University of Missouri Veterinary Medical Diagnostic Laboratory
(VMDL) Annual Report – 2017

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Summary

The University of Missouri Veterinary Medical Diagnostic Laboratory (MUVMDL) 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 VMDL is also a Level II Lab of the National Animal Health Laboratory Network (NAHLN) and Tier I Lab of the FDA Veterinary Laboratory Response Network (FDA Vet-LRN). In 2017, the VMDL processed approximately 45,633 accessions and performed 107,300 diagnostic tests. In a 5-year period from 2013 to 2017, case accessions increased 18.5%. The VMDL diagnostic service was utilized by veterinarians and owners from 46 US states and 110 MO counties/independent city. In 2017, the VMDL faculty taught (or co-taught) 37 courses and 16 clinical/diagnostic rounds. The VMDL faculty and staff completed 5 extramurally funded projects and received 5 new grants, in addition to fee-for-service agreements. The VMDL faculty and staff published 42 peer-reviewed papers and 1 book chapter, presented 41 conference posters and presentations, served on many prestigious national and university committees, and attended 20 international, national and state conferences and trainings.
Introduction

The Veterinary Medical Diagnostic Laboratory (VMDL) Annual Report - 2017 is a compilation of test data from Jan 1, 2017 to Dec 30, 2017. To monitor caseload, testing data from 2013 to 2017 are also included in this report.

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. We strive to provide relevant, timely, and cost-effective diagnostic services to our clients and create a positive learning environment for our students.

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 mission 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

Linda Hickam, DVM, Missouri State Veterinarian
Tony Martin, DVM, Director of Animal Health Division, MFA, Inc.
Don Nikodim, Executive Vice President, Missouri Pork Association
Steve Patterson, DVM, Bethel, MO
Clark Fobian, DVM, Sedalia, MO, Immediate Past President AVMA
Steve Strubberg, DVM, Hermann, MO
Chuck Massengill, DVM, Missouri Cattlemen’s Association
Bruce Addison, President, Addison Biological Laboratory, Inc.
David Wilson, DVM, MS, ACVS, MU VHC Director
Philip Johnson, BVSc, MS, MRCVS, ACVIM MU VHC Equine Service
John Middleton, DVM, PhD, ACVIM MU VHC Food Animal Service

**VMDL Organizational Structure**

![VMDL Organizational Structure Diagram]

**VMDL Section Heads/Leaders**
Avian Diagnostics – Dr. Dan Shaw
Anatomical Pathology – Dr. Gayle Johnson
Bacteriology/Mycology – Dr. Tamara Gull/Ms. Irene Ganjam
Business Office – Mr. Mike Wimmenauer
Clinical Pathology – Dr. Marlyn Whitney/ Cheryl Rojas
Director’s Office – Ms. Geri Hegstad
Histology – Dr. Dae-Young Kim/Candace Kassel
Molecular Diagnostics – Dr. Solomon (Wole) Odemuyiwa
Quality Assurance – Dr. Tom Reilly/Susan Martin
Sample Receiving – Ms. Geri Hegstad
Serology – Dr. Mike Zhang
Toxicology – Dr. Tim Evans

**VMDL Diagnostic Program Coordinators**
Anatomical Pathology Residency Program – Dr. Kei Kuroki
Clinical Pathology Residency Program – Dr. Charles Wiedmeyer
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 Service Activities**

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Accession</th>
<th>Main Lab</th>
<th>Clin Path</th>
<th>MO/Others</th>
<th>VHC/Total</th>
<th>VHC/VMDL</th>
<th>Research</th>
<th>Other</th>
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<tbody>
<tr>
<td>2013</td>
<td>38,499</td>
<td>25,165</td>
<td>13,334</td>
<td>20,081 (52%)</td>
<td>16,460 (43%)</td>
<td>3,126 (12%)</td>
<td>1,867 (4.8%)</td>
<td>91 (&lt;1%)</td>
</tr>
<tr>
<td>2014</td>
<td>37,666</td>
<td>24,431</td>
<td>13,235</td>
<td>19,733 (52%)</td>
<td>16,476 (44%)</td>
<td>3,241 (13%)</td>
<td>1,378 (3.6%)</td>
<td>79 (&lt;1%)</td>
</tr>
<tr>
<td>2015</td>
<td>42,929</td>
<td>26,276</td>
<td>16,653</td>
<td>20,966 (49%)</td>
<td>20,475 (48%)</td>
<td>3,822 (15%)</td>
<td>1,390 (3.2%)</td>
<td>98 (&lt;1%)</td>
</tr>
<tr>
<td>2016</td>
<td>48,674</td>
<td>30,089</td>
<td>18,585</td>
<td>29,257 (60%)</td>
<td>18,476 (38%)</td>
<td>4,028 (13%)</td>
<td>603 (1.2%)</td>
<td>338 (&lt;1%)</td>
</tr>
<tr>
<td>2017</td>
<td>45,633</td>
<td>25,557</td>
<td>20,076</td>
<td>21,083 (46%)</td>
<td>22,479 (49%)</td>
<td>3,873 (15%)</td>
<td>967 (2.1%)</td>
<td>542 (1.2%)</td>
</tr>
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</table>

*A Main Lab accession may include multiple tests for multiple samples whereas each Clin Path accession represents one test performed on one sample.

Caseload increased 13.38% from 2015 to 2016 and decreased 6.7% from 2016 to 2017. In a 5-year period (2013 to 2017), caseload increased 18.5%.

More than 95% of clinical pathology accessions came from VHC.

Up to 15% of main lab accessions came from VHC.

The Necropsy Lab also supported 6 research projects in 2017.
Table 2. Five Year VMDL (Main Lab and Clin Path) Tests by Animal Species*

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Avian</th>
<th>Bovine</th>
<th>Canine</th>
<th>Caprine</th>
<th>Equine</th>
<th>Feline</th>
<th>MISC</th>
<th>Ovine</th>
<th>Porcine</th>
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</thead>
<tbody>
<tr>
<td>2013</td>
<td>86,570</td>
<td>6,554</td>
<td>14,599</td>
<td>36,173</td>
<td>1,649</td>
<td>11,339</td>
<td>6,752</td>
<td>4,614</td>
<td>361</td>
<td>4,529</td>
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<tr>
<td>2014</td>
<td>83,869</td>
<td>5,784</td>
<td>15,806</td>
<td>35,421</td>
<td>1,280</td>
<td>10,038</td>
<td>5,908</td>
<td>4,964</td>
<td>462</td>
<td>4,206</td>
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<tr>
<td>2015</td>
<td>90,515</td>
<td>6,919</td>
<td>17,070</td>
<td>37,258</td>
<td>1,307</td>
<td>10,031</td>
<td>6,563</td>
<td>6,961</td>
<td>404</td>
<td>3,780</td>
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<td>2016</td>
<td>111,506</td>
<td>8,977</td>
<td>19,971</td>
<td>45,036</td>
<td>1,682</td>
<td>9,726</td>
<td>7,159</td>
<td>12,269</td>
<td>671</td>
<td>6,015</td>
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<td>2017</td>
<td>107,300</td>
<td>10,290</td>
<td>18,115</td>
<td>45,872</td>
<td>1,902</td>
<td>9,277</td>
<td>7,601</td>
<td>10,346</td>
<td>572</td>
<td>5,425</td>
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*Data do not include non-technical procedures.

Figure 1. Distribution of Diagnostic Tests by Animal Species

![Figure 1. Distribution of Diagnostic Tests by Animal Species](image)

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Avian</th>
<th>Bacti</th>
<th>Clin Path</th>
<th>Path/Histo</th>
<th>Mol</th>
<th>Sero</th>
<th>Vir</th>
<th>Tox</th>
<th>Other</th>
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<td>2,535</td>
<td>14,849</td>
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<td>23,696</td>
<td>7,105</td>
<td>12,464</td>
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<td>2,145</td>
<td>14,094</td>
<td>18,632</td>
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<td>7,521</td>
<td>12,994</td>
<td>588</td>
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<td>15,371</td>
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<td>14,039</td>
<td>949</td>
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*In 2016 and 2017, analytical chemistry tests were included in Toxicology section.
Table 4. Distribution of VMDL Accessions in 110 MO Counties/Independent City*

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<th>County</th>
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<th>2017</th>
<th>County</th>
<th>2016</th>
<th>2017</th>
<th>County</th>
<th>2016</th>
<th>2017</th>
<th>County</th>
<th>2016</th>
<th>2017</th>
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<td>Pettis</td>
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<td>169</td>
<td>Linn</td>
<td>78</td>
<td>62</td>
<td>Clark</td>
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<td>18</td>
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<td>St. Louis</td>
<td>1628</td>
<td>1322</td>
<td>Barry</td>
<td>213</td>
<td>168</td>
<td>Cedar</td>
<td>62</td>
<td>59</td>
<td>Maries</td>
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<td>17</td>
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<td>Not Specified</td>
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<td>958</td>
<td>Francois</td>
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<td>166</td>
<td>Audrain</td>
<td>60</td>
<td>58</td>
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<td>1036</td>
<td>830</td>
<td>Webster</td>
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<td>158</td>
<td>Macon</td>
<td>74</td>
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<td>Franklin</td>
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<td>472</td>
<td>Saint Clair</td>
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<td>Crawford</td>
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<td>14</td>
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<td>Cole</td>
<td>483</td>
<td>464</td>
<td>Howard</td>
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<td>137</td>
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<td>102</td>
<td>Scotland</td>
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<td>38</td>
<td>Ripley</td>
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*Underline indicates a significant decrease in accessions from 2016 to 2017.
Table 5. Distribution of VMDL Accessions in 46 Non-MO States

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*Underline indicates a significant decrease in accessions from 2016 to 2017.

**External Proficiency Tests**

**Clinical Pathology**
- Chemistry-Routine
- Hematology
- Microscopy
- Urinalysis

**Bacteriology**
- AAVLD Interlaboratory Bacteriology Quality Assurance Survey
- Contagious Equine Metritis (CEM) Culture
- Johne’s Direct Fecal PCR & Liquid Culture
- *Salmonella* Group D Culture and Serology - National Poultry Improvement Plan (NPIP)

**Molecular Diagnostics**
Avian Influenza virus (AIV) RT-PCR
Avian Paramyxovirus (APMV)-1/Exotic New Castle Virus RT-PCR
Classical Swine Fever Virus (CSFV) RT-PCR
Foot-and-Mouth Disease Virus (FMDV) RT-PCR
Swine Influenza Virus (SIV) RT-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 & gl ELISA

Toxicology
- Aflatoxin HPLC
- Deoxynivalenol (DON) HPLC
- Fumonisin HPLC

VMDL Participation in National Diagnostic Network

Figure 3. Level II Lab of National Animal Health Laboratory Network (NAHLN)
VMDL Client Outreach Programs
The VMDL offers an online portal for its clients to check their results in real-time as we work on their samples. VMDL continues to offer the FedEx Express Prepaid Stamps to all its clients which enables inexpensive next day delivery from clients’ office to the VMDL for laboratory testing.

VMDL Faculty Teaching Activities

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

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**Clinical and Diagnostic Rounds and Seminars (n=16)**

- Chemistry Rounds
- Comparative Orthopaedic Laboratory (COL) journal club
- Cytology Rounds
- Dermatology Rounds
- Food for Thought Rounds
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
Neurology Rounds
Ophthalmic Pathology Rounds
Slide treats
VMDL-Food Animal Monthly Rounds

Residency Training Programs
Anatomical Pathology Resident Training
Clinical Pathology Resident Training
Clinical and Diagnostic Microbiology (new)

International Programs
1. Department of Food Science and Engineering (USP) at the University of Sao Paulo (USP), Pirassununga, Sao Paulo, Brazil – Collaborative training and research
2. Agencia de Regulación y Control de la Bioseguridad y Cuarentena para Galápagos or Agency for Biosafety and Quarantine Regulation and Control for the Galápagos (ABG) – Building diagnostic capacity and collaborative research

VMDL Faculty/Staff Academic Service & Leadership Activities

National/State
1. American Association of Veterinary Laboratory Diagnosticians (AAVLD, Directors Committee, Government Relations Committee, Bacteriology and Mycology Subcommittee, Antimicrobial Subcommittee, Publication Committee, Dr. Shuping Zhang
2. American Association of Veterinary Laboratory Diagnosticians (AAVLD), Quality Assurance Committee, Ms. Susan Martin, Dr. Tom Reilly, Dr. Shuping Zhang
3. American Association of Veterinary Laboratory Diagnosticians (AAVLD), Epidemiology Committee, Virology Committee, Dr. Mike Zhang
4. American Board of Veterinary Toxicologists, Dr. Evans
5. American Board of Veterinary Toxicologists, Dr. Evans
6. American College of Veterinary Microbiologists (ACVM), Budget Committee, Exam Committee, Drs. tamara Gull, Shuping Zhang
7. American College of Veterinary Pathologists, Exam Committee, Drs. Linda Berent, Angela Royal
8. Journal of Veterinary Diagnostic Investigation (JVDI) Editorial Board, Dr. Shuping Zhang
9. Missouri Biosecurity Working Group
10. NAHNL Antimicrobial Surveillance Working Group, Dr. Shuping Zhang
11. Phi Zeta Veterinary Honor Society, Dr. Chuck Wiedmeyer
12. USAHA-AAVLD Joint Committee on the Environment and Toxicology, Dr. Evans

University
1. MU Campus Conflict of Interest Committee, Dr. Chuck Wiedmeyer
2. MU Chancellor’s Committee on Student Conduct, Dr. Chuck Wiedmeyer
3. MU Chancellor’s Standing Committee on Safety, Dr. Evans
4. MU Chancellor’s Standing Committee on Safety, Dr. Evans
5. MU Council of International Initiative (CII), Dr. Shuping Zhang
6. MU Engagement Council, Drs. Evans and Zhang
7. MU Faculty Equity Panel, Dr. Shuping Zhang
8. MU Masters in Public Health Program, Dr. Evans

College/Department
1. CVM Academic Research Advisory Board, Dr. Shuping Zhang
2. CVM Administrator Evaluation Committee, Dr. Kei Koroki
3. CVM Admissions and Scholarships Committee, Dr. Dae-Young Kim & Dr. Mike Zhang
4. CVM AES Research Committee, Dr. Evans
5. CVM Animal Resources Committee, Drs. Jeff Mitchell, Mike Zhang
6. CVM Computer Committee, Dr. Kei Kuroki
7. CVM COR Grant Review Committee, Dr. Gayle Johnson
8. CVM Curriculum Committee, Dr. Evans
9. CVM Faculty Responsibility Committee, Dr. Angela Royal
10. CVM Safety Committee, Dr. Shuping Zhang
11. CVM VHC Advisory Board, Dr. Shuping Zhang
12. Pathobiology Non-Tenure Track Promotion Committee, Drs. Dae-Young Kim, Shuping Zhang
13. Vet Pathobiology Promotion and Tenure Committee, Dr. Gayle Johnson

VMDL Faculty Scholarly Activities

Extramural Grants and Contracts


**Publications (N = 42)**


17. Johnson, SA, Javurek, AB, Painter, MS, Murphy, CR, Conard, CM, Gant, KL, Howald, EC, Ellersieck, MR, Wiedmeyer, CE, Vieira-Potter, VJ. Effects of a maternal high fat diet on offspring behavioral and metabolic parameters in a rodent model. J Dev Orig Health Dis 8(1); 75-88, 2017


20. Kumar SR, Kim DY, Henry CJ, Bryan JN, Robinson KL, Eaton AM. Programmed death ligand 1...
is expressed in canine B cell lymphoma and downregulated by MEK inhibitors, Vet Comp Oncol, 2017. doi: 10.1111/vco.12297


Abstracts, Posters, and Presentations (n=41)

1. Berent L. Clinical teaching and learning: From theory to practice. Primary Care Veterinary


5. Evans TJ. Toxicology case reports and Toxicology considerations for reproduction (2 hrs). Kansas State University 79th Annual Conference for Veterinarians. June 2-4, 2017, Manhattan, KS


7. Evans TJ. What can a veterinary diagnostic laboratory do for you (8 hrs)? MU Southwest Research Center Field Day. September 8-9, 2017. Mount Vernon, MO


31. Shoemake C. Chemistry Case Presentation: Mesenteric volvulus in a kangaroo. ACVP/ASVCP meeting in Vancouver, BC Nov 5-8, 2017 (Angela Royal as Mentor). Columbia, MO

32. Whitney MS. A good smear job: the value of the blood smear (what the hematology instrument doesn’t see). Annual Conference of the Missouri Veterinary Medical Association, January 20, 2017. Columbia, MO


*Book Chapter (n=1)*

**Major Annual Professional Meetings and Trainings Attended by VMDL Faculty and Staff**

- AAVLD/NAHLN Auditors Training
- AAVLD/NAHLN Quality Assurance Training
- American Association of Avian Pathologists
- American Association of Veterinary Medical Colleges
- American College of Veterinary Pathologists
- American Society for Veterinary Clinical Pathologists
- American Association of Veterinary Laboratory Diagnosticians
- American Society for Veterinary Clinical Pathology
- American Veterinary Medical Association
- American Society of Microbiology
- CVC Central in Kansas
- Emerald Coast Veterinary Conference
- FDA Vet-LIRN Annual Conference
- Kansas State University 79th Annual Conference for Veterinarians
- Midwest Poultry Confederation
- Missouri Department of Agriculture State and Federal Conference
- Missouri University Southwest Research Center Field Day
- Missouri Veterinary Medical Association
- Monthly MVMA West Central meetings
- Primary Care Veterinary Educators Symposium