

Second Edition



Christopher Chase, Kaitlyn Lutz,
Erica McKenzie, and Ahmed Tibary

BLACKWELL'S FIVE-MINUTE VETERINARY CONSULT RUMINANT



Includes
additional topics,
client education
handouts, and figures
on a companion
website

WILEY Blackwell

**BLACKWELL'S
FIVE-MINUTE
VETERINARY
CONSULT:
RUMINANT
SECOND EDITION**

BLACKWELL'S FIVE-MINUTE VETERINARY CONSULT

RUMINANT

SECOND EDITION

Edited by

Christopher C.L. Chase, DVM, PhD

*Diplomate ACVM (Immunology and Virology)
Professor, Department of Veterinary and Biomedical Sciences
College of Agriculture and Biological Sciences
South Dakota State University, Brookings, South Dakota, USA*

Kaitlyn A. Lutz, VMD

*Diplomate ABVP (Food Animal)
Consultant in Production Animal Agriculture – International
Pennsylvania, USA;
Private Practitioner – Dairy, Ashburton, New Zealand*

Erica C. McKenzie, BSc, BVMS, PhD

*Diplomate ACVIM
Professor, Large Animal Internal Medicine
Department of Clinical Sciences
College of Veterinary Medicine
Oregon State University, Corvallis, Oregon, USA*

Ahmed Tibary, DMV, MS, DSc, PhD

*Diplomate ACT
Professor, Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University, Pullman, Washington, USA*

WILEY Blackwell



This second edition first published 2017 © 2017 by John Wiley & Sons, Inc.

Edition History

John Wiley & Sons, Inc. (1e, 2009)

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by law. Advice on how to obtain permission to reuse material from this title is available at <http://www.wiley.com/go/permissions>.

The right of Christopher C.L. Chase, Kaitlyn A. Lutz, Erica C. McKenzie, and Ahmed Tibary to be identified as the authors of the editorial material in this work has been asserted in accordance with law.

Registered Office

John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA

Editorial Office

111 River Street, Hoboken, NJ 07030, USA

For details of our global editorial offices, customer services, and more information about Wiley products visit us at www.wiley.com.

Wiley also publishes its books in a variety of electronic formats and by print-on-demand. Some content that appears in standard print versions of this book may not be available in other formats.

Limit of Liability/Disclaimer of Warranty: The contents of this work are intended to further general scientific research, understanding, and discussion only and are not intended and should not be relied upon as recommending or promoting scientific method, diagnosis, or treatment by physicians for any particular patient. In view of ongoing research, equipment modifications, changes in governmental regulations, and the constant flow of information relating to the use of medicines, equipment, and devices, the reader is urged to review and evaluate the information provided in the package insert or instructions for each medicine, equipment, or device for, among other things, any changes in the instructions or indication of usage and for added warnings and precautions. While the publisher and authors have used their best efforts in preparing this work, they make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives, written sales materials or promotional statements for this work. The fact that an organization, website, or product is referred to in this work as a citation and/or potential source of further information does not mean that the publisher and authors endorse the information or services the organization, website, or product may provide or recommendations it may make. This work is sold with the understanding that the publisher is not engaged in rendering professional services. The advice and strategies contained herein may not be suitable for your situation. You should consult with a specialist where appropriate. Further, readers should be aware that websites listed in this work may have changed or disappeared between when this work was written and when it is read. Neither the publisher nor authors shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

Library of Congress Cataloging-in-Publication Data

Names: Chase, Christopher C.L. (Christopher Civilian Louis), 1956- editor. |

Lutz, Kaitlyn A. (Kaitlyn Ann), 1985- editor. | McKenzie, Erica C. (Erica Claire), 1974- editor. | Tibary, A. (Ahmed) editor.

Title: Blackwell's five-minute veterinary consult. Ruminant / edited by

Christopher C.L. Chase, Kaitlyn A. Lutz, Erica C. McKenzie, Ahmed Tibary.

Other titles: Five-minute veterinary consult. Ruminant | Ruminant

Description: Second edition. | Hoboken, NJ, USA : Wiley, 2017. | Includes bibliographical references and index. |

Identifiers: LCCN 2017028666 (print) | LCCN 2017029572 (ebook) | ISBN

9781119064695 (pdf) | ISBN 9781119064701 (epub) | ISBN 9781119064688 (cloth)

Subjects: | MESH: Ruminants | Animal Diseases | Veterinary Medicine—methods | Handbooks

Classification: LCC SF997.5.R86 (ebook) | LCC SF997.5.R86 (print) | NLM SF 997.5.R86 | DDC 636.2089—dc23

LC record available at <https://lccn.loc.gov/2017028666>

Cover design by Wiley

Set in 9/10pt GaramondPro by Aptara Inc., New Delhi, India

To Mary Chase, my wife and best friend, whose support and patience was essential for the completion of this project. Thank you for always being there.

Christopher C.L. Chase

To Drs Michaela Kristula, Billy Smith, and Rob Callan whose tireless attention to detail rubbed off and gave me the tools to complete this project, Dr Tim Holt whose passion is contagious, and to my very encouraging friends and family.

Kaitlyn A. Lutz

Dedicated with gratitude to my husband, David, for his endless love and patience, and his understanding of the demands of academic life.

Erica C. McKenzie

To my families in Morocco and Minnesota, my wife Brigitte for her support, and to all who share their clinical knowledge through books.

Ahmed Tibary

PREFACE

With production animal agriculture changing at an alarming rate, the individuals who service these animals, producers, and businesses are called upon to remain current in a myriad of areas. Every farm visit confirms the necessity of possessing knowledge beyond traditional medical and surgical techniques. Veterinarians are challenged to advise producers in areas such as advanced reproductive techniques, precision-feeding, farm economics, facility design, governmental regulations, and biosecurity, to name a few. This second edition of *Wiley-Blackwell's Five-Minute Veterinary Consult: Ruminant* is designed to build upon the first edition by providing food animal practitioners, veterinary students, animal scientists, extension specialists, and researchers with concise and timely chapters relevant to these new challenges. The Five-Minute format allows busy practitioners to access up-to-date information in an easy-to-use format when time does not allow for sifting through the literature. The companion website for the second edition also allows for easier access to information in the field and use of full-color illustrations for improved information transfer.

As we see the consolidation of animal agriculture in many parts of the world, we are also seeing a resurgence of smallholder farming in other areas. To this point, food animal practitioners must be well versed in individual animal care as well as herd management recommendations and production parameters. This textbook, like the first edition, comprehensively covers information useful across a variety of production systems and species and strives for global relevance. Although this text focuses on cattle, sheep, and goats, a significant effort has been made to include key information on other ruminant species including bison, water buffalo, yak, and cervidae as well as pseudoruminants, camelids.

The book editors, along with the hundreds of veterinary specialists who contributed to this second edition of *Wiley-Blackwell's Five-Minute Veterinary Consult: Ruminant*, are delighted to provide this updated text. Our sincere hope is that the reader finds this textbook to be a useful reference guide. Many thanks are also due to Scott R.R. Haskell for his dedication to bringing the first edition of this book to fruition.

Kaitlyn A. Lutz
Christopher C.L. Chase
Erica C. McKenzie
Ahmed Tibary

ACKNOWLEDGMENTS

Immense gratitude is owed to the contributing authors, who dedicated much time and energy towards updating and rewriting chapters for this edition. Their combined knowledge and expertise spanning a multitude of ruminant topics has resulted in a greatly improved reference for practitioners of ruminant and camelid medicine.

It was through the vision and perseverance of Dr. Scott R.R. Haskell that this series was originally born. Many thanks for the efforts of Scott and his team who worked on the first edition.

The perseverance of Mirjana Misina was integral in seeing this project to completion. The editors extend their fervent gratitude to Mirjana for unwavering professionalism and patience. We would also like to thank Heather Addison, copy editor, for her attention to detail and ability to “catch” the little things. Thank you also to the team of editors at Wiley Blackwell who ensured that this project ran smoothly: Purvi Patel, Nancy Turner, Melissa Wahl Hammer, Susan Engelken, and Erica Judisch.

CONSULTING EDITORS

CHRISTOPHER C.L. CHASE, DVM, PhD
Diplomate ACVM (Immunology and Virology)
Professor
Department of Veterinary and Biomedical
Sciences
College of Agriculture and Biological
Sciences
South Dakota State University
Brookings, South Dakota
USA

KAITLYN A. LUTZ, VMD
Diplomate ABVP (Food Animal)
Consultant in Production Animal Agriculture –
International
Pennsylvania, USA
Private Practitioner – Dairy
Ashburton
New Zealand

ERICA C. MCKENZIE, BSc, BVMS, PhD
Diplomate ACVIM
Professor, Large Animal Internal Medicine
Department of Clinical Sciences
College of Veterinary Medicine
Oregon State University
Corvallis, Oregon
USA

AHMED TIBARY, DMV, MS, DSc, PhD
Diplomate ACT
Professor
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, Washington
USA

CONTRIBUTORS

SAMEEH M. ABUTARBUSH, DVM, MVetSc
Diplomate ABVP, Diplomate ACVIM
Associate Professor
Department of Veterinary Clinical Sciences
Faculty of Veterinary Medicine
Jordan University of Science and Technology
Irbid
Jordan

AMBER L. ADAMS-PROGAR, PhD
Assistant Professor
Dairy Management Specialist
Department of Animal Sciences
Washington State University
Pullman, WA
USA

ARN A. ANDERSON, DVM DipL ABUP
(Beef Cattle)
Cross Timbers Veterinary Hospital
Bowie, TX
USA

KEVIN L. ANDERSON, DVM, PhD
Diplomate ABVP (Dairy Specialty)
Professor
Department of Population Health &
Pathobiology
College of Veterinary Medicine
North Carolina State University
Raleigh, NC
USA

CHANCE L. ARMSTRONG, DVM, MS
Diplomate ACT
Assistant Professor
Department of Clinical Sciences
School of Veterinary Medicine
Louisiana State University
Baton Rouge, LA
USA

LORA R. BALLWEBER, DVM, MS
Diplomate ACVM (Parasitology)
Professor
Department of Microbiology, Immunology &
Pathology
College of Veterinary Medicine and
Biomedical Sciences
Colorado State University
Fort Collins, CO
USA

GEORGE M. BARRINGTON, DVM, PhD
Diplomate ACVIM
Professor
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

JULIÁN A. BARTOLOMÉ, MV, FRVCS, MSc,
PhD
Diplomate ACT
Professor, Animal Reproduction
Facultad de Ciencias Veterinarias
Universidad Nacional de La Pampa
La Pampa
Argentina

MICHELLE HENRY BARTON, DVM, PhD
Diplomate ACVIM (Large Animal)
Fuller E. Callaway Endowed Professor
Department of Large Animal Medicine
College of Veterinary Medicine
University of Georgia
Athens, GA
USA

ADRIENNE C. BAUTISTA, DVM, PhD
Diplomate ABVT
Veterinarian
Banfield Pet Hospital
Roseville, CA
USA

SANDRA BAXENDELL, PSM, BVSc(Hons),
PhD MANZCVS, GCertAppSC(RurExt),
GCertPSectMgt, PGDAppSc, MRurSysMan
Goat Veterinary Consultancies – goatvetoz
Brisbane
Queensland
Australia

RONALD E. BAYNES, BSc, MS, PhD
Professor of Pharmacology
Director, Center for Chemical Toxicology
Research and Pharmacokinetics
College of Veterinary Medicine
North Carolina State University
Raleigh, NC
USA

DANIELA BEDENICE, DrMedVet
Diplomate ACVIM (Large Animal)
Diplomate ACVECC (Equine)
Associate Professor
Department of Clinical Sciences
Cummings School of Veterinary Medicine at
Tufts University
North Grafton, MA
USA

DANELLE BICKETT-WEDDLE, DVM, MPH,
PhD, Diplomate ACVPM
Associate Director
Center for Food Security and Public Health
Iowa State University
Ames, IA
USA

NORA M. BIERMANN, MagVetMed
Resident Large Animal Surgery
Department of Health Management
Atlantic Veterinary College
University of Prince Edward Island
Charlottetown
Prince Edward Island
Canada

JENNIFER L. BORNKAMP, DVM, MS
Clinician, Anesthesiology
Veterinary Clinical Sciences
Lloyd Veterinary Medical Center
College of Veterinary Medicine
Iowa State University
Ames, IA
USA

MARGARET M. BROSNAN, DVM, PhD
Diplomate ACVIM, Large Animal Internal
Medicine
Research Associate
Baker Institute for Animal Health
Cornell University College of
Veterinary Medicine
Ithaca, NY
USA

DAVID R. BROWN, PhD
Professor of Pharmacology and Vice Chair
Department of Veterinary Biomedical
Sciences
College of Veterinary Medicine
University of Minnesota
Saint Paul, MN
USA

BARBARA A. BYRNE, DVM, PhD
Diplomate ACVIM (Large Animal)
Diplomate ACVIM (Bacteriology and Mycology)
Professor of Clinical Veterinary Microbiology
Department of Pathology, Microbiology, & Immunology
School of Veterinary Medicine
University of California, Davis
Davis, CA
USA

ALEXIS J. CAMPBELL, DVM, MS
Diplomate ACT
Clinical Instructor of Comparative Theriogenology
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

FRANCISCO R. CARVALLO, DVM, DSc
Diplomate ACVP (Anatomic Pathology)
Assistant Professor
California Animal Health and Food Safety Laboratory
San Bernardino Branch
School of Veterinary Medicine
University of California, Davis
San Bernardino, CA
USA

ALEJANDRO CEBALLOS-MÁRQUEZ, DVM, MSc, PhD
Associate Professor
Research Group on Milk Quality and Veterinary Epidemiology
Faculty of Agricultural Sciences
Universidad de Caldas
Manizales
Colombia

CLEMENCE Z. CHAKO, BVSc, MPH, PhD
Diplomate ACVIM
Assistant Professor
College of Veterinary Medicine
Midwestern University
Glendale, AZ
USA

MANUEL F. CHAMORRO, DVM, MS, PhD
Diplomate ACVIM (Large Animal)
Clinical Assistant Professor
Department of Clinical Sciences
College of Veterinary Medicine
Kansas State University
Manhattan, KS
USA

CHRISTOPHER C.L. CHASE, DVM, PhD
Diplomate ACVIM (Immunology and Virology)
Professor
Department of Veterinary and Biomedical Sciences

College of Agriculture and Biological Sciences
South Dakota State University
Brookings, SD
USA

CELINA CHECURA, DVM, MS, PhD
Diplomate ACT
Clinical Assistant Professor
Department of Medical Sciences
School of Veterinary Medicine
University of Wisconsin-Madison
Madison, WI
USA

MUNASHE CHIGERWE, BVSc, MPH, PhD
Diplomate ACVIM (Large Animal)
Associate Professor
Department of Veterinary Medicine and Epidemiology
School of Veterinary Medicine
University of California, Davis
Davis, CA
USA

MICHELA CICCARELLI, DVM
Comparative Theriogenology Resident
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

THOMAS M. CRAIG, DVM, PhD
Diplomate ACVIM (Parasitology)
Professor
Department Veterinary Pathobiology
Texas A&M University
College Station, TX
USA

BRENT C. CREDILLE, DVM, PhD
Diplomate, ACVIM (Large Animal)
Assistant Professor
Food Animal Health and Management Program
Department of Population Health
College of Veterinary Medicine
University of Georgia
Athens, GA
USA

MAISIE E. DAWES, DVM, PhD
Diplomate ACVIM (Large Animal)
Assistant Professor
Immunology & Large Animal Internal Medicine
College of Veterinary Medicine
Western University of Health Sciences
Pomona, CA
USA

ANDRÉS DE LA CONCHA-BERMEJILLO, DVM, MS, PhD
Veterinary Pathologist
Regents Fellow
Texas A&M Veterinary Medical

Diagnostic Laboratory
Texas A&M University System
College Station, TX
USA

SARAH DEPENBROCK, DVM, MS
Diplomate ACVIM (Large Animal Internal Medicine)
Clinical Instructor
Department of Production Animal Health
University of Calgary
Faculty of Veterinary Medicine
Calgary, Alberta
Canada

ALFREDO DICONSTANZO, PhD
Professor
Department of Animal Science
University of Minnesota
St Paul, MN
USA

DOUGLAS C. DONOVAN, BVetMed, PhD, MRCVS, PAS
PhD Dairy Nutritionist
Standard Dairy Consultants
Omaha, NE
USA

SIAN A. DURWARD-AKHURST, BVMS, MS
Diplomate ACVIM (Large Animal)
PhD Student
Equine Genetics and Genomics Laboratory
University of Minnesota
Department of Veterinary Population Medicine
Saint Paul, MN
USA

RICHARD EHRHARDT, PhD
Small Ruminant Extension Specialist
Departments of Animal Science and Large Animal Clinical Science
Michigan State University
East Lansing, MI
USA

KATHLEEN EMERY, DVM
Dairy Nutritionist
Mycogen Seeds – DowAgroSciences
Maddison, WI
USA

STEVE ENSLEY, DVM, PhD
Veterinary Toxicologist
Veterinary Diagnostics and Production Animal Medicine
College of Veterinary Medicine
Iowa State University
Ames, IA
USA

CYNTHIA FAUX, DVM, PhD
Diplomate ACVIM (Large Animal)
Assistant Professor
Department of Integrative Physiology and Neuroscience
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

MARIE-EVE FECTEAU, DVM
Diplomate ACVIM
Associate Professor of Food Animal Medicine and Surgery
Clinical Studies, New Bolton Center
School of Veterinary Medicine
University of Pennsylvania
Kennett Square, PA
USA

MARIA SOLEDAD FERRER, Vet, MS
Diplomate ACT
Associate Professor
Department of Large Animal Medicine
College of Veterinary Medicine
University of Georgia
Athens, GA
USA

ANNA M. FIRSHMAN, BVSc, PhD
Diplomate ACVIM (Large Animal)
Diplomate ACVSMR (Sports Medicine & Rehabilitation)
Associate Clinical Professor
Department of Veterinary Population Medicine
College of Veterinary Medicine
University of Minnesota
Saint Paul, MN
USA

BRANDON FRASER, DVM, MS
Diplomate ACVIM (Large Animal)
Head of Production Animal Service
School of Veterinary Science
University of Queensland
Gatton, Queensland
Australia

DENNIS D. FRENCH, DVM
Diplomate ABVP (Equine Practice)
Professor and Interim Department Head
Veterinary Clinical Medicine
College of Veterinary Medicine
University of Illinois
Urbana, IL
USA

A. JACQUES FUSELIER, DVM, DABVP, DACT
Board Certified Specialist in Food Animal Practice
Board Certified Theriogenologist (Reproduction Specialist)
Whittington Veterinary Clinic
Abbeville, LA
USA

STEVEN M. GALLEG0, DVM
Veterinary Medical Officer
California Department of Food & Agriculture
Animal Health Branch
Redding, CA
USA

DAVID GALLIGAN, VMD, MBA
Professor of Animal Health Economics
University of Pennsylvania
School of Veterinary Medicine
Kennett Square, PA
USA

JULIE A. GARD, DVM, PhD
Diplomate ACT
Professor
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

EDGAR F. GARRETT, DVM, MS
Clinical Instructor
Department of Veterinary Clinical Medicine
College of Veterinary Medicine
University of Illinois
Urbana, IL
USA

JOHN M. GAY, DVM, PhD
Diplomate ACVPM
Associate Professor, Epidemiology
AAHP Field Disease Investigation Unit
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

SUNNY GEISER-NOVOTNY
Cattle Health Staff, Veterinarian
USDA APHIS VS
Surveillance Preparedness & Response Services
Fort Collins, CO
USA

LAUREL J. GERSHWIN, DVM PhD
Diplomate ACVM
Professor of Immunology
Department of Pathology, Microbiology & Immunology
School of Veterinary Medicine
University of California, Davis
Davis, CA
USA

JEREMY M. GESKE, MS
Animal Science and Industry
Owner/Operator
JMG Suffolks
New Prague, MN
USA

PHILIPPA GIBBONS, BVetMed(Hons), MS, MRCVS
Diplomate ACVIM (LA)
Clinical Assistant Professor, Food Animal Medicine
College of Veterinary Medicine and Biomedical Sciences
Texas A&M University
College Station, TX
USA

MIKE GOEDKEN, DVM PhD
Diplomate ACVP (Anatomic Pathology)
Director
Research Pathology Services
Translational Science
Rutgers University
Piscataway, NJ
USA

JENIFER R. GOLD, DVM
Diplomate ACVIM, ACVECC
Clinical Associate Professor
Department of Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

DIEGO GOMEZ-NIETO, DMV, MSc, MVSc, PhD
Diplomate ACVIM
Infection Control Officer
Department of Pathobiology
Ontario Veterinary College
University of Guelph
Guelph, Ontario
Canada

SERGIO GONZALES
Veterinary Teaching Hospital
University of Minnesota
Saint Paul, MN
USA

EMMA GORDON, BVSc, MS
Diploma ACVIM (Large Animal)
Clinical Instructor in Large Animal Medicine
Department of Clinical Sciences
Oregon State University
Corvallis, OR
USA

DANIEL L. GROOMS, DVM, PhD, DACVM
Professor and Chair
Department of Large Animal Clinical Sciences
College of Veterinary Medicine
Michigan State University
East Lansing, MI
USA

<p>TAMARA GULL, DVM, PhD Diplomate ACVIM (Large Animal) Diplomate ACVPM Diplomate ACVM (Immunology & Bacteriology/Mycology) Assistant Professor Department of Veterinary Pathobiology Center for Veterinary Health Sciences Oklahoma State University Stillwater, OK USA</p>	<p>TROY E.C. HOLDER, DVM Diplomate ACVS (Large Animal) Clinical Assistant Professor Large Animal Surgery Oregon State University Veterinary Teaching Hospital Corvallis, OR USA</p>	<p>MEREDYTH L. JONES, DVM, MS Diplomate ACVIM (Large Animal) Associate Professor Food Animal Field Services Department of Large Animal Clinical Sciences Texas A&M University College of Veterinary Medicine College Station, TX USA</p>
<p>GAYLE HALLOWELL, MA, VetMB, PhD, CertVA, DACVIM, DACVECC, PFHEA, MRCVS Diplomate ACVIM (LAIM), Diplomate ACVECC (LA), Associate Diplomate ECVDI RCVS Specialist in Equine Internal Medicine and Emergency and Critical Care Professor in Veterinary Internal Medicine and Critical Care School of Veterinary Medicine and Science Sutton Bonington Campus University of Nottingham Nottingham United Kingdom</p>	<p>LARRY D. HOLLER, DVM, PhD Professor Veterinary and Biomedical Sciences Department South Dakota State University Brookings, SD USA</p>	<p>SÉRGIO O. JUCHEM, DVM, PhD Researcher in Ruminant Nutrition Embrapa Southern Region Animal Husbandry Bagé, Rio Grande do Sul Brazil</p>
<p>NEIL E. HAMMERSCHMIDT Manager, Animal Disease Traceability United States Department of Agriculture Animal and Plant Health Inspection Service Riverdale, MD USA</p>	<p>RICHARD M. HOPPER, DVM Diplomate ACT Professor & Section Head Food Animal Medicine, Theriogenology & Ambulatory Department of Pathobiology & Population Medicine College of Veterinary Medicine Mississippi State University Starkville, MS USA</p>	<p>RAY M. KAPLAN DVM, PhD Diplomate ACVM (Parasitology) Diplomate EVPC Professor of Parasitology Department of Infectious Diseases College of Veterinary Medicine University of Georgia Athens, GA USA</p>
<p>LAURA Y. HARDEFELDT, BSc, BVMS Diplomate ACVIM (Large Animal) PhD student National Centre for Antimicrobial Stewardship University of Melbourne Parkville, Victoria Australia</p>	<p>LYNN R. HOVDA, RPH, DVM, MS Diplomate ACVIM Director, Veterinary Services SafetyCall International and Pet Poison Helpline Bloomington, MN; Adjunct Assistant Professor Department of Veterinary Biological Sciences College of Veterinary Medicine University of Minnesota Saint Paul, MN USA</p>	<p>ANREW KARTER, PhD Senior Investigator Associate Director Center for Diabetes Translational Research Kaiser Permanente – Division of Research Oakland, CA USA</p>
<p>SCOTT R.R. HASKELL, DVM, MPVM, PhD Director Veterinary Technology Program Yuba College Marysville, CA USA</p>	<p>EUGENE JANZEN, BA, DVM, MVS Professor Department of Production Animal Health Faculty of Veterinary Medicine University of Calgary Calgary, Alberta Canada</p>	<p>PHILIP H. KASS, DVM, PhD Associate Vice Provost for Faculty Equity and Inclusion UC Davis Academic Affairs; Professor of Analytic Epidemiology School of Veterinary Medicine and School of Medicine University of California, Davis Davis, CA USA</p>
<p>MEERA HELLER, DVM, PhD DACVIM (Large Animal) Assistant Professor of Clinical Livestock Medicine and Surgery Department of Medicine & Epidemiology School of Veterinary Medicine University of California, Davis Davis, CA USA</p>	<p>GREGORY W. JOHNSON, DVM Nutritional Consultant Cows Come First, LLC Ithaca, NY USA</p>	<p>J.F. “NIK” KOTERSKI, DVM, PhD, MSS Diplomate ACVPM Veterinary Services of Orrtanna, Pennsylvania Orrtanna, PA USA</p>
<p>DENNIS HERMESCH Kansas State University Manhattan, KS USA</p>	<p>LAURA JOHNSTONE, BVSc MVSc DACVIM (LAIM) Department of Medicine University of Pennsylvania New Bolton Center Kennett Square, PA USA</p>	<p>JENNIFER H. KOZIOL, DVM, MS Diplomate ACT Assistant Professor Department of Clinical Sciences College of Veterinary Medicine Purdue University West Lafayette, IN USA</p>

AMANDA KREUDER, DVM, PhD
Diplomate ACVIM (Large Animal Internal
Medicine)
Assistant Professor
Food Animal and Camelid Hospital
Iowa State University
College of Veterinary Medicine
Ames, IA
USA

MICHAELA KRISTULA, DVM, MS
Associate Professor
New Bolton Center
Department of Clinical Studies
Section of Field Service
University of Pennsylvania School of
Veterinary Medicine
Kennett Square, PA
USA

THIBAUD KUCA, DVM
Large Animal Medicine Resident
Department of Clinical Sciences
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

REBECCA LADRONKA, MPH, DVM
Graduate Research Assistant
Comparative Medicine and Integrative
Biology Program
College of Veterinary Medicine
Michigan State University
East Lansing, MI
USA

JEFF LAKRITZ, DVM, PhD
Diplomate ACVIM (Large Animal)
Diplomate ACVCP
Vernon L. Tharp Professor of Food Animal
Medicine
Hospital for Farm Animals
Veterinary Medical Center
College of Veterinary Medicine
The Ohio State University
Columbus, OH
USA

STEPHEN H. LEMASTER, PharmD, MPH,
DABT
Pharmacist and Senior Clinical Toxicologist
Safetycall International, PLLC & Pet Poison
Helpline
Bloomington, MN;
Clinical Associate Professor
Department of Experimental and Clinical
Pharmacology
College of Pharmacy
University of Minnesota
Minneapolis, MN
USA

HUICHU LIN, DVM, MS
Diplomate ACVAA (Anesthesia and
Analgesia)
Professor
Department of Clinical Sciences
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

BONNIE R. LOGHRY, BAS, MPH, CPH
Public Health & Safety Specialist
Yuba College
Marysville, CA
USA

KATHARINA L. LOHMANN, MedVet, PhD,
DACVIM (Large Animal)
Associate Professor
Department of Large Animal Clinical
Sciences
Western College of Veterinary Medicine
University of Saskatchewan
Saskatoon, SK
Canada

DAVID M. LOVE, DVM
Conservation Medicine Fellow
Department of Conservation Medicine
The Wilds
Cumberland, OH
USA

KAITLYN A. LUTZ, VMD
Diplomate ABVP (Food Animal)
Consultant in Production Animal
Agriculture – International
Pennsylvania, USA;
Private Practitioner – Dairy
Ashburton
New Zealand

ROBERT J. MACKAY, BVSc, PhD
Diplomate ACVIM
Professor, Large Animal Medicine
University of Florida
Gainesville, FL
USA

ANTOINETTE E. MARSH, MS, PhD, Esq.
Associate Professor
Service Head Veterinary Medical Center
Diagnostic Parasitology
The Ohio State University
College of Veterinary Medicine
Department of Veterinary Preventive
Medicine
Columbus, OH
USA

KYLE G. MATHIS, DVM
Director/Associate Professor
Veterinary Technology Program
Yuba Community College
Marysville, CA
USA

HERRIS MAXWELL, DVM
Diplomate ACT
Clinical Professor
J. T. Vaughan Large Animal Teaching
Hospital
Department of Clinical Sciences
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

KATE MCCARTHY LOTT, DVM
Veterinary Services of Oregon
Tillamook, OR
USA

ERICA C. MCKENZIE, BSc, BVMS, PhD
Diplomate ACVIM
Professor, Large Animal Internal Medicine
Department of Clinical Sciences
College of Veterinary Medicine
Oregon State University
Corvallis, OR
USA

CARLOS E. MEDINA-TORRES, DVM, MSc,
DVSc, PhD
Diplomate ACVIM (LAIM)/Diplomate ECEIM
Cert Uni Teaching Practice
Senior Lecturer – Equine Medicine Specialist
Equine Specialist Hospital
Veterinary Medical Centre
School of Veterinary Science
The University of Queensland
Gatton, Queensland
Australia

RICHARD W. MEIRING, DVM
Diplomate ACVPM
Clinical Professor
Department of Pathobiology and Population
Medicine
College of Veterinary Medicine
Mississippi State University
Mississippi State, MS
USA

PEDRO MELENDEZ, DVM, MS, PhD
Associate Professor
Department of Veterinary Medicine &
Surgery
College of Veterinary Medicine
University of Missouri
Columbia, MO
USA

PAUL E. MENNICK, DVM
Owner
Pacific International Genetics
Los Molinos, CA
USA

JAMES MERONEK, DVM, MPH
Head Veterinarian
ABS Global, Inc
DeForest, WI
USA

NATHAN MEYER, MS, MBA, PhD, DVM
Consulting Nutritionist/Veterinarian (Beef Cattle)
JBS Five Rivers Cattle Feeding, LLC
Greeley, CO;
Affiliate Faculty
College of Veterinary Medicine & Biomedical Sciences
Colorado State University
Fort Collins, CO
USA

JOHN R. MIDDLETON, DVM, PhD
Diplomate ACVIM
Professor, Food Animal
Assistant Director
Agricultural Experiment Station
Department of Veterinary Medicine and Surgery
College of Veterinary Medicine
University of Missouri
Columbia, MO
USA

JOSEPH A. MILLER, BS, MS, JD
Attorney-at-Law
Seymour, IN
USA

ROBERT B. MOELLER Jr., DVM
Diplomate ACVP
Diplomate ABT
California Animal Health and Food Safety Laboratory, Tulare
University of California, Davis
Tulare, CA
USA

HARRY MOMONT, DVM, PhD
Diplomate ACT
Clinical Associate Professor
Department of Medical Sciences
School of Veterinary Medicine
University of Wisconsin-Madison
Madison, WI
USA

MICHELLE MOSTROM, DVM, MS, PhD
Diplomate ABVT
Diplomate ABT (Toxicology)
Veterinary Toxicologist
Veterinary Diagnostic Laboratory
North Dakota State University
Fargo, ND
USA

MARY E. MOWRER, DVM
Stonehouse Veterinary Service
St. Clairsville, OH
USA

DANIELLE A. MZYK, BS
Graduate Research Assistant
Food Animal Residue Avoidance Databank
Population Health and Pathology
College of Veterinary Medicine
North Carolina State University
Raleigh, NC
USA

DUSTY W. NAGY, DVM, MS, PhD
Diplomate ACVIM (Large Animal)
Associate Teaching Professor
Department of Veterinary Medicine and Surgery
College of Veterinary Medicine
University of Missouri
Columbia, MO
USA

REGG D. NEIGER, DVM, PhD
Professor
Department of Veterinary and Biomedical Sciences
Animal Disease Research and Diagnostic Laboratory
South Dakota State University
Brookings, SD
USA

BENJAMIN W. NEWCOMER, DVM, PhD
Diplomate ACVIM (Large Animal)
Diplomate ACVPM (Epidemiology)
Assistant Professor
Department of Pathobiology
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

ANDREW J. NIEHAUS, DVM, MS
Diplomate ACVS (Large Animal)
Associate Professor
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
The Ohio State University
Columbus, OH
USA

JORGE L. NORICUMBO-SAENZ, MS
(Animal Science)
Milk Quality Specialist
Tular County, CA
USA

AKINYI C. NYAOKE, BVM, MSc, PhD
Assistant Professor
California Animal Health and Food Safety Laboratory
San Bernardino Branch
University of California, Davis
San Bernardino, CA
USA

LARRY OCCHIPINTI, DVM, MPVM
Owner
Guardsman Veterinary and K9
Reproduction Services
Tidewater, OR
USA

KATE O'CONOR, BS
Consultant at Yodle
Scottsdale, AZ
USA

DUSTIN OEDEKOVEN, DVM
Diplomate ACVPM
State Veterinarian
South Dakota Animal Industry Board
Pierre, SD
USA

ERIK J. OLSON, DVM, PhD
Diplomate ACVP (Anatomic Pathology)
Associate Professor
Veterinary Diagnostic Laboratory and Department of Veterinary Population Medicine
College of Veterinary Medicine
University of Minnesota
Saint Paul, MN
USA

DONAL O'TOOLE, MVB, PhD, DipECVP, FRCPath
Professor
Department of Veterinary Sciences and Wyoming State Veterinary Laboratory
University of Wyoming
Laramie, WY
USA

ZENHWA BEN OUYANG, VMD, MSE
Department of Clinical Sciences
College of Veterinary Medicine and Biomedical Sciences
Colorado State University
Fort Collins, CO
USA

LAUREN PALMER, DVM, MPH
Veterinarian
The Marine Mammal Care Center at Fort
MacArthur
San Pedro, CA
USA

LISA K. PEARSON, DVM, MS, PhD
Diplomate ACT
Adjunct Faculty
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

KEVIN D. PELZER, DVM, MPVM
Diplomate ACVPM
Professor
Department of Large Animal Clinical
Sciences
Production Management Medicine
Virginia Maryland College of Veterinary
Medicine
Virginia Tech
Blacksburg, VA
USA

ARUN PHATAK
Nutrition and Reproductive
Management Specialist
Reproduction Specialties, Inc.
Modesto, CA
USA

PABLO PINEDO, DVM, PhD
Assistant Professor
Department of Animal Sciences
Colorado State University
Fort Collins, CO
USA

PAUL J. PLUMMER, DVM, PhD
Diplomate, ACVIM (Large Animal)
Diplomate, European College of Small
Ruminant Health Management
Associate Professor
Veterinary Diagnostic and Production Animal
Medicine;
Veterinary Microbiology and Preventive
Medicine
College of Veterinary Medicine
Iowa State University
Ames, IA
USA

ELEONORA PO, DVM, MRCVS, CVA (IVAS)
Resident, ACVIM (LA) Candidate
Department of Veterinary Clinical Medicine
College of Veterinary Medicine
University of Illinois
Urbana-Champaign, IL
USA

SALUNA POKHREL, BVSc & AH, MVSc
(Veterinary Parasitology)
Assistant Professor
Department of Veterinary Microbiology and
Parasitology
Institute of Agriculture and Animal Science,
Tribhuvan University
Nepal

MARIANNE POLUNAS, RPh, PhD
Assistant Research Professor
Department of Pharmacology & Toxicology
Ernest Mario School of Pharmacy
Rutgers University
Piscataway, NJ
USA

KEITH P. POULSEN, DVM, PhD
Diplomate ACVIM
Clinical Assistant Professor
Large Animal Internal Medicine
Section Head, Client Services
Wisconsin Veterinary Diagnostic Laboratory
School of Veterinary Medicine
University of Wisconsin
Madison, WI
USA

EDWARD L. POWERS, DVM, MPVM
California Department of Public Health
Division of Communicable Disease Control
Infectious Diseases Branch
Veterinary Public Health Section
Richmond, CA
USA

MARIA E. PRADO, MV, PhD
Diplomate ACVIM (Large Animal)
Assistant Professor of Practice
Department of Animal Science
University of Tennessee
Knoxville, TN
USA

STEPHEN R. PURDY, DVM
Director, North American Camelid
Studies Program
President
Nunoa Project
Peru;
Adjunct Associate Professor
UMass Amherst
Amherst, MA
USA

BIRGIT PUSCHNER, DVM, PhD
Diplomate ABVT
Professor and Chair
Department of Molecular Biosciences
School of Veterinary Medicine
University of California
Davis, CA
USA

MERL F. RAISBECK, DVM, MS, PhD
Diplomate ABVT
Professor Emeritus, Veterinary Toxicology
Department of Veterinary Sciences
University of Wyoming
Laramie, WY
USA

CHELSEY R. RAMIREZ, DVM
Clinical Instructor
Integrated Food Animal Management
Systems
Department of Veterinary Clinical Medicine
College of Veterinary Medicine
University of Illinois
Urbana-Champaign, IL
USA

JAMES M. RASMUSSEN, DVM
Senior Veterinarian
Minnesota Zoological Garden
Apple Valley, MN
USA

JIM P. REYNOLDS DVM, MPVM
Diplomate ACAW
Vice President of Consulting
Praedium Ventures
Visalia, CA
USA

JERRY R. ROBERSON, DVM, PhD, ACVIM
Professor Food Animal Medicine and Surgery
Lincoln Memorial University-College of
Veterinary Medicine
Harrogate, TN
USA

JENNIFER N. ROBERTS, DVM
Diplomate ACT
Assistant Professor
Department of Large Animal Clinical
Sciences
College of Veterinary Medicine
Michigan State University
East Lansing, MI
USA

NICHOLAS A. ROBINSON, BVSc (Hons),
PhD, MACVSc
Diplomate ACVP (Anatomic Pathology)
Associate Professor
Cummings School of Veterinary Medicine
Tufts University
North Grafton, MA
USA

JOE RODER, DVM, PhD
Diplomate ABVT
Director
Swine Technical Services
Merck Animal Health
De Soto, KS
USA

FRANCISCO C. RODRIGUEZ, DVM
Associate Professor, Large Animal Medicine
and Surgery
Department of Clinical Sciences
School of Veterinary Medicine
St. Matthew's University
Grand Cayman
British West Indies

KEITH A. ROEHR, DVM
State Veterinarian
Colorado Department of Agriculture
Animal Health Division
Broomfield, CO
USA

EMMANUEL ROLLIN, DVM, MFAM
Clinical Assistant Professor, Dairy Production
Medicine
Department of Population Health
College of Veterinary Medicine
University of Georgia
Athens, GA
USA

JENNIFER A. SCHLEINING, DVM, MS
Diplomate, ACVS (Large Animal)
Associate Professor
Department of Veterinary Diagnostic and
Production Animal Medicine
College of Veterinary Medicine
Iowa State University
Ames, IA
USA

DAVID A. SCHNEIDER, DVM, PhD
Diplomate ACVIM (Large Animal)
Research Veterinary Medical Officer
US Department of Agriculture
Agricultural Research Service
Animal Disease Research Unit
Pullman, WA
USA

CLARE M. SCULLY, MA, DVM, MS
Diplomate ACT
Assistant Professor
Department of Veterinary Clinical Sciences
Louisiana State University School of
Veterinary Medicine
Baton Rouge, LA
USA

WILLIAM J. SEGLAR, DVM
Senior Nutritionist/Veterinarian
Global Nutritional Sciences
DuPont/Pioneer Global Forages
Johnston, IA
USA

JAN K. SHEARER, DVM, MS
Diplomate, American College of Animal
Welfare
Professor and Extension Veterinarian
Iowa State University, CVM, VDPAM
Ames, IA
USA

CLIFFORD F. SHIPLEY, DVM
Diplomate ACT (Theriogenology)
Associate Clinical Professor
Attending Veterinarian
Agricultural Animal Care and Use Program
Department of Veterinary Clinical Medicine
College of Veterinary Medicine
University of Illinois
Urbana, IL
USA

SUVASH SHIWAKOTI, BVSc & AH, MSc
(Microbiology)
Veterinary Officer
Government of Nepal
North Dakota State University
Fargo, ND
USA

EGENDRA KUMAR SHRESTHA, BVSc &
AH, MVSc
Associate Academic Director
Associate Professor
College of Agriculture and Veterinary
Sciences
Nepal Polytechnic Institute Ltd
Bharatpur-11, Chitwan
Nepal

KATHARINE M. SIMPSON, DVM, MS
DACVIM
Associate Professor
Food Animal Medicine and Surgery
Large Animal Medicine and Surgery
Department
St. George's University
School of Veterinary Medicine
True Blue, Grenada
West Indies

BILLY I. SMITH, DVM, MS
Diplomate ABVP (Food Animal)
University of Pennsylvania
School of Veterinary Medicine
New Bolton Center
Department of Large Animal Clinical Studies
Section of Field Service
Kennett Square, PA
USA

JACK D. SMITH, DVM
Diplomate ACT
Associate Professor, Theriogenology
Interim, Associate Dean for Academic Affairs
College of Veterinary Medicine
Mississippi State University
Starkville, MS
USA

JOE S. SMITH, DVM, MPS, DACVIM (LAIM)
Clinician
Food Animal and Camelid Hospital
Department of Veterinary Diagnostic and
Production Animal Medicine
College of Veterinary Medicine
Iowa State University
Ames, IA
USA

KEELY A. SMITH, DVM
Private Practitioner
Hudson, FL
USA

JAMIE L. STEWART, DVM, MS
Theriogenology Resident
Department of Veterinary Clinical Medicine
College of Veterinary Medicine
University of Illinois
Urbana, IL
USA

AUDUN STIEN, PhD
Senior Researcher
Norwegian Institute for Nature
Research – NINA
Fram Centre
Tromsø
Norway

KELLY M. STILL BROOKS, DVM, MPH
Diplomate ACVPM
Clinical Assistant Professor
Veterinary Diagnostic and Production Animal
Medicine
College of Veterinary Medicine
Iowa State University
Ames, IA
USA

RICARDO M. STOCKLER, DVM, MS
Diplomate ABVP (Dairy Practice)
Assistant Clinical Professor of Farm Animal
Ambulatory Services
JT Vaughan Large Animal Teaching Hospital
College of Veterinary Medicine at Auburn
University
Auburn, AL
USA

CAROLYN L. STULL, MS, PhD
Diplomate ACAN (Animal Nutrition), ACAWS
(Animal Welfare Science)
Animal Welfare Cooperative Extension
Specialist, Emerita
Department of Population Health and
Reproduction
School of Veterinary Medicine
University of California
Davis, CA
USA

JENNIFER S. TAINTOR, DVM, MS
Diplomate ACVIM (Large Animal)
Diplomate ACVSMR (Equine)
Associate Professor
Department of Clinical Sciences
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

RACHEL H. H. TAN BVSc, DVCS, MACVSc,
CertVetAc, MS, DipACVIM, GradCertEd
Senior Lecturer, Large Animal
College of Public Health, Medical and
Veterinary Sciences
James Cook University
Townsville, Queensland
Australia

AHMED TIBARY, DMV, MS, DSc, PhD
Diplomate ACT
Professor
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
Washington State University
Pullman, WA
USA

FERENC TOTH, DVM, PhD
Diplomate ACVS (Large Animal)
Assistant Professor
Department of Veterinary Population
Medicine
College of Veterinary Medicine
University of Minnesota
Saint Paul, MN
USA

ALEX K. TURNER, DVM
Traceability Veterinarian
Colorado Department of Agriculture
Animal Health Division
Broomfield, CO
USA

TORKILD TVERAA, PhD
Senior Researcher
Norwegian Institute for Nature
Research – NINA
Fram Centre
Tromsø
Norway

JEFFREY W. TYLER (Deceased)
College of Veterinary Medicine
University of Missouri
Columbia, MO
USA

FRANCISCO A. UZAL, DVM, FRVC,
MSc, PhD
Diplomate ACVP
Professor of Veterinary Pathology
California Animal Health and Safety
Laboratory System
San Bernardino Branch
University of California, Davis
San Bernardino, CA
USA

MODEST VENGUST, DVM, DVSc, PhD
Diplomate ACVIM (Large Animal)
Diplomate ACVSMR (Equine)
Veterinary Faculty
University of Ljubljana
Ljubljana
Slovenia

PAUL H. WALZ, DVM, MS, PhD
Diplomate ACVIM (Large Animal)
Professor
Department of Pathobiology
College of Veterinary Medicine
Auburn University
Auburn, AL
USA

MUHAMMAD SALMAN WAQAS,
DVM, M.Phil
Lecturer
Department of Theriogenology
Faculty of Veterinary Science
University of Agriculture
Faisalabad
Pakistan

MATT G. WELBORN, DVM, MPH
Diplomate ACVPM
Professor
Food Animal Health Management
Department of Veterinary Clinical Sciences
LSU School of Veterinary Medicine
Louisiana State University
Baton Rouge, LA
USA

ASHLEY WHITEHEAD, DVM, BSc, DVSc
Diplomate ACVIM (Large Animal)
Assistant Professor
Department of Veterinary Clinical and
Diagnostic Sciences
Faculty of Veterinary Medicine
University of Calgary
Calgary, Alberta
Canada

JEFFREY J. WICHTEL, BVSc, PhD
Diplomate ACT
Professor and Dean
Ontario Veterinary College
University of Guelph
Guelph, Ontario
Canada

AUDREY WIEMAN, DVM
Owner
Ridgeline Veterinary Services, LLC
Lynch, NE
USA

CHRISTINE M. WINSLOW, DVM
Diplomate, ACT
Assistant Professor
Animal Health Institute
Midwestern University
Glendale, AZ
USA

AMELIA WOOLUMS, DVM, MVSc, PhD
Diplomate ACVIM
Diplomate ACVM
Professor
Department of Pathobiology and Population
Medicine
College of Veterinary Medicine
Mississippi State University
Mississippi State, MS
USA

ALAN YOUNG, PhD
Professor of Veterinary and Biomedical
Science
South Dakota State University
Brookings, SD
USA

ABOUT THE COMPANION WEBSITE

This book is accompanied by a companion website:

www.fiveminutevet.com/ruminant

The website includes:

- Additional topics not found in the book
- Client education handouts
- The figures from the book in PowerPoint

CONTENTS

TOPIC	
Abomasal Emptying Defect in Sheep	1
Abomasal Impaction	3
Abomasal Ulceration	5
Abortion: Bacterial	7
Abortion: Bovine	9
Abortion: Camelid	11
Abortion: Farmed Cervidae	13
Abortion: Small Ruminant	16
Abortion: Viral, Fungal, and Nutritional	19
Actinobacillosis: Wooden Tongue	21
Actinomycosis: Lumpy Jaw	23
Acupuncture	24
Acute Renal Failure	26
Agricultural Chemical Toxicities	27
Agricultural Practices Contributing to Disease*	
Agroterrorism*	
Akabane	29
Alternative Medicine*	
Anaphylaxis	31
Anaplasmosis	32
Anemia, Nonregenerative	33
Anemia, Regenerative	35
Anesthesia: Inhalation	38
Anesthesia: Injectable	40
Anesthesia: Local and Regional	43
Anestrus	45
Angular Limb Deformity	47
Animal Disease Traceability (ADT)*	
Animal Welfare*	
Anthelmintic Resistance	50
Anthrax	52
Arsenic Toxicosis	54
Arthrogryposis	56
Artificial Insemination: Bovine	59
Artificial Insemination: Camelid*	
Artificial Insemination: Cervidae*	
Artificial Insemination: Small Ruminant	61



*Published online, see www.fiveminutevet.com/ruminant

Aspiration Pneumonia	63
Atypical Interstitial Pneumonia	65
Avocado Toxicosis	67
Babesiosis	68
Bacillary Hemoglobinuria	71
Bacterial Endocarditis	73
Bacterial Meningitis	76
Beef Bull Management*	
Beef Herd Records*	
Beef Herd Reproductive Worksheets*	
Biosecurity: Beef Cow/Calf*	
Biosecurity: Cervidae*	
Biosecurity: Dairy*	
Biosecurity: Goats*	
Biosecurity: Research Herds*	
Biosecurity: Sheep*	
Bison: Bacterial Diseases	78
Bison: Clinical Examination and Treatment*	
Bison: Management*	
Bison: Parasitic Diseases	81
Bison: Viral Diseases	83
Black Locust Toxicity	86
Bloat	87
Blood Chemistry*	
Blue-Green Algae Poisoning	89
Bluetongue Virus	91
Body Condition Scoring: Alpacas and Llamas*	
Body Condition Scoring: Beef*	
Body Condition Scoring: Camels*	
Body Condition Scoring: Cervidae*	
Body Condition Scoring: Dairy Cattle*	
Body Condition Scoring: Goats*	
Body Condition Scoring: Sheep*	
Border Disease	94
Borna Disease	96
Bovine and Ovine Implants*	
Bovine Anthelmintics*	
Bovine Dermatology	98
Bovine Digital Dermatitis	100
Bovine Ephemeral Fever	103
Bovine Leukemia Virus	105
Bovine Papular Stomatitis	107
Bovine Petechial Fever	108
Bovine Respiratory Syncytial Virus	109
Bovine Spongiform Encephalopathy	111
Bovine Viral Diarrhea Virus	113
Bracken Fern Toxicity	117



*Published online, see www.fiveminutevet.com/ruminant

Brain Assessment and Dysfunction*	
<i>Brassica</i> spp. Toxicity	119
Breeding Soundness Examination: Bull	122
Breeding Soundness Examination: Camelids	124
Breeding Soundness Examination: Cervidae	128
Breeding Soundness Examination: Small Ruminant	130
Brisket Disease	132
Brucellosis	134
Buckeye (<i>Aesculus</i> spp.) Toxicity	136
Burn Management	137
Cache Valley Virus	140
Calf Diphtheria/Necrotic Stomatitis	142
Camel Diseases	145
Camel Management and Health Programs	149
Camelid: Dentistry	152
Camelid: Dermatology	154
Camelid: Gastrointestinal Disease	158
Camelid: Heat Stress	160
Camelid: Parasitology	162
Camelid: Reproduction	165
Camelid: Venipuncture*	
Campylobacter	169
Candidiasis	172
Caprine Arthritis Encephalitis Virus	174
Carbamate Toxicity	177
Cardiac Failure	179
Cardiotoxic Plants	181
Caseous Lymphadenitis (CLA)	184
Castor Bean Toxicity	187
Castration/Vasectomy: Bovine	188
Castration/Vasectomy: Camelid	190
Castration/Vasectomy: Small Ruminant	192
Caudal Vena Caval Thrombosis Syndrome	194
Cecal Dilation and Volvulus	196
Cervidae: Captive Management	198
Cervidae: Capture Myopathy	201
Cervidae: Chronic Wasting Disease	203
Cervidae: Game Park Management, Facilities	205
Cervidae Mortality	208
Cervidae: Reproduction	211
Cesarean Section: Bovine	213
Cesarean Section: Camelid	215
Cesarean Section: Small Ruminant	217
Chlamydiosis	219
Cleaning and Disinfection*	
Clostridial Disease: Gastrointestinal	221
Clostridial Disease: Muscular	223



*Published online, see www.fiveminutevet.com/ruminant

Clostridial Disease: Nervous System	225
Coccidioidomycosis	228
Coccidiosis	230
Coenurosis	232
Colic: Bovine	234
Colic: Small Ruminant	236
Colostrum and Milk Replacers*	
Common Pharmacologic Therapies: Adult Dairy Cattle*	
Congenital Defects: Bovine	239
Congenital Defects: Camelid	241
Congenital Defects: Small Ruminant	243
Congenital Ocular Disorders	245
Contagious Bovine Pleuropneumonia	247
Contagious Caprine Pleuropneumonia	249
Controlled Substances*	
Copper Deficiency and Toxicity	251
Corkscrew Claw	255
Corneal Disorders	257
Coronavirus	260
Cow-Calf Management*	
Cowpox	263
Cranial Nerve Assessment and Dysfunction*	
Cryptococcosis	265
Cryptosporidiosis	267
Cyanide Toxicosis	269
Dairy Cattle Behavior*	
Dairy Cow Comfort*	
Dairy Economics*	
Dairy Heifer Management Program*	
Dairy Heifer Nutrition: Basics*	
Dairy Informatics*	
Dairy Nutrition: Ration Guidelines for Milking and Dry Cows*	
Dairy Record Evaluation*	
Dairy Reproduction*	
Dairy Sheep and Goat Industries*	
Death Camas	271
Dehorning/Cornuectomy*	
Dermatophilosis	272
Dermatophytosis	274
Diarrheal Diseases: Bovine	276
Diarrheal Diseases: Camelid	278
Diarrheal Diseases: Small Ruminant	280
Disaster and Emergency Preparedness and Response*	
Displaced Abomasum	282
Disseminated Intravascular Coagulopathy	285
Down Bovine	287
Down Camelid	289



*Published online, see www.fiveminutevet.com/ruminant

Down Small Ruminant	292
Drug Hypersensitivities	294
Drug Interactions	296
Drug Residues in Milk*	
Drug Storage Requirements and Veterinarian-Client-Patient Relationship (VCPR)*	
Drug Toxicities	298
Dystocia: Bovine	300
Dystocia: Camelid	302
Dystocia: Small Ruminant	304
Echinococcosis	306
Economics: Net Present Value*	
Economics: Partial Budgeting*	
Embryo Transfer: Bovine	308
Embryo Transfer: Camelid	310
Embryo Transfer: Small Ruminant	312
Emesis	314
Employee Management*	
Endocrine Disorders	316
Endometritis	318
Enucleation/Exenteration*	
Environment and Mastitis*	
Enzootic Ataxia	321
Enzootic Pneumonia of Calves	323
Epidemiologic Study Designs*	
Epidemiology: Clinical Versus Statistical Significance*	
Epidemiology: Diagnostic Test Use*	
Epidemiology: Informatics*	
Epidemiology of Mastitis*	
Epidemiology: Risk Analysis*	
Epidemiology: Systematic Approach to Disease Outbreak Investigations*	
Epizootic Hemorrhagic Disease Virus	325
Erythrocytosis (Polycythemia)	327
Escherichia coli	330
Esophageal Disorders	332
Estrus Synchronization: Bovine	335
Estrus Synchronization: Small Ruminant	337
Evaluating Corn Silages for Feed Value*	
Ewe Flock Nutrition*	
Extra-label Drug Use and Compounding*	
Failure of Passive Transfer	339
Fatty Liver	341
Feed Additives*	
Feeding By-Products to the Beef Cow Herd*	
Feeding for Milk Components*	
Fescue Toxicity	343
Floppy Kid Syndrome	345
Fluid Therapy: Intravenous	347



*Published online, see www.fiveminutevet.com/ruminant

Fluid Therapy: Oral	350
Fluoride Toxicity	353
Food Animal Residue Avoidance Databank (FARAD)*	
Foot and Mouth Disease	355
Foot Rot: Bovine	357
Foot Rot: Small Ruminant	359
Freemartinism	361
Frostbite	363
Fungal Tremorgens	365
Gaseous Toxicities*	
Gastrointestinal Pharmacology*	
Gastrointestinal Surgeries: Laparotomy*	
Gastrointestinal Surgeries: Rumenotomy/Rumenostomy*	
Goat Milk Quality*	
Goat Nutrition*	
Gossypol Toxicosis	367
Grass Tetany/Hypomagnesemia	369
Grayanotoxin	371
HACCP (Hazard Analysis Critical Control Point)*	
Haemonchosis	372
Hazardous Materials Spills Awareness and Response*	
Heartwater (Cowdriosis)	376
Heat Stress	378
Heavy Metal Toxicosis	380
Hemorrhagic Bowel Syndrome	384
Hemotropic Mycoplasmas (Formerly Eperythrozoonosis)	386
Hereditary Chondrodysplasia: Ovine	388
Hernia Surgery*	
<i>Histophilus somni</i> Complex	390
Hydrometra	394
Hydrops	396
Hypocalcemia: Bovine	398
Hypocalcemia: Small Ruminant	401
Indigestion	403
Induction of Parturition	405
Infectious Bovine Rhinotracheitis	407
Infectious Necrotic Hepatitis	410
Infectious Pustular Vulvovaginitis	412
Infertility and Subfertility Issues	414
Injection Site Lesions	416
Iodine Deficiency and Toxicity	418
Jimsonweed Toxicity (<i>Datura stramonium</i>)	420
John's Disease	421
Juvenile Llama Immunodeficiency Syndrome	423
Ketosis: Dairy Cattle	425
Lactation Failure (Dysgalactia, Agalactia, Hypogalactia)	428
Lameness: Bovine	430



*Published online, see www.fiveminutevet.com/ruminant

Lameness: Camelid	433
Lameness: Small Ruminant	435
Laminitis in Cattle	437
Lantana Toxicosis	439
Lead Toxicosis	441
Leptospirosis	444
Leukocyte Responses in Cattle	447
Lightning Strike	451
Listeriosis	453
Liver Abscesses	455
Liver Flukes	458
Low-Fat Milk Syndrome	462
Lumpy Skin Disease	464
Lupine Toxicity	466
Lymphocytosis	468
Lymphosarcoma	470
Maedi-Visna (Ovine Progressive Pneumonia)	473
Malignant Catarrhal Fever	476
Management of Gunshot Wounds	478
Managing Neglect Cases*	
Manure Management and Environmental Planning*	
Manure Microbiology and Zoonosis*	
Mastitis: Bulk Tank Monitoring and Somatic Cell Counts*	
Mastitis: Camelids	480
Mastitis: Coliform	482
Mastitis: Fungal	484
Mastitis: Involvement of Milking Equipment and Stray Voltage*	
Mastitis: Milking Procedures and Teat Disinfection*	
Mastitis: Minor Bacteria	486
Mastitis: Monitoring*	
Mastitis: Mycoplasmal	488
Mastitis: No Growth	491
Mastitis: Pharmacology*	
Mastitis: Small Ruminant	493
Mastitis: Staphylococcal	496
Mastitis: Streptococcal	498
Melioidosis	501
Metaldehyde Toxicosis	503
Metritis	505
Microbiologic Sampling*	
Milk Cow Nutrition Monitoring*	
Milk Quality and Composition*	
Milk Vein Rupture	508
Milkweed (<i>Asclepias</i> spp.) Toxicosis	509
Molybdenum Toxicity	511
Monensin Toxicity	513
<i>Mycoplasma bovis</i> Associated Diseases	516



*Published online, see www.fiveminutevet.com/ruminant

Mycotoxins	518
Nairobi Sheep Disease	522
Nematodirosis	524
Neonatal Diarrhea	526
Neonatal Septic Arthritis	529
Neonatology: Beef	531
Neonatology: Camelid	533
Neonatology: Caprine	535
Neonatology: Dairy Cattle*	
Neonatology: Ovine*	
Neosporosis	537
Nightshade (<i>Solanum</i> spp.) Toxicosis	539
Nitrate and Nitrite Toxicosis	540
Nonsteroidal Anti-inflammatory Drugs (NSAIDs)*	
Nutrition and Metabolic Diseases: Beef	542
Nutrition and Metabolic Diseases: Camelid*	
Nutrition and Metabolic Diseases: Cervidae	544
Nutrition and Metabolic Diseases: Dairy	546
Nutrition and Metabolic Diseases: Small Ruminant	548
Nutrition and Metabolic Diseases: Water Buffalo	550
Nutritional Assessment*	
Oak (<i>Quercus</i> spp.) Toxicity	553
<i>Oestrus ovis</i> Infestation	555
Oleander and Cardiotoxic Plant Toxicity	557
Oral Disorders	560
Orchitis and Epididymitis	562
Orf (Contagious Ecthyma)	564
Organophosphate Toxicity	566
Osteochondrosis	568
Ostertagiasis	570
Otitis Media/Interna	573
Ovarian Cystic Degeneration	576
Ovarian Hypoplasia, Bursal Disease, Salpingitis	578
Ovine Encephalomyelitis (Louping Ill)	580
Ovine Pulmonary Adenocarcinoma	582
Oxalate Toxicity	584
Pain Management*	
Parainfluenza-3 Virus	586
Parasite Control Programs: Beef	588
Parasite Control Programs: Camelid	590
Parasite Control Programs: Dairy	594
Parasite Control Programs: Small Ruminant	596
Parasitic Pneumonia	600
Parasitic Skin Diseases: Bovine	602
Parasitic Skin Diseases: Camelid	605
Parasitic Skin Diseases: Small Ruminant	609
<i>Parelaphostrongylus tenuis</i> (Meningeal Worm)	612



*Published online, see www.fiveminutevet.com/ruminant

Parenteral Nutrition	614
PCR Diagnostics*	
Penile Disorders	617
Penile Hematoma	620
Pericarditis	622
Perinatal Lamb Mortality	625
Peripheral Nerve Assessment and Dysfunction*	
Peste des Petits Ruminants	628
Petroleum Product Poisoning	630
Pharmaceutical Use: Legal Issues*	
Pharmacokinetics and Pharmacodynamics*	
Phenoxy Toxicity	632
Phosphorus Deficiency/Excess	634
Photosensitization	637
Pine Needle Toxicity	641
Plants Producing Acute Respiratory Distress Syndrome	643
Poison Hemlock (<i>Conium</i> spp.) Toxicity	645
Polyarthritis	647
Postpartum Disorders	649
Postparturient Hemoglobinuria	651
Postparturient Paresis (Hypocalcemia)	653
Precocious Udder	655
Pregnancy Diagnosis: Bovine	657
Pregnancy Diagnosis: Camelid	659
Pregnancy Diagnosis: Small Ruminant	661
Pregnancy Toxemia: Bovine	663
Pregnancy Toxemia: Camelid	666
Pregnancy Toxemia: Small Ruminant	668
Prolonged Pregnancy	671
Protein Nutrition	673
Prudent Use of Antimicrobials*	
Pseudocowpox	675
Pseudorabies	677
Pyelonephritis	679
Pyometra	681
Pyrrolizidine Alkaloids	683
Q Fever (Coxiellosis)	685
Quality Assurance for Meat Goats*	
Quality Assurance Programs for Beef and Dairy*	
Rabies	688
Reading and Evaluating Scientific Literature*	
Rectal Prolapse	690
Reindeer Management: Overview	691
Reindeer Management: Population Dynamics	693
Repeat Breeder Management	695
Reproductive Pharmacology	697
Reproductive Prolapse	700



*Published online, see www.fiveminutevet.com/ruminant