds
Hematology Rounds
Human Health and the Environment
Image Review
Joint Pathology Center Wednesday Slide Conference
Mentoring International Students
Mentoring Pre-Vet Students (Including Pre-Vet Scholars)
Mentoring Veterinary Professional Students at VET Orientation for VM-1s
Neurology Rounds
Ophthalmic Pathology Rounds
Slide Treats
VMDL-Food Animal Monthly Rounds

Residency Training Programs

Anatomical Pathology
Clinical Pathology
Clinical and Diagnostic
Microbiology

Scholarly Activities

New and Active Grants

1. Kemin Industries

Investigators: Bailey (PI), **Du X (Co-PI)**

Duration: 06/01/2021 – 03/31/2022.

Title: Use of mycotoxin binders in beef cattle diets containing ergot-like alkaloids

Award: \$81,259, Amount for MU VMDL: \$1,000.

2. FDA Vet-LIRN U18FD007511

Investigators: **Du X (PI), Evans T (Co-PI)**

Duration: 09/06/2021 – 08/31/2022.

Title: Enhancing food contaminant surveillance capacity using ultra-performance liquid chromatography with UV/fluorescence detection

Award: \$173,000

3. DHHS/NIH 1R01HD092254-01A1

Investigators: Lucy MC (PI), **Evans TJ (Co-I, 2.5% shared credit), Gull T (Co-I, 2.5% Shared credit)**

Duration: 08/15/18 – 04/20/23

Title: Uterine microbiome: Functional significance in establishing the uterine program postpartum

Award: \$1,597,127 (2021: \$321,625).

4. Purdue University

Investigator: **Evans T (PI)**

Duration: 08/01/2021 – 07/31/2022

Title: See Us-Be Us: Inspiring future veterinarians using a Veterinary STEM Ecosystem

Award: \$1,500

5. NIFA/USDA

Investigators: Adkins P (PI), **Evans T (Co-PI, 30% Shared credit)**

Duration: 09/01/2020 – 08/31/2023

Title: Show-Me VET ECHO: Veterinary Education and Training (VET) through Extension for Community Healthcare Outcomes (ECHO) Program

Award: \$238,228

6. Kemin Industries

Duration: 06/01/2021 – 03/31/2022

Investigators: Bailey E, **Evans T (Co-PI, 20% shared credit)**

Title: Use of Mycotoxin Binders in Beef Cattle Diets Containing Ergot-like Alkaloids

Award: \$69,725

7. ACVS Surgeon-in-training Research Grant

Investigators: Byer B, Skinner O, **Gull T (Co-I)**, Mickelson M (PI)

Duration: 4/1/21 – 9/30/22

Title: Effect of subcutaneous lavage on bacterial contamination in dogs and cats undergoing gastrointestinal surgery.

Award: \$12,555

8. MU CVM Phi Zeta Grant

Investigator: **Ierardi R (PI)**, Raghavan R (Mentor)

Duration: 12/1/2021 – 11/30/2022

Title: A cross-sectional study to determine prevalence, geographic distribution, and herd-level risk factors of bovine anaplasmosis in Missouri beef cattle.

Award: \$200 gift card plus additional funds to help pay publication fees (up to \$1,000) or travel costs to attend a scientific meeting (up to \$500)

9. CHILDRENS MERCY HOSPITAL

Investigators: Middleton J (PI), **Kim DY (Co-I, 15% shared credit)**

Duration: 03/15/2018 – 12/31/2022

Title: Fetal Lamb Tracheal Occlusion

Award: \$327,843

10. NIH OFFICE OF THE DIRECTOR

Investigators: Wells KD (PI), Prather R (Co-PI), Green J (Co-I), Safranski T (Co-I), Schnabel R (Co-I), **Kim DY (Co-I, 5% shared credit)**

Duration: 06/01/2019 – 05/31/2024

Title: Swine Somatic Cell Genome Editing Center

Award: \$8,631,151 (2021: \$133,557)

11. Missouri Department of Conservation 450Zhang

Investigators: **Zhang S (PI)**, **Zhang M (Co-PI)**, Almasri M (Co-PI).

Duration: 01/01/2020 – 02/28/2023

Title: Development and Application of MEMS-based Biosensor and RT-QulC Assay for the Detection of Chronic Wasting Disease Prion in Anti- and Post-Mortem Cervid Samples.

Award: Total \$657,011 (2021: \$187,068)

12. FDA Vet-LIRN NIH 1U18FD006670-03

Investigators: **Zhang S (PI)**, **Evans T (Co-PI)**, **Johnson GC (Co-PI)**, **Gull T (Co-PI)**, **Shen Z (Co-PI)**, **Odemuyiwa S (Co-PI)**

Duration: 06/01/2021 – 05/31/2022

Title: FDA Vet-LIRN Site - Tier I Lab Renewal

Award: \$46,549 (Direct: \$34,999)

13. USDA 2021-37624-35453

Project Director: **Zhang, S**

Duration: 08/08/2021 – 07/31/2022

Title: NAHLN Level 1 Lab - Maintaining and Further Improving Capacity and Capabilities

Award: \$250,000 (Direct: \$227,273)

14. USDA AP21VSD&B000C129

Project Director: **Zhang S**

Duration: 09/01/2021 – 08/31/2023

Title: NAHLN Level Infrastructure II

Award: \$281,200 (Direct: \$255,635)

15. USDA-APHIS/MDNR

Investigator: **Zhang S.**

Duration: 2021 – 2022

Title: A multicenter validation of RT-QuIC assay for sensitive detection of Chronic Wasting Award:
\$35,000 (Direct: \$31,818)

16. USDA AP21VSD&B000C028

Investigator: **Zhang, S**

Duration: 03/01/2020 – 02/28/2023

Title: Validation of ASR1 Peptoids-ELISA for the Detection of Chronic Wasting Disease Prion in Samples
with Low Prion Burden

Award: \$116,323 (Direct: \$105,740)

Completed Grants

1. ACVIM Resident Research Grant

Investigators: Walker K (PI), **Gull T (Co-I)**

Duration: 07/01/19 – 06/30/21

Title: Bacterial culture and susceptibility of septic foot lesions of adult bovine originating from cow-calf
operations.

Award: \$9,285.

2. Phi Zeta Resident Grant

Investigators: McCurdy K, **Gull T (Faculty Mentor)** and McCracken M.

Duration: 12/1/2020 – 11/30/2021

Title: Effect of Intra-articular Morphine on the Antimicrobial Activity of Amikacin in Equine Synovial
Fluid.

Award: \$1,000

3. USDA Animal Health Formula Funds

Investigators: **Gull T (PI)**, **Kittana H**, Calcutt M and **Odemuyiwa S.**

Duration: 10/1/2020 – 9/30/2021

Title: Multi-locus sequence typing of divergent Mannheimia isolates and molecular and serological
detection of leukotoxin from cases with and without disease

Award: \$8,000

4. ABK BIOMEDICAL INC.

Investigators: Bryan J (PI) and **Kim DY (Co-I, 20% shared credit)**

Duration: 08/01/2020 – 02/02/2021

Title: Evaluation of Eye90™ Radioembolic Microspheres radiopacity and delivery in healthy rabbits.

Award: \$28,398.00.

5. ABK Biomedical Inc.

Investigators: Bryan J (PI), **Kim DY (Co-I, 20%)**, Lattimer J (Co-I), Maitz C (Co-I), Schlink S (Co-I).

Duration: 2020 – 2021.

Title: Evaluation of Eye90™ Radioembolic Microspheres radiopacity and delivery in healthy rabbits.

Award: \$48,659.

6. DEPT. OF DEFENSE W81XWH1810430

Investigators: Stannard JP (PI), **Kuroki K (Co-I, 2% shared credit, 5% FTE)**

Duration: 01/09/18 – 08/31/21

Title: A biologic joint replacement strategy to treat patients with post-traumatic osteoarthritis – Expansion.

Award: \$1,989,044 (Direct \$1,302,402)

7. NIH/NIAMS/Columbia University R01AR071316

Investigators: Lee CH (PI), Cook JL (Consortium PI), **Kuroki K (Co-I, 5% shared credit, 2% FTE)**

Duration: 09/06/17 – 06/30/21

Title: Seamless healing of avascular meniscus tears by stem cell recruitment.

Award: Total \$2,970,249, MU award \$1,121,817 (\$752,298 direct)

8. NIH/NIAMS/Columbia University R01AR068133

Investigators: Hung C (PI), Cook JL Consortium PI, **Kuroki K (Co-I, 20% shared credit, 5% FTE)**

Duration: 06/01/16 – 05/31/21

Title: Incorporation of dexamethasone delivery with engineered cartilage.

Award: \$406,820 (Direct \$265,029)

9. USDA/UGA AP20VSD&B00c018

Investigator: **Shen Z (PI)**

Duration: 03/01/2020 – 02/28/2021

Title: United front to develop harmonized NGS training and procedures to increase the capabilities and capacity of NAHLN laboratories in response to antimicrobial resistance (AMR). Award: \$81,311 (Direct: \$73,919, Indirect: \$7,392).

10. FDA Vet-LIRN 1U18FD006670-01.

Investigators: **Zhang S (PI), Evans T (Co-PI), Johnson GC (Co-PI), Gull T (Co-PI), Zhang MZ (Co-PI), Odemuyiwa S (Co-PI)**.

Duration: 06/10/2020 – 05/31/2021

Title: Maintaining FDA Vet-LIRN Tier I Lab.

Award: \$39,900 (Direct: \$30,000).

11. USDA/APHIS AP20VSD&B000C082

Project Director: **Zhang S**

Duration: 9/1/2020 – 08/31/2021

Title: Maintaining NAHLN Level I Member Lab. US Department of Agriculture.

Award: \$295,000 (Direct: \$265,500)

12. FDA Vet-LIRN/KSU 1U18FD006990-01

Investigators: **Zhang S (PI), Gull T (Co-PI).**

Duration: 9/15/2020 – 8/31/2021

Title: Prototype reporting and veterinarian and animal owner educational materials for cases of antimicrobial resistant bacteria of public health importance in companion animals.

Award: \$7,500

13. USDA/APHIS AP20VSD&B000C017

Investigator: **Zhang S (PI)**

Duration: 03/01/2020 – 02/28/2021

Title: Enhancing Testing Capacity in Biosafety Level-3 Laboratory for Improved Detection of and Response to Foreign Animal Diseases. USDA.

Award: \$104,108 (Direct: \$9,369.7, Indirect: \$10,411).

Peer Reviewed Publications

Published

1. Bae H, Kim J, Chun D, Jung D-I, Park J, **Kim DY**, Yu D. Idiopathic ulcerative dermatitis in a cat with feline infectious peritonitis. *Vet Med and Sci* 2021; 7:572-576. <http://dx.doi.org/10.1002/vms3.396>
2. Bellrichard M, Snider C, **Kuroki K**, Brockman J, Grant DA, Grant SA. The use of gold nanoparticles in improving ACL graft performance in an ovine model. *J Biomater Appl* 2021 Sep 2;8853282211039179. doi: 10.1177/08853282211039179. Online ahead of print.
3. Dhital R, **Shen Z, Zhang S**, Mustapha A. Detection of virulence and ESBL genes in Salmonella by multiplex high-resolution melt-curve real-time PCR assay. *J Appl Microbiol* 2021; Doi:10.1111/jam.15334
4. **Hancock TS**, Karaffa K. Obligated to keep things under control?: Sociocultural barriers to seeking mental health services among veterinary medical students. *J Vet Med Educ* 2021; 48(6). doi: 10.3138/jvme-2021-0069
5. **Havis BM**, Walker KE, Adkins P, **Shen Z**, Middleton JR, **Gull T**, Nagy D, **Kim DY**. Systemic coccidioidomycosis in a llama cria native to Missouri. *J Vet Diagn Invest* 2021; 33: 587-590. Doi: 10.1177/1040638721994615

6. Kang, H., Bienzle, D., Lee, G.K.C., Piche, E., Viel, L., **Odemuyiwa, S.O.**, Beeler-Marfisi, J., 2021. Flow cytometric analysis of equine bronchoalveolar lavage fluid cells in horses with and without severe equine asthma. *Veterinary Pathology* 2022; 59: 91 - 99.
7. **Kim DY, Zinn MM, Odemuyiwa SO, Mitchell WJ Jr, Johnson GC.** Myocarditis caused by naturally acquired canine distemper virus infection in 4 dogs. *J Vet Diagn Invest* 2021; 33(1):167-169. doi: 10.1177/1040638720971828.
8. **Kuroki K**, Williams N, Cook JL. Histologic evidence for a humoral immune response in synovitis associated with cranial cruciate ligament disease in dogs. *Vet Surg* 2021; 50:1032-41.
9. LePage EC, Stoker AM, **Kuroki K**, Cook JL. Effects of cyclic compression on intervertebral disc metabolism using a whole-organ rat tail model. *J Orthop Res* 2021;39:1945-54.
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In Press and Submitted

1. Burbick CR, Alexander TL, Wolking R, **Gull T**, Ceric O and Reimschuessel R. Non-carbapenemase producing carbapenem-resistant *Klebsiella pneumoniae* isolated from the urinary tract of a dog. *Canadian Vet J* 2021: Submitted.
2. **De New KM**, Coates JR, Millman Z, **Kim DY**, Hong H-P, **Royal AB**. What is your diagnosis? Spinal mass in a young dog. *Vet Clin Path* 2022; In Press
3. **Gull T**. Bacterial causes of intestinal disease in dairy calves: acceptable control measures. *Clin N Am Food Animal Pract* 2022; In press.

4. **Ierardi RA**, Anderson MN, Bryan JN, Matheson JS, Sample SH, Coates JR. Epidural myelolipoma in a Silken Windhound. *Vet Clin Path* 2022; In Press.
5. **Ierardi RA, Delaney RE, Gull T, Havis BM, Hinds CA, Johnson GC, Kim DY, Kuroki K, Mammone RM, Mitchell WJ, Rivero LA, Uzal FA, Valerio CM, Zinn MM.** Bacillary hemoglobinuria in Missouri beef cattle with *Fascioloides magna*. The 64th AAVLD Annual Meeting, October 21-27, 2021. Denver, CO.
6. Kovarik C, **Hancock TS.** A student-created video impacts learning outcomes and professional development. *J Vet Med Educ* 2021; Submitted.
7. Townsend KS, Johnson PJ, LaCarrubba AM, Leach SB, **Zinn MM, Kim DY, Johnson GC.** Vegetative Endocarditis affecting the Tricuspid Valve of a Quarter Horse mare. *J Am Vet Med Assoc* 2022; In Press
8. Waltenburg M, Shugart A, Loy JD, Tewari D, **Zhang S**, Cole S, Burbick C, Burklund A, Byrne B, Diaz-Campos D, **Gull T**, LeCuyer T, Mani R, Mitchell M, Mohan S, Paul N, Sanchez S, Walters M and Nichols M. A survey of current activities and technologies used to detect carbapenem resistance in bacteria isolated from companion animals at veterinary diagnostic laboratories—United States, *J Clin Microbiol* 2022; In press.

Scientific Presentations

1. **Bowman JW, Gull T, Ulmanis EG, Shen Z, Odemuyiwa SO.** The mitochondrial genome of a novel oomycete cultured from a mass on the tail of a domestic cat. The 64th AAVLD Annual Meeting, October 21-27, 2021. Denver, CO.
2. **Ierardi RA.** Retrospective evaluation of *Anaplasma marginale* seroprevalence among Missouri cattle submitted to a veterinary diagnostic laboratory, 2010-2019. VET ECHO December 14, 2021.
3. **Ierardi RA, Delaney L, Gull T, Havis BM, Hinds CA, Johnson GC, Kim DY, Kuroki K, Mammone RM, Mitchell WJ, Rivero LA, Uzal FA, Valerio CM, Zinn MM.** Bacillary hemoglobinuria in Missouri beef cattle with *Fascioloides magna*. The 64th AAVLD Annual Meeting, October 21-27, 2021. Denver, CO.
4. Johnson G, **Odemuyiwa SO**, and Levine, C. Zooanthroponotic transmission of human herpesvirus type 1 to two different species of pet monkeys in one household. The 2021 ACVIM Annual Meeting (Virtual), June 9-12, 2021.
5. Puga K, Adkins PRF, Rivero L, **Zhang S.** Disease prevalence among beef cows submitted for necropsy to a veterinary diagnostics laboratory. MU CVM Research Day, April 23, 2021, Columbia, MO.
6. Rivero LA, Adkins PRF, **Zhang S.** Disease prevalence among neonatal beef calves submitted for necropsy to a veterinary diagnostic laboratory. The 2021 ACVIM Annual Meeting (Virtual), June 9-12, 2021.
7. Rivero LA, Adkins PRF, **Zhang S.** Disease prevalence among neonatal beef calves submitted for necropsy to a veterinary diagnostic laboratory. MU CVM Research Day, April 23, 2021, Columbia, MO

8. **Shen Z**, Wang L, Ma W, **Zhang S**. Detection of Mammalian Orthoreovirus from Clinical Samples with Metagenomic Sequencing Using MiSeq. The 64th AAVLD Annual Meeting, October 21-27, 2021. Denver, CO.
9. Topka, J and **Odemuyiwa SO**. Modulation of chicken macrophage function by microbial catabolites of tryptophan. VRSP Boehringer Ingelheim-NIH Symposium August 4 – 6, 2021
10. **Warang A, Shen Z, Zhang M, Odemuyiwa S, Zhang S**. Comparison of column extraction and Kingfisher Flex automated extraction for DNA extraction from Gram positive bacteria. The 64th AAVLD Annual Meeting, October 21-27, 2021. Denver, CO.
11. **Williams III F**. Animal Abortion. MVMA Convention (Virtual), January 2021.
12. **Williams III F**. Ruminant Abortions (Invited Talk), Penn State Spring Symposium, June 8, 2021
13. **Zhang S**. An overview of top zoonotic diseases in the US (Invited Talk). MU SOM, April 14, 2021

Extension/Outreach/Engagement Presentations

1. **Delaney L**. Under the Scope – VMDL Quarterly Newsletter
2. **Ierardi R** and **Delaney L**. Diagnostic Lab Report to Academy of Veterinary Consultants (AVC)
3. **Ierardi R**. Diagnostic Pathology of Bacillary Hemoglobinuria & Related Conditions. MU Extension CVM Update, virtual meeting, 5/4/2021
4. **William III F**. Pathology of Birds for the Avian Club, 9/29/2021
5. **Williams III F**. What Pathologists Do! For the Pre-vet club, 11/3/2021

Diversity, Equity, and Inclusion Activities

Williams III F. Introduction of veterinary medicine to students in local elementary schools so that the underserved children get to learn about veterinary medicine as a career choice.

Williams III F. A member of the League of Veta-Humanz (a human being with superpowers who protects animal and public health; synonym: veterinarian). This program is supported by the Science Education Partnership Award (SEPA) program of the National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health (NIH). <https://vet.purdue.edu/vetahumanz/vetahumanz/dr-fred-williams-iii/>

William III F. Faculty advisor for VOICE (Veterinary As One Inclusive Community), a student-run organization that seeks to increase awareness, respect, and sensitivity to differences among all individuals and communities in the field of veterinary medicine.

Williams III F. Presentation: Black voices in pathology panel for the C. L. Davis Pathology Foundation, 1/8/2021

Williams III F. Presentation to the VOICE Club: Diversity and my journey as a pathologist, 3/24/2021

Zhang S. Creation of AAVLD DEI Committee

National and State Leadership Activities

1. **Evans T**. AAVLD Committee on Environment Chair

2. **Evans T.** ABVT Student Award Committee and Education Committee member
3. **Gull T.** ACVIM Examination Committee Chair, ACVIM/ACVPM Consensus Statement Contributor
4. **Gull T.** ACVM Examination Committee and Biosecurity Committee
5. **Gull T.** CLSI (Vet09) Revision Working Group
6. **Royal A.** Member of ACVP Certifying Exam Assembly and Administration Group (Clinical Pathology).
7. **Zhang S.** AAVLD President, Bacteriology/Mycology/Antimicrobial Subcommittees, Quality Assurance Committee, Government Relations Committee, Strategic Planning Committee, and Workforce Development Committee.
8. **Zhang S.** Missouri Biosecurity Working Group
9. **Zhang S.** Missouri Council on Captive Wild and Exotic Animals.

Major Annual Professional Meetings and Trainings

1. American Association of Veterinary Laboratory Diagnosticians (AAVLD) Annual Meeting
 2. AAVLD Accreditation Auditor Training
 3. American College of Veterinary Internal Medicine (ACVIM) Annual Meeting
 4. American College of Veterinary Microbiologists (ACVM) Annual Meeting
 5. Combined Annual Meetings of the American College of Veterinary Pathologists (ACVP) and American Society for Veterinary Clinical Pathology (ASVCP)
 6. American Veterinary Medical Association (AVMA) Annual Meeting
 7. Conference for Research Workers in Animal Diseases (CRWAD) Annual Meeting
 8. Midwest Association of Veterinary Pathologists Annual Meeting
 9. Missouri Veterinary Medical Association (MVMA) Annual Meeting and District Meetings
 10. Missouri Biosecurity Working Group Quarterly Meetings
 11. Missouri Captive Wild Animal Health Meetings
 12. NAHLN Preparedness Weekly Conference
 13. USAHA/AAVLD Government Relations Meeting
 14. Veterinary Laboratory Investigation and Response Network Monthly Conference
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