

University of Missouri Veterinary Medical Diagnostic Laboratory (VMDL) Annual Report – 2020

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Summary

The University of Missouri Veterinary Medical Diagnostic Laboratory (VMDL) is Missouri's only full service for all animal species diagnostic lab and only lab accredited by the American Association of Veterinary Laboratory Diagnosticians (AAVLD). In 2020, the VMDL retained the status of National Animal Health Laboratory Network (NAHLN) Level 1 Lab, FDA Veterinary Laboratory Response Network (FDA Vet-LRN) Tier 1 Lab, and National Poultry Improvement Plan (NPIP) Certification. The VMDL processed approximately 52,036 accessions and performed more than 142,744 diagnostic tests, which represents a 0.7% increase in accessions and 14.56% decrease in lab tests from 2019 to 2020. The VMDL provided diagnostic service to veterinarians and owners from 105 MO counties/independent cities and 43 US states and Canadian provinces. In 2020, the VMDL faculty taught (or co-taught) 37 courses and 18 clinical/diagnostic rounds. The VMDL faculty led and participated in 21 extramurally funded projects, including 10 new projects. The VMDL faculty published 33 peer-reviewed research and clinical papers, presented 13 conference posters and oral presentations, served on many prestigious national, state and university committees, attended important international, national and state conferences and trainings, and participated in various outreach and engagement activities.

Introduction

The MU VMDL is a full service veterinary diagnostic laboratory and it is Missouri's only laboratory accredited by the American Association of Veterinary Laboratory Diagnosticians (AAVLD). The faculty and staff of VMDL 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 2020 VMDL Annual Report summarizes diagnostic testing data, grants, publications, abstracts, and leadership activities from Jan 1, 2020 to Dec 31, 2020. To monitor caseload, data from 2016 to 2019 are also included in the report.

VMDL Mission Statement

To provide appropriate and timely diagnostic support to veterinary practitioners, livestock and poultry interests, companion animal interests, wildlife conservationists, and state-federal regulatory officials.

To monitor domestic animals, indigenous wildlife, and zoo animals for diseases that are a threat to livestock health and public health.

To support the teaching and service missions of the College of Veterinary Medicine.

To create new knowledge through fundamental and translational research.

The VMDL Advisory Board

Mission Statement

To advise VMDL management on policies, long-term developmental strategies, and collaborations with relevant university, private, state, national and international organizations.

VMDL Advisory Board Membership

The Advisory Board consists of 12 members representing the State Veterinarian's office, commodity groups, small animal practice, large animal practice, and the Veterinary Health Center.

VMDL 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

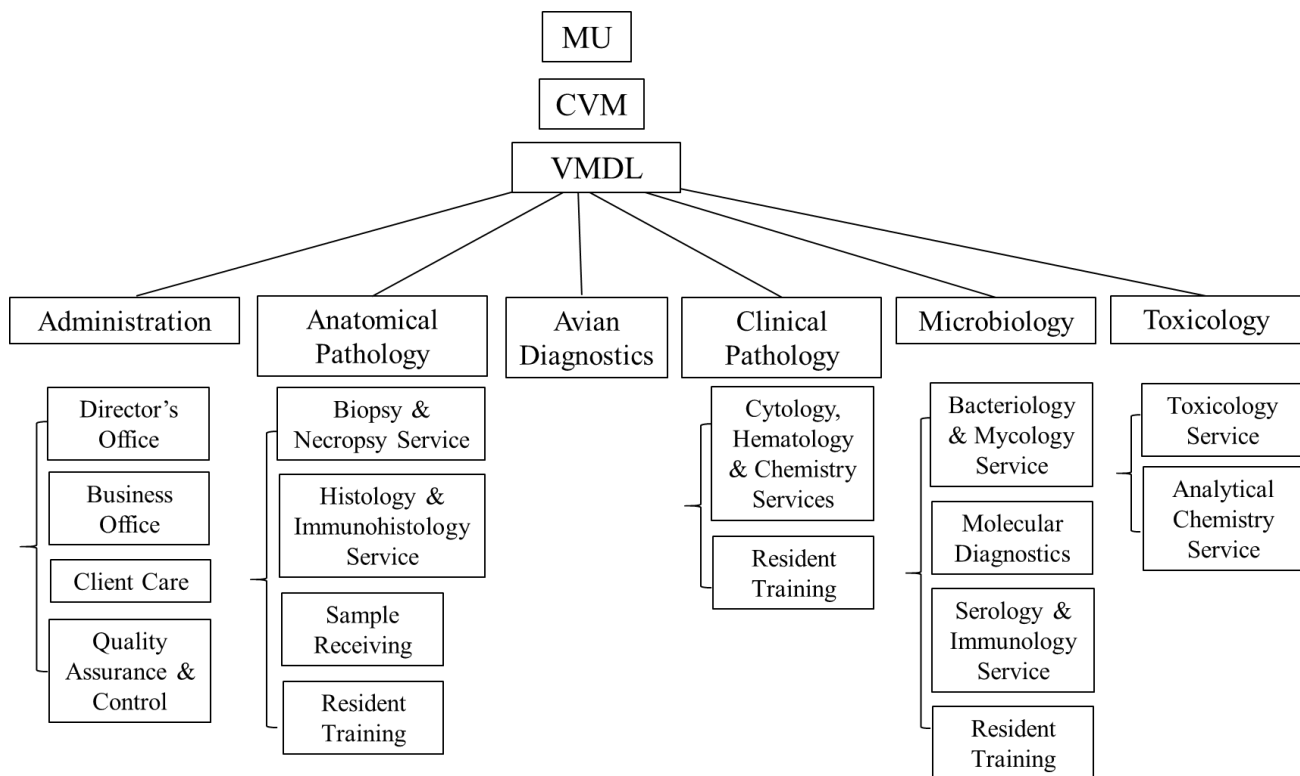
Chuck Massengill, DVM, Missouri Cattlemen's Association

David Wilson, DVM, MS, ACVS, MU VHC Director

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

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

VMDL Organizational Structure



VMDL Section Heads/Managers

Anatomical Pathology – Dr. Gayle Johnson

Avian Diagnostics – Dr. Dan Shaw/Dr. Mike Zinn

Business Office – Mr. Kirk Thompson

Client Service – Dr. Lauren Delaney

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

Director's Office – Ms. Geri Hegstad

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

Microbiology – Dr. Tamara Gull/Mr. Jesse Bowman

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

Quality Assurance – Ms. Susan Martin/Mr. Brian Nodine

Sample Receiving – Dr. Lauren Delaney

Serology/Immunology – Dr. Michael Zhang

Toxicology/Analytical Chemistry – Dr. Tim Evans/Dr. Xiangwei Du/Mr. Ben Landers

VMDL Diagnostic Program Coordinators

Anatomical Pathology Residency Program – Dr. Kei Kuroki

Clinical Pathology Residency Program – Dr. Angela Royal

Clinical and Diagnostic Microbiology – Dr. Tamara Gull

Equine Diagnostic Investigations – Dr. Fred Williams III

Food Animal Diagnostic Investigations – Dr. Tim Evans

Neuropathology and Oncopathology – Dr. Gayle Johnson

Small Animal Internal Medicine Pathology – Dr. Dae-Young Kim

VMDL Client Outreach Programs

Outreach Section has been established to address clients' needs and concerns.

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

FedEx Express Prepaid Stamps enables inexpensive next day delivery.

Columbia Area Sample Courier service is available.

After-hours Sample Drop-off refrigerator is available at the VHC Small Animal Emergency Clinic.

Food Animal Field Investigations

VMDL Exhibitor presence at various veterinary and livestock meetings including booth at Missouri State Fair

VMDL Attendance at Regional VMA Meetings

Diagnostic Service Activities

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

Year	Source (%) and Type					
	Total Accessions	Main Lab	Clin Path	MO & Others/Total	VHC/Total	VHC/Main Lab
2016	48,617	30,032	18,585	26,293 (54%)	22,324 (46%)	3,879 (13%)
2017	45,680	25,598	20,082	22,631 (50%)	23,049 (50%)	3,873 (15%)
2018	48,538	27,719	20,819	24,339 (50%)	24,202 (50%)	4,156 (15%)
2019	51,668	26,933	24,675	23,417 (45%)	28,251 (55%)	4,309 (16%)
2020	52,036	27,028	25,008	24,049 (46%)	27,987 (54%)	4,235 (16%)

*A Main Lab accession may include multiple tests for multiple samples whereas each Clinical

Pathology accession represents one test performed on one sample. Approximately 95% clinical pathology accessions came from the VHC. From 2019 to 2020, total accessions increased 7.1%.

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

Species	Avian	Bovine	Canine	Caprine	Equine	Feline	Wild/ Exotic	Non- Animal	Ovine	Porcine	Total
2016	8,954	19,345	42,979	1,633	9,483	6,891	6,277	4,784	643	6,022	107,011
2017	10,298	17,693	44,570	2,270	9,156	7,517	15,657	4,590	568	3,557	115,876
2018	8,773	19,128	46,191	1,331	10,263	7,558	30,050	2,728	537	2,607	129,166
2019	4,118	15,878	64,204	1,778	10,140	9,975	44,882	1,790	1,414	3,715	157,894
2020	4,141	16,488	68,169	1,743	9,161	10,253	24,673	2,574	774	4,768	142,744

Figure 1. Distribution of Diagnostic Tests by Animal Species

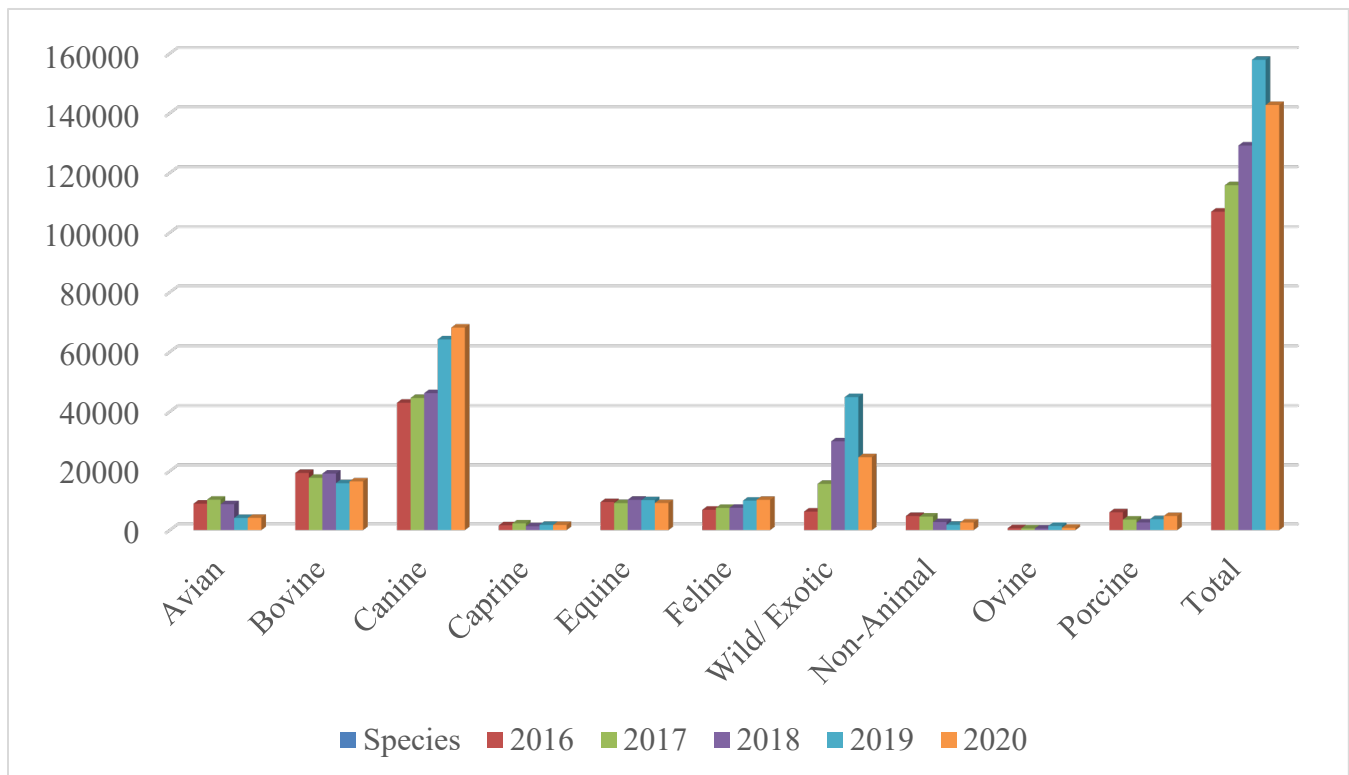


Table 3. Five Year VMDL (Main Lab and Clin Path) Tests by Section*

Year	Avian Dx.	Ana Path	Histo/ IHC	Clin Path	Micro	Molecular Dx.	Serology /Immuno	Tox/Ana Chem	Other	Total
2016	5,375	11,289	19,773	26,011	17,160	9,982	13,066	4,355	N/A	107,011
2017	5,415	11,352	29,850	28,249	16,727	10,911	21,634	4,610	N/A	128,748
2018	4,411	12,065	28,966	29,126	15,246	9,872	38,515	2,838	N/A	141,039
2019	1,587	12,154	41,117	31,992	13,589	8,449	46,646	2,360	9,193	167,087
2020	1,815	11,996	43,405	35,184	13,558	7,624	26,452	2,610	100	142,744

*The number of diagnostic tests decreased 14.56% from 2019 to 2020.

Table 4. Distribution of VMDL Accessions in 105 MO Counties/Independent City

County	#ACCN*	County	#ACCN	County	#ACCN	County	#ACCN
Boone	33,018	Webster	169	Scott	88	Carroll	25
St. Louis County	1,422	Nodaway	165	Osage	86	Stoddard	25
St. Charles	733	Taney	157	Grundy	80	Maries	21
Greene	717	Howell	153	Clay	77	Andrew	19
Jackson	626	Marion	147	Dunklin	73	Benton	19
Cole	590	Moniteau	147	Laclede	72	Perry	19
Callaway	567	Buchanan	137	Shelby	66	Atchison	18
Franklin	504	Barry	136	Wright	66	St. Clair	17
Johnson	462	Ray	136	Macon	62	Mississippi	16
Christian	390	Saline	132	Pulaski	62	Dent	15
Jefferson	373	Randolph	126	Henry	53	Sullivan	13
Not Specified	350	Pettis	125	Morgan	48	Chariton	12
Camden	322	McDonald	121	Platte	48	DeKalb	12
St. Louis City	306	Miller	119	Ste. Genevieve	47	Clark	11
Phelps	279	Howard	113	Knox	46	Harrison	11
Cape Girardeau	254	Lawrence	111	Cedar	44	Ozark	10
Cass	245	Polk	111	Bollinger	43	Shannon	10
Newton	239	Putnam	111	Vernon	42	Boone	7
Lincoln	235	Oregon	109	Crawford	40	Clinton	5
Gasconade	215	Texas	109	Adair	37	Scotland	4
Monroe	209	Bates	107	Lewis	37	Gentry	3
Lafayette	207	Cooper	104	Linn	37	Dade	2
Jasper	194	Barton	101	Dallas	34	Daviess	1
St. Francois	194	Warren	97	Madison	33	Douglas	1
Butler	193	Pike	93	Caldwell	31	Holt	1
Livingston	172	Audrain	88	Montgomery	31	Reynolds	1

*ACCN: Accession

Table 5. Distribution of VMDL Accessions in 43 Non-MO States

State/Country	# Accession	State/Country	# Accession
Illinois	1,014	Indiana	13
Arkansas	839	Michigan	13
Oklahoma	423	Texas	8
Florida	396	New Mexico	7
North Carolina	299	Alabama	6
Kansas	243	Maryland	6
Iowa	144	Washington	6
California	136	Kentucky	5
Minnesota	113	Wyoming	5
Montana	63	Georgia	4
New York	49	Nevada	4
New Jersey	40	South Dakota	4
Virginia	35	Wisconsin	4
South Carolina	27	Colorado	3
Massachusetts	25	New Hampshire	3
Manitoba	23	Oregon	2
Puerto Rico	23	British Columbia	1
Arizona	22	Idaho	1
Pennsylvania	22	Ontario	1
Tennessee	18	Rhode Island	1
Nebraska	17	Saskatchewan	1
Ohio	16	Indiana	13

External Proficiency Tests

NAHLN Data Transmission

ASF Electronic Messaging Competency
CSF Electronic Messaging Competency
FMD Electronic Messaging Competency
IAV-A Electronic Messaging Competency
IAV-S Electronic Messaging Competency
Pseudorabies Electronic Messaging Competency

Clinical Pathology

Chemistry-Routine

Hematology

Microscopy

Urinalysis

Histology

Chronic Wasting Disease IHC

Microbiology

Contagious Equine Metritis (CEM) Culture

Listeria and *Salmonella* in Raw Dog Food

Salmonella Group D Culture and Serology - National Poultry Improvement Plan (NPIP)

Molecular Diagnostics

Avian Influenza Virus (IAV-A) qRT-PCR

Avian Paramyxovirus (APMV)-1/Exotic New Castle Virus qRT-PCR

African Swine Fever (ASF) qPCR

Classical Swine Fever Virus (CSFV) qRT-PCR

Foot-and-Mouth Disease Virus (FMDV) qRT-PCR

Swine Influenza Virus (SIV) qRT-PCR

Serology

Bluetongue Serology

Bovine Leukemia Virus (BLV) Serology

Brucellosis Serology

Chronic Wasting Disease (CWD) ELISA

Equine Infectious Anemia (EIA)

Johne's ELISA

Pseudorabies Virus (PRV) gB & gI ELISA

Toxicology

Aflatoxin in Feedstuffs HPLC

Aflatoxin M1 in Tissues HPLC

Deoxynivalenol (DON) in Feedstuffs HPLC

Fumonisin in Feedstuffs HPLC

VMDL Participation in National Diagnostic Programs

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

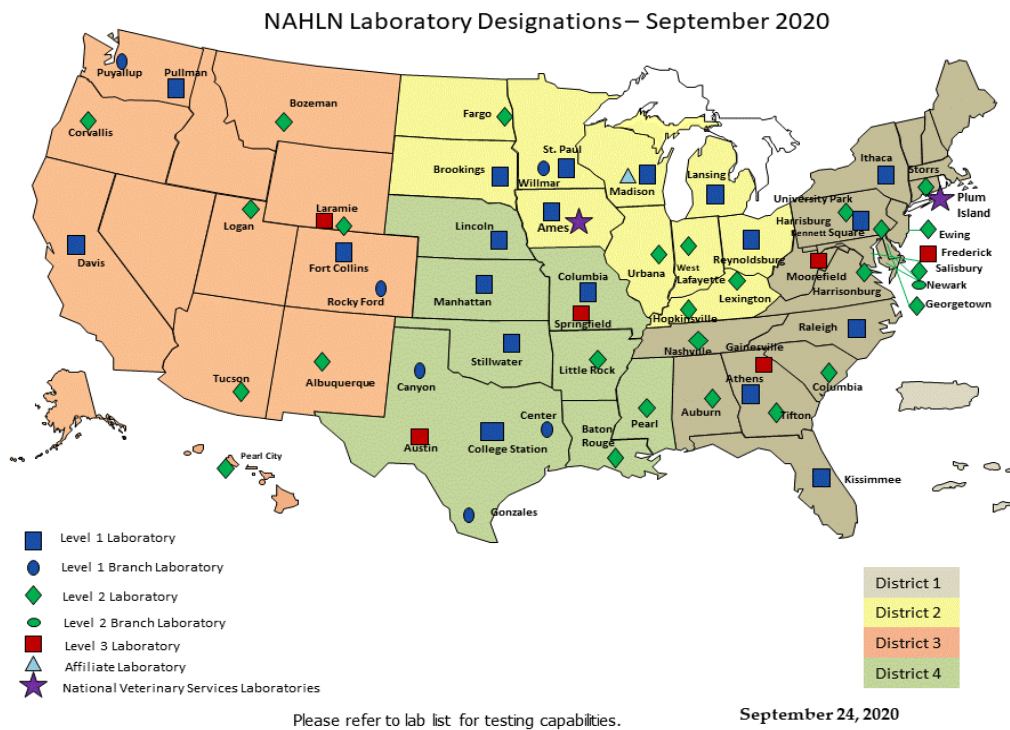
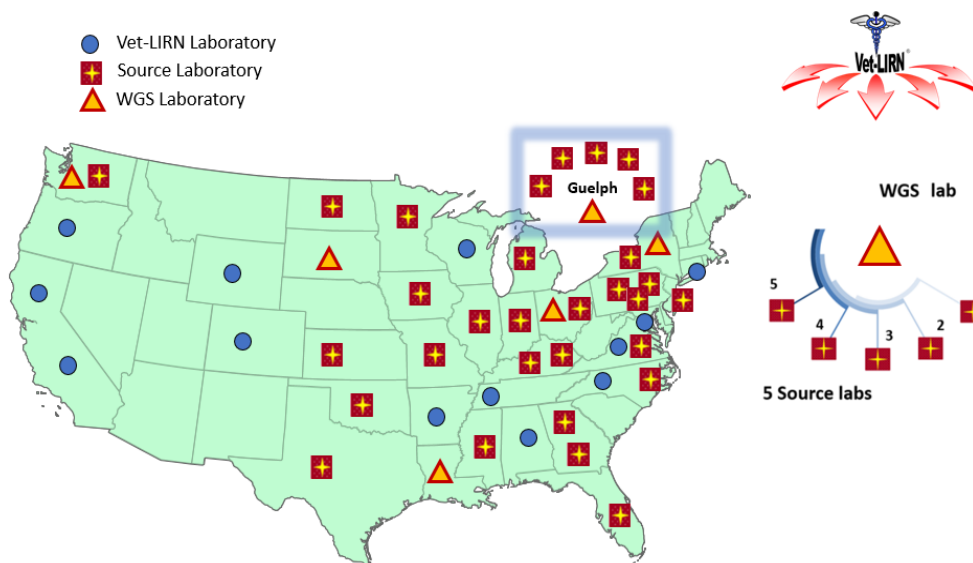


Figure 4. Tier I Member of FDA Veterinary Laboratory Investigation and Response Network (Vet-LIRN)



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 = 18)

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

International Programs

1. Agencia de Regulación y Control de la Bioseguridad Cuarentena para Galápagos or Agency for Biosafety and Quarantine Regulation and Control for the Galápagos (ABG) – Building diagnostic capacity and collaborative research

National and State Leadership Activities

National and State Leadership

1. **Evans T.** Co-Chair AAVLD Toxicology Committee
2. **Evans T.** ABVT Student Award Committee and Education Committee member
3. **Evans T.** Veterinary Education Assessment Examination Question Reviewer
4. **Gull T.** ACVIM Credentials Committee.
5. **Gull T.** ACVM Board of Governors, ACVM Examination Committee, ACVIM Examination Committee.
6. **Gull T.** Chair, Drug & Medications Committee for the North American Trail Riding Conference
7. **Royal A.** Member of ACVP Certifying Exam Assembly and Administration Group (Clinical Pathology).
8. **Zhang S.** AAVLD President, Member of AAVLD Bacteriology/Mycology Subcommittee, Antimicrobial Susceptibility Subcommittee, Quality Assurance Committee, Government Relations Committee, Strategic Planning Committee, and Workforce Development Committee.
9. **Zhang S.** Missouri Biosecurity Working Group
10. **Zhang S.** Missouri Council on Captive Wild and Exotic Animals.
11. **Zhang S.** USDA NAHLN Antimicrobial Resistance Working Group, Technical Working Group.

Scholarly Activities

Grants and Contracts

New Grants and Contracts

1. 2020-2020. Lyons B, Reinero C, Ericsson A, **Gull T.** Examination of the spatial and temporal dynamics of microbiota on select surfaces in a small animal intensive care unit. MU Clinician-Scientist Grant. \$8,000.
2. 2020-2021. **Gull T** (PI), **Kittana H**, **Odemuyiwa S**, Calcutt M. Multi-locus sequence typing of divergent *Mannheimia* isolates and molecular and serological detection of leukotoxin from cases with and without disease. USDA AHFF. \$8,000.
3. 2020-2021. Jeffery Bryan (PI, 35%), **Dae Kim** (Co-I, 20%), Jimmy Lattimer (Co-I, 10%), Charles Maitz (Co-I, 30%), Sarah Schlink (Co-I, 5%). Evaluation of Eye90™ Radioembolic



Veterinary Medical Diagnostic Laboratory

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Microspheres radiopacity and delivery in healthy rabbits. ABK Biomedical Inc. \$48,659.

4. 2020-2021. McCurdy K, MacCracken M, **Gull T**. The effect of intra-articular morphine on amikacin antimicrobial activity and concentration. Phi Zeta. \$1000.
5. 2020-2021. **Zhang S (PD)**. Maintaining NAHLN Level I Member Lab. US Department of Agriculture. Total: \$295,000 (Direct: \$265,500, Indirect: \$29,500).
6. 2020-2021. **Zhang S (PI), Evans T (Co-PI), Johnson GC (Co-PI), Gull T (Co-PI), Zhang MZ (Co-PI), Odemuyiwa S (Co-PI)**. Maintaining FDA Vet-LIRN Tier I Lab. NIH 1U18FD006670-01. \$39,900 (Direct: \$30,000).
7. 2020-2021. **Zhang S (PI), Gull T (Co-PI)**. Prototype reporting and veterinarian and animal owner educational materials for cases of antimicrobial resistant bacteria of public health importance in companion animals. KSU-FDA/ Vet-LIRN. \$7,500
8. 2020-2021. **Zhang S (PI)**. Enhancing Testing Capacity in Biosafety Level-3 Laboratory for Improved Detection of and Response to Foreign Animal Diseases. USDA. Total: \$104,108 (Direct: \$9,369.7, Indirect: \$10,411).
9. 2020-2022. **Shen Z (PI)**. United front to develop harmonized NGS training and procedures to increase the capabilities and capacity of NAHLN laboratories in response to antimicrobial resistance (AMR). UGA-USDA (AP20VSD&B00c018). \$81,311 (Direct: \$73,919, Indirect: \$7,392).
10. 2020-2023. **Zhang S (PI), Zhang M (Co-PI), Almasri M (Co-PI)**. 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. Missouri Department of Conservation. Total: \$657,011 (Direct: \$597,283, Indirect: \$59,728).

Existing Active Grants

1. 2016-2021. Hung C (PI) (Cook JL Consortium PI), **Kuroki K (Co-I, 20% shared credit, 5% FTE)**. Prime sponsor NIH/NIAMS (R01AR068133). \$406,820 (Direct \$265,029).
2. 2017-2020. Cook JL (PI), Kuroki K (Co-I, 5% shared credit). Seamless Healing of Avascular Meniscus Tears by Stem Cell Recruitment. COLUMBIA UNIV/NIH NIAM. Total: \$158,064.00
3. 2017-2021. Lee CH (PI) (Cook JL Consortium PI), **Kuroki K (Co-I, 5% shared credit, 2% FTE)**. Seamless healing of avascular meniscus tears by stem cell recruitment. NIH/NIAMS (R01AR071316). \$239,281 (Direct \$155,883).
4. 2018-2021. Stannard JP (PI), **Kuroki K (Co-I, 2% shared credit, 5% FTE)**. A biologic joint replacement strategy to treat patients with post-traumatic osteoarthritis – Expansion. DEPT. OF DEFENSE (W81XWH1810430). \$1,989,044 (Direct \$1,302,402).
5. 2018-2023. Lucy M (PI), **Evans TJ (Co-I, 5% shared credit), Gull T (Co-I, 5% shared credit)**. Uterine microbiome: Functional significance in establishing the uterine program postpartum. NIH (1R01HD092254-01A1), \$1.6 million (Direct: \$720,000, Indirect: \$880,000).
6. 2019-2020. **Evans T (PI), Zhang S (Co-PI), Rottinghaus G (Co-PI)**. Updating GC/MS Analytical Capabilities to Enhance Human and Animal Health. NIH 1U18FD006710. \$110,378.

7. 2019-2020. **Evans T** (PI), **Zhang S** (Co-PI), **Rottinghaus G** (Co-PI). Updating GC/MS Analytical Capabilities to Enhance Human and Animal Health. NIH 1U18FD006710. \$110,378.
8. 2019-2020. Sebastian Cardona-Ramirez (PhD student), **Kuroki K** (Faculty Sponsor). Measurement of ECM metabolism in human and canine tendon fibroblasts subjected to clinically relevant mechanical stress. Phi Zeta Research. \$1,000.
9. 2019-2020. **Zhang S** (PD). NAHLN Level I Member Lab. USDA 16-9419-0159. \$300,000 (Direct: \$270,000).
10. 2019-2020. **Zhang S** (PI), **Evans T** (Co-PI), **Johnson GC** (Co-PI), **Gull T** (Co-PI), **Zhang MZ** (Co-PI), **Odemuyiwa S** (Co-PI). FDA Vet-LIRN Tier I Lab. NIH 1U18FD006670-01. \$39,900 (Direct: \$30,000).
11. 2019-2022. Kevin Wells (PI), **Kim DY** (Co-PI, 5% effort). Swine somatic cell genome editing center. NIH office of the director. \$1,129,562.00

Peer Reviewed Publications

Published

1. Ajamian F, Ilarraza R, Wu Y, Morris K, **Odemuyiwa SO**, Moqbel R, Adamko DJ. CCL5 persists in RSV stocks following sucrose-gradient purification. *J Leukoc Biol.* 108(1):169-176, 2020.
2. Agulian L, Mann FA, Middleton JR, **Kim DY**. Evaluation of various carbon dioxide laser settings on the time and number of laser beam passes required to make a full-thickness skin incision and amount of laser-induced tissue artifact. *Am. J. Vet. Res.* 81(6): 514-520, 2020.
3. Bae H, Kim J, Chun D, Jung DI, Park J, **Kim DY***, Yu D*. Idiopathic ulcerative dermatitis in a cat with feline infectious peritonitis. *Vet. Med. Sci.* Dec. 31, 2020 <https://doi.org/10.1002/vms3.396>
4. Buckley RM, Davis BW, Brashear WA, Farias FHG, **Kuroki K**, Graves T, Hillier LW, Kremitzki M, Li G, Middleton RP, Minx P, Tomlinson C, Lyons LA, Murphy WJ, Warren WC. A new domestic cat genome assembly based on long sequence reads empowers feline genomic medicine and identifies a novel gene for dwarfism. *PLoS Genetics* 2020;16:e1008926
5. Chu S, Wylie TN, Wylie KM, **Johnson GC**, Skidmore ZL, Fleer M, Griffith OL, Bryan JN. A virome sequencing approach to feline oral squamous cell carcinoma to evaluate viral causative factors. *Microbiol.* 240:108491, 2020. doi: 10.1016/j.vetmic.2019.108491.
6. Clemensen AK, Villalba JJ, **Rottinghaus GE**, Lee ST, Provenza FD, Reeve JR. Do plant secondary metabolite-containing forages influence soil processes in pasture systems? *J. Agron.* 112:3744-3757, 2020.
7. Flesner BK, Wood GW, Gayheart-Walsten P, Sonderegger FL, Henry CJ, Tate DJ, Bechtel SM, Donnelly LL, **Johnson GC**, **Kim DY**, Wahaus TA, Bryan JN, Reyes N. Autologous cancer cell vaccination, adoptive T-cell transfer, and interleukin-2 administration results in long-term survival for companion dogs with osteosarcoma. *J. Vet. Intern. Med.* 34(5):2056-2067, 2020. doi: 10.1111/jvim.15852.

8. Franklin SP, Stoker AM, Lin ASP, Pownder SL, Bozynski CC, **Kuroki K**, Guldberg RE, Cook JL, Holmes SP. T1ρ, T2 mapping, and EPIC-μCT Imaging in a Canine Model of Knee Osteochondral Injury. *J. Orthop. Res.* 38:740-746, 2020
9. Gomez Y, **Gull T**, Merrill KM, **Royal AB**. What is your diagnosis? BAL fluid from a dog. *Vet Clin Pathol.* 49(2):356-358, 2020. doi: 10.1111/vcp.12848.
10. **Hancock TS**. Embroidery as method: Stitching together narrative becomings and data. *J. Educ.* 78, 2020. <https://doi.org/10.17159/2520-9868/i78a06>
11. **Hancock, TS.** & Fontanella-Nothom, O. Becoming with/in flux: Pedagogies of sustainment (POSt). *Qualitative Inquiry* 26(1), 81-88, 2020. doi: 10.1177/1077800419874827
12. Hoffman JM, Kiklevich JV, Austad M, Tran V, Jones DP, **Royal A**, Henry C, Austad SN. Tryptophan metabolism is differently regulated between large and small dogs. *GeroScience.* 42(3):881-896, 2020. doi: 10.1007/s11357-019-00114-x.
13. Jaffey JA, Hess RS, Webster CR, Blois SL, Hostnik ET, Heilmann RM, Jacobs C, Steiner JM, Reusch CE, Rogers E, **Royal A**, Piech T, Musella C, Carvalho L, Fink MJ, Motta GE, Kilkucki SN, Cigarro A, Roedler FS, Seidel T, DeClue AE. Diagnostic contribution of individual components of adrenal function tests to diagnose canine hyperadrenocorticism. *Vet. J.* 263:105520, 2020. doi: 10.1016/j.tvjl.2020.105520.
14. Karaffa K, Bradtke J, **Hancock TS**. Embedded student counseling services: Insights from veterinary mental health practitioners. *J. Coll. Couns.* 09 October 2020
<https://doi.org/10.1002/jocc.12171>
15. Katz ML, Buckley RM, Biegen V, O'Brien DP, **Johnson GC**, Warren WC, Lyons LA. Neuronal Ceroid Lipofuscinosis in a Domestic Cat Associated with a DNA Sequence Variant That Creates a Premature Stop Codon in CLN6. *G3.* 10(8):2741-2751, 2020. doi: 10.1534/g3.120.401407.PMID: 32518081
16. **Kim DY***, **Zinn MM**, **Odemuyiwa SO.**, **Mitchell WJ**, **Johnson GC.** (2021). Myocarditis caused by naturally acquired canine distemper virus infection in 4 dogs. *Journal of Veterinary Diagnostic Investigation.* *J. Vet. Diagn. Invest.* 33(1), 167-169, 2020.
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In Press and Submitted:

1. **Rothacker T**, Pohlman L, Lin D, Andrews G. Pathology in practice: mediastinal mass in a dog. *J Am Vet Med Assoc*
2. McKenzie EC, Guerra JC, Middleton JR, **Kim DY**, **Williams III F**, Garcia TM, Russell DS (Accepted). Black oil sunflower seed ingestion associated with renal azotemia, gastrointestinal ulceration and high mortality in 4 alpacas and 2 llamas. *J. Am. Vet. Med. Assoc.*
3. Havis BM, Walker KE, Adkins PRF, Shen Z, Middleton JR, Gull T, Nagy D, **Kim DY**. (Accepted). Systemic coccidioidomycosis in a llama (*Llama glama*) cria native to Missouri. *J. Vet. Diagn. Invest.* Kuroki K, Williams N, Cook JL. Histologic evidence for a humoral immune response in synovitis associated with cranial cruciate ligament disease in dogs. (Accepted) *Vet. Surg.*

Scientific Presentations

1. Sanchez S, **Zhang S**, Goodman L, Ruth N, Brianna S, Lin A, Aulik N, **Shen Z**, Yan L. No nonsense bacterial NGS. The 63rd AAVLD Annual (Virtual) Meeting. October 6-21, 2020.
2. Knebel E, **Shen Z**, **Zhang S**. Efficacy of beta-defensin derived cationic antimicrobial peptides against biofilm-producing bacteria. The 71st AALAS Annual (Virtual) Meeting, October 25-29, 2020.
3. **Warang A**, **Zhang M**, **Zhang S**, **Shen Z**. A panel of realtime PCR assay for the detection of Bourbon virus, Heartland virus, West Nile virus, and *Trypanosoma cruzi* in major disease transmitting vectors. The 63rd AAVLD Annual (Virtual) Meeting. October 6-21, 2020.
4. Schreiner AJ, Stannard JP, Stoker AM, Bozynski CC, **Kuroki K**, Cook CR, Cook JL. Unicompartmental Bipolar Osteochondral and Meniscal Allograft Transplantation is Effective for Treatment of Medial Compartment Gonarthrosis in a Canine Model. DKOU 2020 – German Congress of Orthopaedics and Traumatology, Berlin, Germany, Oct 20-23, 2020.
5. Schreiner AJ, Stannard JP, Cook CR, Bozynski CC, **Kuroki K**, Stoker AM, Smith PA, Cook JL. Comparison of meniscal allograft transplantation techniques using a preclinical canine model. AGA Kongress, Davos, Switzerland, Sept 17-19, 2020.
6. **Kuroki K**, Williams N, Cook JL. Histopathologic characterization of synovial biopsies from clinical canine patients with cranial cruciate ligament disease. Orthopaedic Research Society, Paper #1910. Phoenix, AZ. Feb. 8-11, 2020.
7. **Odemuyiwa SO**. The next pandemic will still come from animals. Webinar presentation on the



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COVID-19 pandemic: Science, Art and Policy. Hosted by the Center for Control and Prevention of Zoonoses, University of Ibadan, Nigeria as part of the 2020 One Health Commission events.

07/02/2020. (https://www.onehealthcommission.org/index.cfm/37526/97983/covid10_pandemic_the_science_art_and_policy)

8. Smith MJ, Bozynski CC, **Kuroki K**, Cook CR, Stoker AM, Cook JL. Comparison Of Biological Scaffolds For Augmentation Of Partial Rotator Cuff Tears In A Preclinical Model. Orthopaedic Research Society, Paper #0364. Phoenix, AZ. Feb. 8-11, 2020.
9. **Gull T**. Zoonotic Diseases in Dogs and Cats. Society for the Advancement of Animal Chiropractic CE cruise, 2020 (invited).
10. **Gull T**. Zoonotic Diseases in Horses. Society for the Advancement of Animal Chiropractic CE cruise, 2020 (invited).
11. **Gull T**. Potential Chiropractic Interventions in Urinary Tract Infections in Small Animals. Society for the Advancement of Animal Chiropractic CE cruise, 2020 (invited).
12. Walker K, **Gull T**, Adkins PRF, Middleton J. Bacterial culture and susceptibility of samples taken from septic foot lesions of adult beef cattle. American College of Veterinary Internal Medicine Annual Forum, Baltimore MD 2020.
13. Sidhu DS, **Gull T**, Skinner OT. Gown cuffs are not a source of bacterial contamination during intra-operative closed glove exchange in clean soft tissue surgeries. American College of Veterinary Surgeons Veterinary Surgery Summit Symposium, via Zoom, October 2020.

Extension/Outreach/Engagement Presentations

1. **Ierardi R** and **Delaney L**. Diagnostic Lab Report for data period 2019-11-01 through 2020-04-30. Academy of Veterinary Consultants (AVC), 7/01/2020
2. **Ierardi R** and **Delaney L**. Diagnostic Lab Report for data period 2020-05-01 through 2020-10-31. Academy of Veterinary Consultants (AVC), 11/08/2020
3. **Williams III F**. Rabies seminar for high school students at the Center Project. 1/16/20.
4. **Williams III F**. Presentation on zoo animal and wildlife pathology for the Zewclub and Comparative Pathology clubs, 4/21/20
5. **Williams III F**. CL Davis Foundation lunch seminar on animal abortion for pathologists, residents, and various students, 8/21/20
6. **Williams III F**. Pathology review for the VM-4's, 9/22/2020 and 9/23/2020
7. **Williams III F**. Necropsy Review for veterinary students, 9/30/20, 10/3/20, and 10/10/20
8. **Royal A**. Microscopy cases presented for MU Student Chapter of the ACVP, 9/17/20
9. **Royal A** and DeNew K. ASVCP Online Rounds, 11/24/20
10. **Gull T**. Veterinary Disaster Management: Creating a Business Continuity Plan. MU SAVMA General Meeting, February 2020

Major Annual Professional Meetings and Trainings

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