

UNIVERSITY OF MISSOURI VETERINARY MEDICAL DIAGNOSTIC LABORATORY ANNUAL REPORT – 2022

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Summary

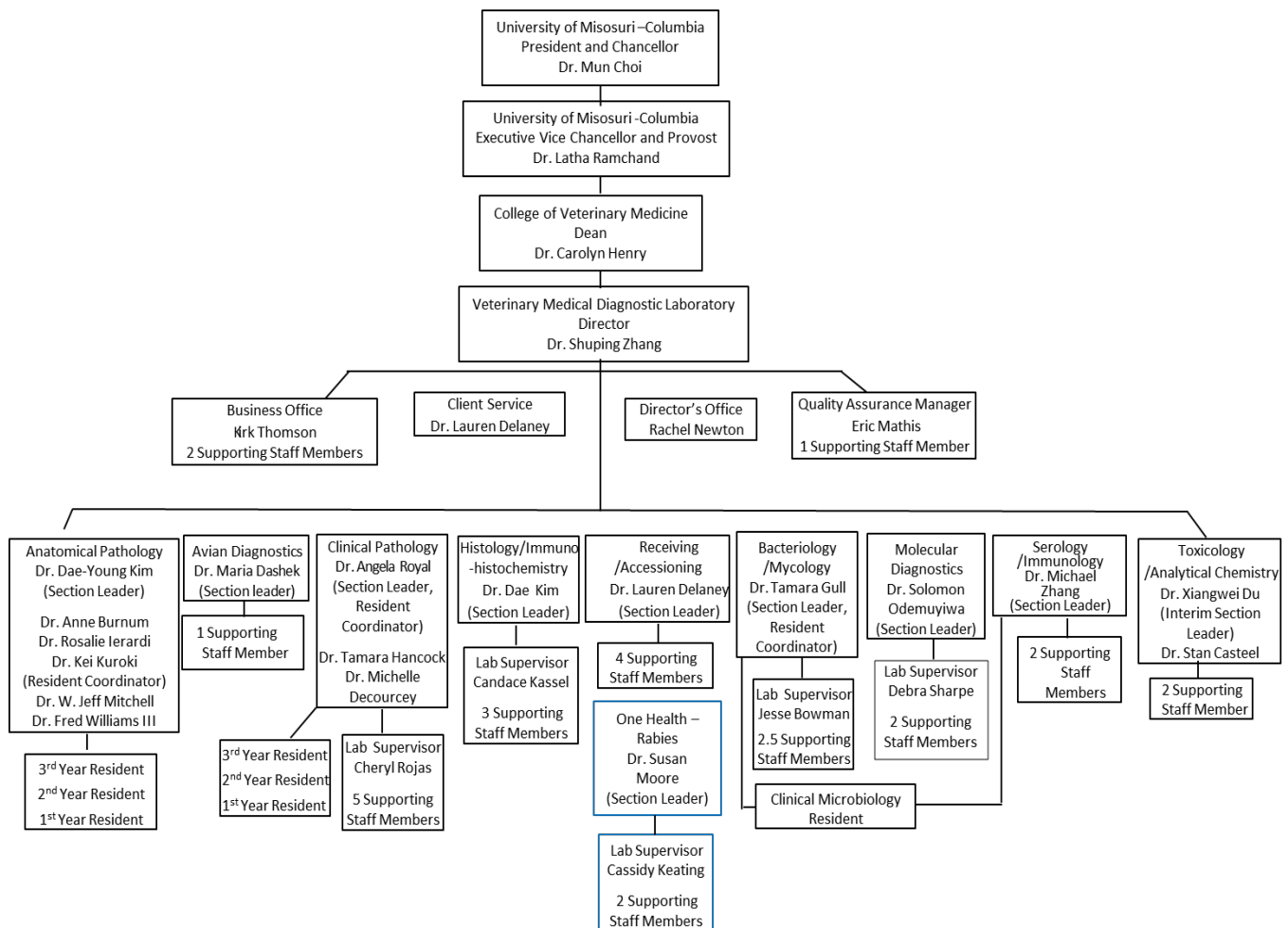
In 2022, the VMDL provided diagnostic service to veterinarians and owners from 111 MO counties/independent cities and 48 US states and Canadian provinces. The VMDL achieved another 5-year (2023 – 2027) AAVLD full accreditation and retained NAHLN Level 1 and FDA Vet-LRN Tier 1 lab status, as well as NPIP and USDA EIA testing lab status. The VMDL processed approximately 58,566 accessions and performed more than 175,000 laboratory tests, which represent annual increases of 5.25% and 8.55% in accessions and laboratory tests, respectively.

The faculty taught (or co-taught) 37 DVM graduate and undergraduate courses and 20 clinical/diagnostic rounds. The faculty led and participated in 18 actively and newly funded and research projects. The faculty and staff published 30 peer-reviewed research and diagnostic papers, submitted an additional 9 papers, and presented 25 conference posters and oral presentations. The faculty and staff also actively participated in extension and outreach events, as well as diversity, equity, and inclusion programs. In addition, the faculty and staff provided leadership service to many international, national, state, and local organizations and programs and attended pertinent international, national, and state conferences and trainings.

Introduction

The 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 VMDL is also a Level 1 lab of the USDA National Animal Health Laboratory Network (NAHLN) and Tier I lab of the FDA Veterinary Laboratory Investigation and Response Network (Vet-LIRN). 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 2022 VMDL Annual Report outlines the major diagnostic, teaching, research, and university service activities. To track diagnostic caseload for professional DVM education and better service to the state of Missouri, 5-year data are presented. The diagnostic data for years 2018 to 2021 are slightly different but more accurate than those included in previous annual reports.

VMDL Organizational Structure



VMDL Client Outreach Programs

Client outreach at the VMDL is designed to facilitate client access to the laboratory's services. An online portal is available for clients to check results and charges in real-time. A partnership with FedEx Billable Stamps enables inexpensive next day delivery of samples. A courier service within the Columbia area is available through the VMDL for convenient transport of samples. Samples may be dropped off after-hours and securely stored at the VHC Small Animal Emergency Clinic until the next business day. VMDL personnel maintain attendance at district 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 the Missouri Department of Agriculture, the 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
 Cody Lewis, DVM, Howard County Veterinary Service
 Gerelyn Henry, DVM, MBA, DACVP, MU VHC Director
 Joan Coates, DVM, MS, DACVIM-Neurology, MU VHC Interim Director
 Austin Hinds, DVM, MS, DACVIM-LA, MU VHC Food Animal Medicine
 Philip Johnson, BVSc, MS, MRCVS, DACVIM-LA, DECEIM, MU VHC Equine Service

Diagnostic Service Activities

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

Year	Total Access.	Main Lab	Clin** Path	VHC/Main Lab (%)	VHC/Clin Path (%)	VHC/ VMDL (%)	Outside/ VMDL (%)
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	4,353 (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%)
2022	58,681	30,796	27,885	4,091 (13.28%)	27,419 (98.33%)	31,510 (53.70%)	27,171 (46.30%)

*A Main Lab accession may include samples for various tests whereas most Clinical Pathology accessions include a single sample. **Accessions involving both the main lab and clin path are included in the main lab count. Cases (including research cases) from VHC accounted for approximately 13% and 98% of main lab and clinical pathology accessions, respectively. From 2021 to 2022, total accessions increased 5.25%.

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

Year	Total	Avian	Bovine	Canine	Caprine /Ovine	Cervid/ Exotic	Equine	Feline	Porcine	Non-Animal
2018	153,125	8,493	21,086	57,719	2,149	37,461	10,224	8,896	2,868	4,229
2019	158,035	4,136	16,590	64,001	3,366	42,994	10,234	9,918	3,877	2,919
2020	148,248	4,164	17,029	68,744	2,673	26,541	9,191	10,347	4,887	4,672
2021	162,022	4,228	15,798	70,261	2,474	42,247	9,161	10,666	3,069	4,118
2022	175,866	10,408	16,153	76,029	2,780	44,619	9,852	11,325	3,898	802

* From 2021 to 2022, the total testing numbers increased 8.55%.

Figure 1. Distribution of Diagnostic Tests by Animal Species

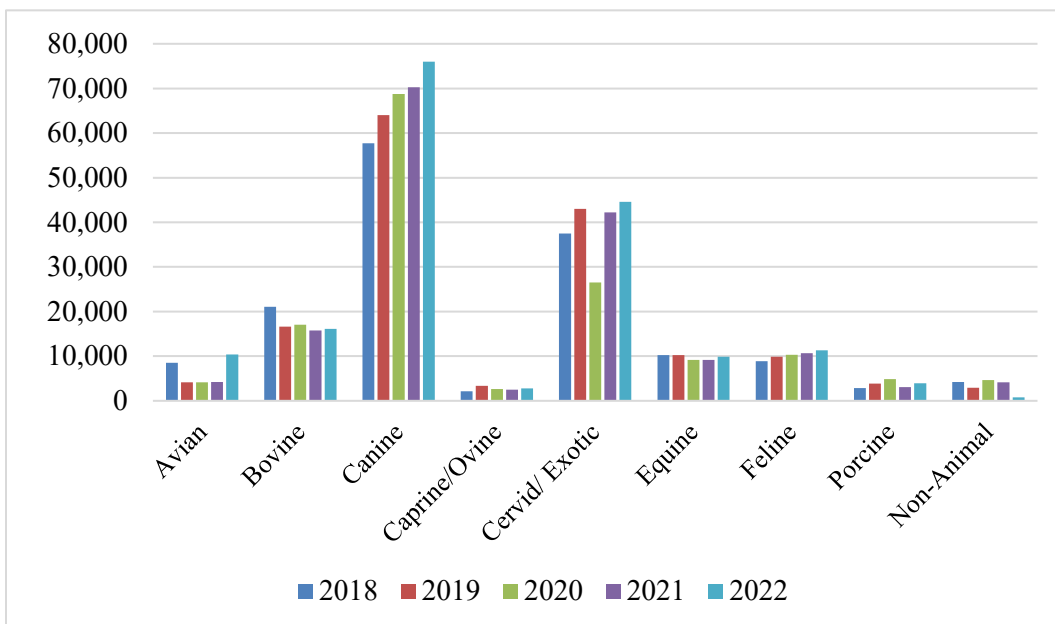


Table 3. Five Year VMDL Testing Numbers by Section

Year	Total	Change %	Avian	Ana Path	Histo/ IHC	Clin Path	Micro	Mol/ Vir	Sero/ Immuno	Tox	Other
2018	154,318	9.41	4,411	12,882	40,376	29,126	15,246	9,872	38,515	3,890	
2019	160,998	4.33	1,604	12,934	42,373	31,797	13,761	8,548	46,646	3,335	
2020	147,547	-8.35	1,822	13,051	45,270	35,206	13,720	7,717	27,539	3,222	
2021	166,571	12.89	1,586	15,294	44,227	37,151	13,625	8,537	43,364	2,787	
2022	175,866	8.55	1,530	13,223	46,319	39,341	13,993	15,239	44,176	1,067	978
5-Year Total											
Change (%)		14.85									

Table 4. Distribution of VMDL Accessions in 111 MO Counties/Independent City

County	Acc. #	County	Acc. #	County	Acc. #	County	Acc. #
Boone	27,858	Monroe	168	Macon	61	Perry	16
Boone	9,275	Livingston	165	Dunklin	57	Knox	15
St. Louis	1,557	Lafayette	157	Dent	56	Benton	14
St. Charles	1,107	Barry	154	Vernon	51	Warren	12
Greene	854	St. Francois	154	Caldwell	50	Shannon	8
Jackson	844	Buchanan	145	Adair	49	Dekalb	7
Cole	688	Ray	142	Madison	46	Mississippi	7
Johnson	598	Polk	139	Audrain	43	Andrew	6
Franklin	557	Miller	138	Linn	42	Sullivan	6
Not Specified	538	Pike	134	Lewis	41	Washington	6
Moniteau	488	Phelps	132	Laclede	40	Audrain	5
Christian	472	Howard	129	Henry	38	Chariton	5
Callaway	471	Putnam	129	Platte	38	Dade	4
Cape Girardeau	360	Pettis	128	Wright	38	Daviess	3
						Not	
Randolph	355	Lawrence	114	Cedar	37	Specified	2
Saint Louis				Sainte			
City	290	Pulaski	108	Genevieve	34	Clinton	2
Jefferson	282	Oregon	104	Clay	32	Ozark	2
Butler	281	Scott	99	Dallas	32	Schuyler	2
Marion	240	Saline	98	Montgomery	32	Cooper	1
Newton	234	Nodaway	97	Morgan	32	Douglas	1
Camden	229	Texas	95	Stoddard	30	Gentry	1
Gasconade	228	Cooper	88	Maries	26	Howard	1

Cass	226	Grundy	87	Saint Clair	25	Mercer	1
Webster	224	Osage	85	Atchison	22	Ralls	1
Jasper	214	Bates	81	Bollinger	22	Randolph	1
Howell	211	Taney	80	Carroll	20	St. Charles	1
McDonald	202	Shelby	69	Clark	18	Wayne	1
Lincoln	172	Crawford	61	Barton	17	Worth	1

Table 5. Distribution of VMDL Accessions in 48 Non-Missouri States

State	Acc. #	State	Acc. #	State	Acc. #
Illinois	1,032	Pennsylvania	34	Virginia	5
Arkansas	965	South Carolina	33	Wyoming	5
Florida	400	Tennessee	26	Georgia	3
Kansas	394	New Jersey	21	Nevada	3
North Carolina	352	Arizona	20	Ohio	3
Oklahoma	312	Massachusetts	19	Michigan	2
Colorado	307	Indiana	18	British Columbia	2
Michigan	298	Manitoba	18	Idaho	2
California	169	Maine	15	Alaska	1
Washington	122	Alabama	10	Connecticut	1
Iowa	101	Texas	10	Hawaii	1
Minnesota	81	Nebraska	8	Mississippi	1
New York	62	Maryland	6	New Mexico	1
Montana	53	Wisconsin	6	Ontario	1
Puerto Rico	36	Louisiana	5	Oregon	1
South Dakota	36	North Dakota	5	West Virginia	1

Table 6. External Proficiency Tests

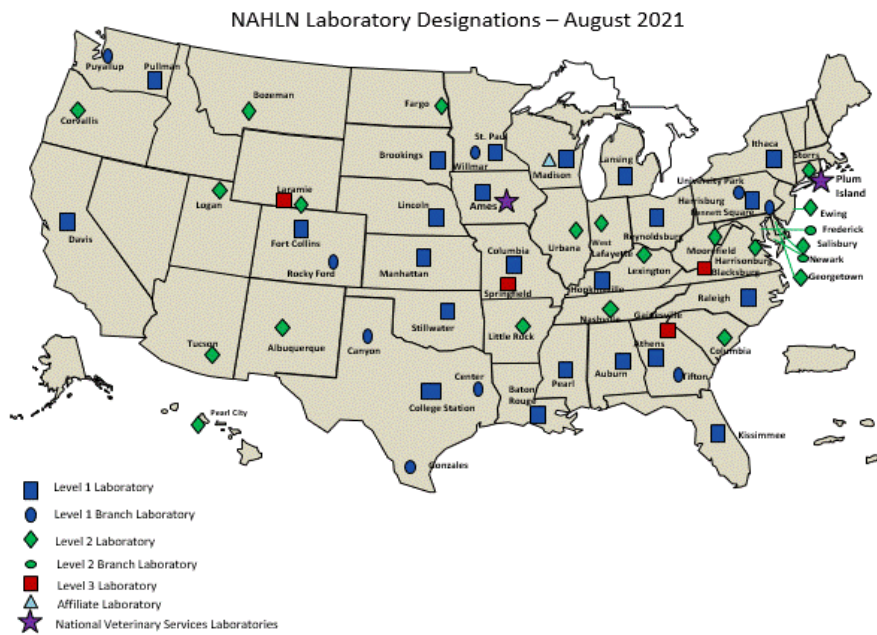
Bacteriology/Mycology	Molecular Diagnostics
Contagious Equine Metritis Culture	African Swine Fever rPCR
<i>Listeria</i> and <i>Salmonella</i> in Raw Dog Food	Classical Swine Fever Virus rRT-PCR
<i>Salmonella</i> Group D Culture and Serology	Foot-and-Mouth Disease Virus rRT-PCR
Clinical Pathology	<i>Mycoplasma gallisepticum</i> PCR
Chemistry-Routine	<i>Mycoplasma synoviae</i> 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
 IAV-S Electronic Messaging
 Pseudorabies Electronic Messaging
Molecular Diagnostics
 Avian Influenza Virus rRT-PCR
 Avian Paramyxovirus -1/END Virus rRT-PCR

Johne's ELISA
 Pseudorabies Virus gB & gI ELISA
Toxicology/Analytical Chemistry
 Aflatoxin in Feedstuffs HPLC
 Aflatoxin M1 in Tissues HPLC
 Copper in Liver ICP
 Deoxynivalenol in Feedstuffs HPLC

VMDL Participation in National Programs

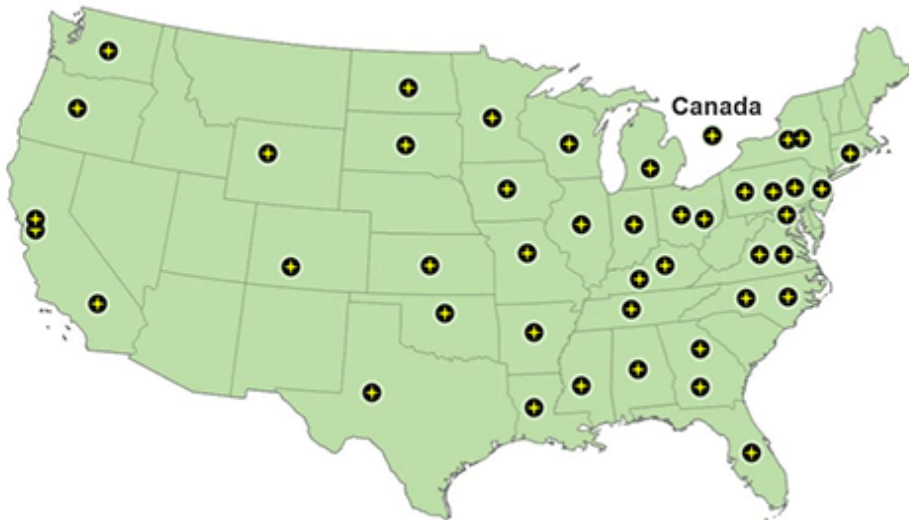
1. **National Poultry Improvement Plan (NPIP)**
2. **USDA EIA Testing lab**
3. **Level I Lab of the USDA National Animal Health Laboratory Network (NAHLN)**



Please refer to lab list for testing capabilities.

August 24, 2021

4. **Tier I Lab 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_P BIO 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 (Bacteriology, Immunology and Virology)

Scholarly Activities

New and Active Grants

1. Bryan J (PI), **Kuroki K (Co-I, 50% shared credit)**; Edge Animal Health. Analysis of renal biopsies by University of Missouri, College of Veterinary Medicine; 10-01-2022 to 09-30-2023; Total: \$15,317
2. **Du X (PI), Evans T (Co-PI), Zhang S (Co-I)**; FDA Vet-LIRN U18FD007511; Enhancing Food Contaminant Surveillance Capacity using Ultra-Performance Liquid Chromatography with UV/Fluorescence Detection; 09-06-2021 to 08/31/2023; Total: \$224,277 (Direct: \$149,356)
3. **Gull T (PI)**. MU CVM COR Grant. Anaerobic chamber for research and diagnostic use. Jan 2022. Total: \$38,140 (CVM: \$18,140 and VMDL matching: \$20,000)
4. Hung C (PI) (Cook JL Consortium PI), **Kuroki K (Co-I, 20% shared credit)**; Columbia University- NIH/NIAMS (R01AR068133); Incorporation of Dexamethasone Delivery with Engineered Cartilage; 05-16-16 to 04-30-22; Total: \$951,813 (\$272,210 in 2021-2022)
5. **Ierardi RA (PI)**, Raghavan R (Co-PI), **Zhang S (Co-PI)**; USDA Formula Fund. Prevalence estimation of *Anaplasma marginale*, agent of bovine anaplasmosis, among the American dog tick (*Dermacentor variabilis*) on beef cattle pastures in Missouri; 09-01-2022 to 08-31-2023; Total: \$9,990
6. Lucy MC, **Evans T (Co-I, 2.5% shared credit)**, **Gull T (Co-I, 2.5% shared credit)**. DHHS/NIH 1R01HD092254-01A1. Uterine microbiome: Functional significance in establishing the uterine program postpartum. 08/15/18-04/20/23; Total: \$1,597,127
7. Mickelson M (PI), Byer B, Skinner O, **Gull T (Co-I)**. ACVS Surgeon-in-training Research Grant. 4/1/21to 9/30/22; Total: \$12,555
8. **Shen Z (PI), Odemuyiwa S (Co-PI), Zhang S (Co-PI)**; NIH/FDA 1U18FD007720-01 Development of Metagenomic RNA-Seq Standard Operating Procedure for Variant-agnostic Whole Genome Sequencing of SARS-CoV-2 isolates from Animal Samples; 09-01-2022 to 08-31-2023; Total: \$97,564 (Direct: \$74,977)
9. Wells K (PI), **Kim D (Co-I, 5% shared credit)**; LATC Collaborative Project 2: Swine Somatic Cell Genome Editing (SCGE) Center; Total: \$ 66,108



10. Wells K (PI), **Kim D (Co-I, 5% shared credit)**; NIH OFFICE OF THE DIRECTOR Swine Somatic Cell Genome Editing Center - Year 4; Total: \$ 198,944.00
11. **Zhang S (Kay Personnel, 5% Credit; PI: Almasri M)**; NSF Convergence Accelerator Track J: Rapid detection technologies and decision-support systems to mitigate food supply chain threats; 11-15-2022 to 11-30-2023 Total: \$750,000 (Direct: \$521,337)
12. **Zhang S (PD)**; USDA 022-37624-38175; NAHLN Level 1 Lab - Maintaining and Further Improving Capacity and Capabilities; 08-01-2022 to 07-31-2023; Total: \$250,000 (Direct: \$234,000)
13. **Zhang S (PD)**; USDA-APHIS-AP21VSD&B000C129. NAHLN Level - Maintaining and Further Improving Capacity and Capabilities - II. 09-01-2021 to 08-31-2023; Total: \$281,200 (Direct: \$255,635)
14. **Zhang S (PI), Odemuyiwa S (Co-PI), Gull T (Co-PI), Shen Z (Co-PI)**; NIH 5U18FD006670-04. FDA Vet-LIRN Site - Tier I Lab Renewal; 06-01-2022 to 05-31-2023; Total: \$39,900 (Direct: \$30,000)
15. **Zhang S (PI), Zhang M (Co-PI), Almasri M (Co-PI)**; Missouri Department of Conservation #450; Development and Application of MEMS-based Biosensor and RT-QuIC Assay for the Detection of Chronic Wasting Disease Prion in Anti- and Post-Mortem Cervid Samples; 03-01-2020 to 12-01-2024; Total: \$979,825 (Direct: \$881,842.5)
16. **Zhang S (PI)**; Michigan Department of Natural Resources-USDA-APHIS; A Multicenter Validation of RT-QuIC Assay for Sensitive Detection of Chronic Wasting Disease; 09-01-2021 to 08-30-2023; Total: \$35,000 (Direct: \$31,818)
17. **Zhang S (PI)**; USDA-AP21VSD&B000C028. Validation of ASR1 Peptoids-ELISA for the Detection of Chronic Wasting Disease Prion in Samples with Low Prion Burden; 03-01-2021 to 02-28-2023; Total: \$116,323 (Direct: \$105,740)
18. **Zhang S. (PD)**; APHIS/Oklahoma State University; Increasing capacity to handle surge samples through online submissions and elimination of the sample data entry step in the laboratory; 01-02-2022 to 08-31-2023; Total: \$ 41,968 (Direct: \$38,125)

Peer Reviewed Publications

Published

1. Alvarez Narvaez S, **Shen Z**, Yan L, Stenger BL, Goodman LB, Lim A, Nissly RH, Nair MS, **Zhang S**, Sanchez S. Optimized conditions for *Listeria*, *Salmonella* and *Escherichia* whole genome sequencing using the Illumina iSeq100 platform with point-and-click bioinformatic analysis. Plos one. 2022;17(11): e0277659. doi:<https://doi.org/10.1371/journal.pone.0277659>
2. Aronson RK, Conway DS, Pumphrey SA, Almela RM, Powers A, **Burnum A**, de Oliveira Conrado F. Pathology in practice. J Am Vet Med Assoc 2022; 261(1):1-4. doi: <https://doi.org/10.2460/javma.22.06.0269>

3. Bae H, Yoon JS, Choi E, Kim SH, Jung DI, Park J, Kim SK, **Kim DY**, Yu D. (2022). A case of leukaemia cutis in a dog with T-cell chronic lymphocytic leukaemia. *Vet Med Sci.* 2022;8(3):947-952. doi: 10.1002/vms3.749
4. Bailey E, Meng K, Brake D, **Du X**, Zeltwanger J. Prescribed burning of endophyte-infected tall fescue plots: effects on forage production, ergot-like alkaloid concentrations, and botanical composition. *Appl. Anim. Sci.*, 2022, doi.org/10.15232/aas.2022-02324
5. 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* 2022; 36:1076-86
6. 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*, 63(7):740-744, July 2022.
7. Chen PR, Rowland RR, Stoian AM, Petrovan V, Sheahan M, Ganta C, Cino-Ozuna G, **Kim DY**, Dunleavy JM, Whitworth KM, Samuel MS, Spate LD, Cecil RF, Bene JA, Yan X, Fang Y, Croix BS Lechtenberg K, Wells KD, Prather RS. Disruption of anthrax toxin receptor 1 in pigs leads to a rare disease phenotype and protection from senecavirus A infection. *Scientific Reports.* 2022;12(1):5009. doi: 10.1038/s41598-022-09123-x
8. **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 May 6. doi.org/10.1111/vcp.13106
9. Dhital R, **Shen Z**, **Zhang S**, Mustapha A. Detection of virulence and extended spectrum β -lactamase genes in *Salmonella* by multiplex high-resolution melt curve real-time PCR assay. *Journal of Applied Microbiology.* 2022; 132(3):2355-67. <https://doi.org/10.1111/jam.15334>
10. **Gull T**. Bacterial Causes of Intestinal Disease in Dairy Calves: Acceptable Control Measures. *Vet Clin N Am Food Animal Pract*, 38:107-119, March 2022.
11. Huang J, McFadden KK, Powers A, **Burnum AL**, de Oliveira Conrado F. What is your diagnosis? Fine-needle aspirate from an intestinal mass in a cat. *Vet Clin Path.* doi: <https://doi.org/10.1111/vcp.13075>
12. **Ierardi RA**, Anderson MN, Bryan JN, Matheson JS, **Sample SH**, Coates JR. Epidural myelolipoma in a Silken Windhound. *Vet Clin Path* 51(3): 422–425, 2022. <https://doi.org/10.1111/vcp.13090>
13. Jung R, Bae H, Cho A, Kim YJ, Jun Y, Kim M, Cha S, Kang M-J, Hwang T-S, Lee H-C, Cho K-W, Jung D-I, **Kim DY**, Yu D. Hemostatic dysfunction in a dog with mammary gland carcinoma. *J Vet Clin.* 2022 39:373-377. doi=10.17555/jvc.2022.39.6.373
14. Kang H, Bienzle D, Cheong Lee GK, Piche E, Viel L, **Odemuyiwa SO**, and Beeler-Marfisi J. Flow Cytometric Analysis of Equine Bronchoalveolar Lavage Fluid Cells in Horses with and without Severe Equine Asthma. *Vet. Pathology*, 59, 91 – 99. PMID 34521286
15. Knobel DL, Jackson AC, Bingham J, Ertl HCJ, Gibson AD, Hughes D, Joubert K, Mani RS, Mohr BJ, **Moore SM**, Rivett-Carnac H, Tordo N, Yeates JW, Zambelli AB, Rupprecht CE. A

- One Medicine Mission for an Effective Rabies Therapy. *Front Vet Sci.* 2022; 9:867382. doi: 10.3389/fvets.2022.867382. eCollection 2022. PMID: 35372555
16. **Kovarik M, Hancock TS.** Effectiveness of a student-developed instructional video in learning the anatomy of the equine distal limb. *J Vet Med Educ* 2022 Aug 18;e20210167. doi: 10.3138/jvme-2021-0167
 17. **Kuroki K, Morishima Y, Door L, Cook CR.** Alveolar echinococcosis in a dog in Missouri, USA. *J Vet Diagn Invest* 2022; 34:746-51
 18. **Mammone RM, Havis B, Royal A, Donnelly LL, Kim DY.** Urothelial carcinoma with tonsillar metastasis in a dog. *J Vet Diagn Invest.* 2022 May;34(3):564-567. doi: 10.1177/10406387221088596. Epub 2022 Apr 10. PMID: 35403515; PMCID: PMC9254048
 19. Marquis CR, **Gull T, Dodam J, Thombs L and Bukoski A.** Comparison of four endotracheal tube cleaning protocols in anesthetized dogs. *J Am Vet Med Assoc* <https://doi.org/10.2460/javma.22.10.0446>
 20. Mitchell PK, Wang L, Stanhope BJ, Cronk BD, Anderson R, Mohan S, Zhou L, Sanchez S, Bartlett P, Maddox C, DeShambo V, Mani R, Hengesbach LM, Gresch S, Wright K, Mor S, **Zhang S, Shen Z, Yan L, Mackey R, Franklin-Guild R, Zhang Y, Prarat M, Shiplett K, Ramachandran A, Narayanan S, Sanders J, Hunkapiller AA, Lahmers K, Carbonello AA, Aulik N, Lim A, Cooper J, Jones A, Guag J, Nemser SM, Tyson GH, Timme R, Strain E, Reimschuessel R, Ceric O, Goodman LB.** Multi-laboratory evaluation of the Illumina iSeq platform for whole genome sequencing of *Salmonella*, *Escherichia coli*, and *Listeria*. *Microb Genom* 2022;8(2). doi: 10.1099/mgen.0.000717
 21. Muhsin SA, Al-Amidie M, **Shen Z, Mlaji Z, Liu J, Abdullah A, El-Dweik M, Zhang S, Almasri M.** A microfluidic biosensor for rapid simultaneous detection of waterborne pathogens. *Biosensors and Bioelectronics* 2022; 203:113993 DOI: 10.1016/j.bios.2022.113993
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31. **De New K**, Coates J, Wellehan Jr. J, **Gull T**, Childress A, Anderson M and **Royal A**. *Mycobacterium haemophilum* infection in canine cerebrospinal fluid. *Vet Clin Path*
32. Lee N, **Kim DY**, Kim Y-J, Kim DY. Splenic epidermoid cyst in a dog. *Journal Veterinary Diagnostic Investigation*
33. Flatland B, Dehghanpir S, Freeman K, Grimes C, **Hancock T**, Hollinger C, Hooijberg E, Korchia J, Lawson C, Matlow J, **Sample S**, Viall A. Guidelines for resident training in veterinary clinical pathology. IV: Laboratory quality management – teaching domains, competencies, and suggested learning outcomes. *Vet Clin Path*
34. Walker K, Middleton J, **Gull T**, Payne C and Adkins P. Bacterial culture and susceptibility of samples taken from septic foot lesions of adult beef cattle. *J Vet Internal Med*
35. Wang L, Zheng B, **Shen Z**, Deb Nath N, Li Y, Walsh T, Li Y, **Mitchell WJ**, He D, Lee J, **Moore S**, Tong S, **Zhang S**, Ma W. Isolation and characterization of mammalian orthoreovirus from bats in the United States

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36. **Bowman JW, Gull T**, Ulmanis EG, **Ogunbadewa AJ, Shen Z, Johnson GJ** and **Odemuyiwa SO**. Metagenomic Identification of a Novel Oomycete Pathogen Cultured from a Mass on the Tail of a Domestic Cat. *J Vet Diag Invest*
37. Compañen A, **Moore SM**, Boulanger B, Kostense S and Marissen WE. Validation of adapted

neutralization assays developed to discriminate anti-rabies virus activity of two different anti-rabies virus monoclonal antibodies administered as a combination. *Biologics*.

38. KuKanich K, Burklund A, Muturi N, Thomason S, Chengappa MM, **Zhang S** and **Gull T**. Prevalence of carbapenem-resistant Enterobacterales, carbapenem-resistant *Pseudomonas*, and methicillin-resistant *Staphylococcus* isolates from veterinary hosts, and a One Health approach for surveillance, storage, and reporting. *Emerging Infect Dis*
39. KuKanich K, McGaughey R, Muturi N, Thomason S, Chengappa MM, **Zhang S** and **Gull T**. Educational fliers for veterinarians and pet owners to guide response when carbapenem-resistant Enterobacterales, carbapenem-resistant *Pseudomonas*, or methicillin-resistant *Staphylococcus* are isolated from companion animals. *Veterinary Medicine and Science*

Abstract/Scientific Presentations

1. Ajibade FA, **Ogunbadewa AJ**, and **Odemuyiwa SO**. Rapid Barn-side Detection of Swine Pathogens. Poster presented at National Veterinary Scholars Symposium; August 2022; Minneapolis, MN.
2. **Ierardi RA**. A prospective seroprevalence survey of *Anaplasma marginale* among Missouri beef cows, 2021-2022. 65th AAVLD-USAHA Annual Meeting. October 8-9, 2022. Minneapolis MN
3. **Ierardi RA**, **Gull T**, **Odemuyiwa SO**, Stansell M. Detection of viral and bacterial pathogens in postmortem lung specimens from bovine respiratory disease cases at the University of Missouri Veterinary Medical Diagnostic Laboratory, 2019-2021. 65th AAVLD-USAHA Annual Meeting. October 8-9, 2022. Minneapolis MN
4. **Ierardi RA**, Ver Mehren G, Raghavan RK. Collection of host-seeking *Dermacentor variabilis*, vector of bovine anaplasmosis, on beef cattle pastures in Missouri. 65th AAVLD-USAHA Annual Meeting. October 8-9, 2022. Minneapolis MN
5. Kittana H, **Ogunbadewa AJ**, Calcutt M, **Gull T**, and **Odemuyiwa SO**. Genetic Diversity of *Mannheimia haemolytica* isolates from Bovine Respiratory Disease Cases in Missouri. 65th AAVLD-USAHA Annual Meeting. October 8-9, 2022. Minneapolis MN
6. Knobel D, Jackson A, Bingham J, Gibson A, Mani R, **Moore S**, Yeates J, Rupprecht C, Hughes D, Mohr B, Zambelli A, Ertl H. A proposed clinical trial protocol for investigational rabies treatments in naturally infected dogs. Presentation. 33rd Rabies in the Americas Meeting; October 2022; Queretaro, Mexico
7. Morelli F, Augard C, Bourhy H, Bravo C, Coudeville L, **Moore S**, Quiambao B, Recuenco S. Immunogenicity of rabies vaccines in postexposure prophylaxis (PEP) or simulated PEP regimens: a systematic literature review and meta-analysis. 33rd Rabies in the Americas Meeting; October 2022; Queretaro, Mexico
8. Morelli F, Augard C, Bourhy H, Bravo C, Coudeville L, **Moore S**, Quiambao B, Recuenco S. Immunogenicity of rabies vaccines in pre-exposure prophylaxis regimen: a meta-analysis of literature data. Poster. 33rd Rabies in the Americas Meeting, October 2022; Queretaro, Mexico
9. **Kovarik M**, **Hancock TS**. A student-created video impacts learning outcomes an professional development. International Association of Medical Science Educators; June 2022; Denver, CO
10. **Kuroki K**, Morhishima Y. Two cases of canine *echinococcus multilocularis* in Missouri. 65th AAVLD-USAHA Annual Meeting; October 8-9, 2022; Minneapolis MN

11. **Kuroki K.** Joint tissues and osteoarthritis. Japanese Society of Veterinary Anesthesia and Surgery, 104th Annual meeting (*Invited Speaker*); July 22-24, 2022; Virtual
12. **Mammone R, Evans T, Sikes D, Kim DY.** Adverse reproductive outcomes in pregnant and lactating bitches exposed to aflatoxins. ACVP Annual Conference; November 12-15, 2022; Boston, MA
13. Morelli F, Augard C, Bourhy H, Bravo C, Coudeville L, **Moore S**, Quiambao B, Recuenco S. Immunogenicity of rabies vaccines in pre-exposure prophylaxis (PrEP) regimen: a meta-analysis of literature data (poster attached). Rabies in the Americas Meeting; October 2022; Querétaro, Mexico
14. Mueller M, Reiner C, Cowan C, **Royal A.** Disseminated cryptococcosis including bone marrow involvement in a domestic shorthair cat. ACVP Annual Conference; November 12-15, 2022; Boston, MA
15. Rogic A, Noall LG, Bryan JN, **Kuroki K, Johnson GC**, Chu S. BRAF is not commonly mutated in feline bladder transitional cell carcinoma. Veterinary Cancer Society Annual Conference; October 15-18, 2022; Norfolk, VA
16. **Susan Moore.** Progress on Serological Tests. Joint WHO/WOAH meeting of Head of WHO Rabies Reference Laboratories and WHO Rabies Experts; December 2022; Paris, France
17. **Ogunbadewa AJ, Mitchell Jr. WJ, Odemuyiwa SO.** Canine Parvovirus Variants in Missouri: 2012 – 2022. 65th AAVLD-USAHA Annual Meeting. October 8-9, 2022. Minneapolis MN
18. Topka J, **Hancock TS.** Role adjustments and identity norms affiliated with interprofessional collaboration across DVM and MD students. Poster presented at National Veterinary Scholars Symposium; August 2022; Minneapolis, MN
19. Waitkevich K, **Kim DY, Royal A.** Perianal gland adenoma on the face of a canine patient. ACVP Annual Conference; November 12-15, 2022; Boston, MA
20. **Kobashigawa EH, Zhang MZ,** Russell S, Batten J, **Zhang S.** Evaluation of ASR1 peptoid-conjugated beads for the detection of chronic wasting disease (CWD) prion. 65th AAVLD-USAHA Annual Meeting; October 8-9, 2022; Minneapolis, MN
21. **Kobashigawa EH, Zhang MZ,** Russel S, **Zhang S.** Detection of chronic wasting disease (CWD) prion in blood by Real-Time Quaking-Induced Conversion (RT-QuIC). International Wildlife Disease Association (WDA) Conference; July 23-29, 2022; Madison, WI
22. Mushin S, Abdullah A, **Kobashigawa EH,** Al-Amidie M, Russell S, Russel S, **Zhang MZ, Zhang S,** M Almasri. A Microfluidic Biosensor Architecture for the Rapid and Accurate Detection of Chronic Wasting Disease Prion. 65th AAVLD-USAHA Annual Meeting; October 8-9, 2022; Minneapolis, MN
23. **Smith A, Burnum-Looney A.** Congenital ocular abnormalities in a calf due to intrauterine bluetongue infection. 2022 ACVP/ASVCP Annual Meeting; Nov 12-15, 2022; Boston, MA
24. **Torres AS, Kobashigawa EH, Zhang MZ, Zhang S.** ASR1 Enrichment RT-QuIC for Antemortem diagnosis of Chronic Wasting Disease in Cervids. VSRP Presentation; July 14, 2022; Columbia, MO
25. **Shen Z, Wang L, Ma W, Zhang S.** Detection of Porcine Parainfluenza Virus 1 from Metagenomic Whole Genome Sequencing of Swine Sample. 65th AAVLD-USAHA Annual Meeting; October 8-9, 2022; Minneapolis MN

Engagement & Outreach Presentations

1. **Dashek M.** Reviewing publication documents for University of Missouri Extension: G8903: Prevention of Poultry Disease, G8904: Control of Poultry Disease Outbreaks, G8909: Basics of Bird Flu: Avian Influenza, and G8910: Avian Influenza Biosecurity for Small Flock Owners
2. **Dashek M.** Television Interview KRCG 13 on 12/13/22 – Current situation in highly pathogenic avian influenza (HPAI), recommendations for backyard poultry producers, and the VMDL's role in ongoing HPAI outbreak.
3. **Gull T.** Pinkeye Update. Veterinary Education & Training (VET) ECHO; online CE event for practitioners, June 14, 2022
4. **Hancock TS.** MU News: <https://showme.missouri.edu/2022/social-cultural-factors-in-veterinary-field-may-hinder-students-professionals-from-seeking-mental-health-help/>
5. **Hancock TS.** Today's Veterinary Practice: <https://todaysveterinarypractice.com/personal-wellbeing/veterinary-mental-health-and-the-influence-of-culture/>
6. **Ierardi RA.** Bovine Anaplasmosis in Missouri. Beef Producers' Meeting Hosted by Concordia Veterinary Clinic; March 8, 2022; Concordia, MO. *Invited Speaker.*
7. **Ierardi RA.** Bovine anaplasmosis in Missouri. KOMA Beef Cattle Conference; March 31, 2022; Mt. Vernon, MO
8. **Ierardi RA.** Losses in a Small Ruminant Herd. Veterinary Education & Training (VET) ECHO; online CE Event for Practitioners; September 13, 2022
9. **Ierardi RA.** Neurologic Disease in a Feeder Calf. Veterinary Education & Training (VET) ECHO; online CE Event for Practitioners; March 8, 2022
10. **Ierardi RA.** The Invasive Longhorned Tick: Why It Matters in Linn County. Linn County chapter of the Missouri Cattlemen's Association; November 15, 2022; Brookfield, MO
11. **Ierardi RA.** The Invasive Longhorned Tick. Missouri Livestock Symposium; December 3, 2022; Kirksville, MO; *Invited Speaker*
12. Karaffa K, **Hancock TS.** Interpersonal effectiveness skills for veterinarians. Presentation at Missouri Veterinary Medical Association Annual Meeting, January 2022; Columbia, MO
13. **Moore S**, Briggs D. Putting the New Rabies Pre-Exposure Prophylaxis Guidelines into Practice. Advisory Board on the New ACIP Rabies Vaccination Pre-exposure Series; November 2022; *Presenter and Moderator*
14. **Williams III F.** Improving diagnostic yield. 130th Missouri Veterinary Medical Association Annual Convention; January 28, 2022; Columbia, MO
15. **Williams III F.** Wetlabs for high school students interested in studying veterinary medicine. Advanced Veterinary Academy (AVA) at the University of Missouri; August 13, 2022; Columbia, MO

Diversity, Equity, and Inclusion Activities

Williams III F. Introduction of veterinary medicine to students in local elementary schools so that 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.

Zhang S. Creation of AAVLD President's Award for Special Initiatives - DEI

International, National, State, and Local Leadership Activities

1. **Gull T.** ACVPM representative to the NAVLE Item-writing Committee; ACVM Examination Committee (Immunology subcommittee chair); ACVIM Form Writing (Examination) Committee, chair; NATRC Judges' Committee Veterinary Co-chair; University of Missouri Faculty Advisory Council; University of Missouri Military and Veterans' Committee member; University of Missouri Status of Women Committee member; NATRC Drug Committee Chair; CLSI VET09 Working Group; ACVIM/ACVPM Joint Consensus Statement Working Group; USEF Drug Testing Veterinarian; FEI Permitted Treatment Veterinarian; Colonel, U.S. Army Reserve Veterinary Corps; Boone County Large Animal Rescue Team; Missouri Volunteer Veterinary Corps member
2. **Hancock T.** Academic Veterinary Assessment Committee Member; International Council on Veterinary Assessment
3. **Ierardi RA.** Academy of Veterinary Consultants (AVC), coordinator of the biannual Diagnostic Laboratory Report for the Beef Cattle Health & Well-Being Committee; October 2022-Present.
4. **Kuroki K.** AAVLD Pathology Committee Member; Japanese Group of ACVP (JaGA) Vice President; International Veterinary Pathology Coalition; ACVP Member
5. **Moore S.** WHO Rabies Experts Committee; ACIP Rabies Workgroup; National Institute for Biological Standards and Control (NIBSC) in the UK; USDA National Rabies Management Plan Blue Ribbon Committee for Rabies Serology, writing/editing the update of the US National Plan for Wildlife Rabies Management (USNP), APHL Laboratory Systems and Standards (LSS) Committee Member, American Association of Bioanalysts (ABB) Member
6. **Royal A.** ACVP Certifying Exam Board Member; Chair for Clinical Pathology Exam Assembly and Administration Group
7. **Zhang S.** AAVLD Immediate Past President, AAVLD Award Committee Chair, AAVLD Nominating Committee Chair, AAVLD Government Relations Committee Member, Strategic Planning Committee Member.
8. **Zhang S.** Missouri Biosecurity Working Group
9. **Zhang S.** Missouri Council on Captive Wild and Exotic Animals.

Major Professional Meetings and Trainings

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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. National Animal Health Laboratory Network (NAHLN) Preparedness Weekly Conference
 13. National Poultry Improvement Plan (NPIP) Salmonella Workshop
 14. USAHA/AAVLD Government Relations Meeting
 15. Veterinary Laboratory Investigation and Response Network Monthly Conference
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