Kirkbride’s Diagnosis of Abortion and Neonatal Loss in Animals, Fourth Edition is a concise resource for determining the causes of abortion and neonatal loss in cattle, small ruminants, pigs, horses, dogs, cats, and exotic mammals. Presenting current procedures for diagnosing abortion, this classic reference has been fully updated and expanded, offering new coverage of dogs, cats, and nondomestic mammals. Published in association with the American Association of Veterinary Laboratory Diagnosticians, Kirkbride’s Diagnosis of Abortion and Neonatal Loss in Animals provides a valuable aid for understanding abortion and neonatal loss, with thorough coverage of possible causes.

The book begins with a general chapter on the approach to an abortion, followed by species-specific chapters. Each chapter begins by outlining the pathogenesis of abortion and neonatal loss, then moves on to special diagnostic techniques, fetal and placental anatomy and physiology, and detailed descriptions of the various causes of abortion or neonatal loss. Kirkbride's Diagnosis of Abortion and Neonatal Loss in Animals, Fourth Edition is a useful guide for veterinary practitioners, diagnosticians, pathologists, theriogenologists, students, and technicians.

**Key Features**
- Provides complete information for diagnosing abortion and neonatal loss in animals
- Covers cattle, sheep, goats, pigs, horses, dogs, cats, and non-domestic mammals
- Details the characteristics of many abortifacient causes and associated lesions
- Published in association with the American Association of Veterinary Laboratory Diagnosticians
- Now in full color throughout
- Includes a companion website with digital images for download at www.wiley.com/njaa

**The Editor**
Bradley L. Njaa, BSc, DVM, MVSc, DACVP is Associate Professor of Pathology, Department of Veterinary Pathobiology, Center for Veterinary Health Sciences, Oklahoma State University in Stillwater, Oklahoma.

**Related Titles**
- Atlas of Comparative Diagnostic and Experimental Hematology, Second Edition
  By Clifford Smith and Alfred Jarecki
  9780813818105
- Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology
  Edited by Kenneth S. Latimer
  9780813820149
- Clinical Canine and Feline Reproduction: Evidence-Based Answers
  By Margaret V. Root Kustritz
  9780813818348
- Equine Reproduction
  Edited by Angus O. McKinnon, Edward L. Squier, Wendy E. Vaila and Dickson D. Varner
  9780813818976

**FOURTH EDITION**
Edited by Bradley L. Njaa

---

**Isbn 978-0-470-95852-0**

**WILEY-BLACKWELL**

[www.wiley.com/njaa](http://www.wiley.com/njaa)
Kirkbride’s
Diagnosis of Abortion and Neonatal Loss in Animals

Fourth Edition
Companion website

This book is accompanied by a companion website:

www.wiley.com/go/njaa

The website includes powerpoints of all figures from the book for downloading.
Kirkbride’s
Diagnosis of Abortion and
Neonatal Loss in Animals

Fourth Edition

Edited by
Bradley L. Njaa

WILEY-BLACKWELL
A John Wiley & Sons, Ltd., Publication
Dr. Clyde A. Kirkbride served the AAVLD and the discipline of veterinary diagnostic medicine for approximately three decades. He did so with distinction, humility and excellence. His public service record goes back to WW II where he served as B-26 bomber pilot, flying 21 missions over Europe. He received his DVM from Oklahoma State University in 1953, was engaged in private practice for 10 years, held a faculty appointment at KSU, and finally served 22 years as a faculty member and diagnostician at South Dakota State University. He rapidly became the national authority on the diagnostic investigation of the causes of food animal abortion. He taught undergraduate students an animal disease course at SDSU for 20 years, and for which he was awarded teacher of the year in 1982 - the course “Animal Diseases and their Control”.

In cooperation with AAVLD he published Laboratory Diagnosis of Bovine Abortion in 1974; that book morphed into a second AAVLD publication Laboratory Diagnosis of Abortion in Food Animals in 1984; and finally the third edition published in 1989 became Laboratory Diagnosis of Livestock Abortions. All of these books were a huge success, drawing upon AAVLD diagnostic experts/collaborators from across the country. The books are still found at the diagnostic benches of veterinary diagnostic labs around the world. Dr. Kirkbride was delighted and honored when he learned that a 4th edition would be published and would acknowledge him in the title.

Dr. Kirkbride wrote numerous publications and reviews on the subject of reproductive failure in livestock, and conducted research projects that clarified many disease syndromes. In 1985 he described a new infectious agent causing abortion in sheep, the spirillum Flexispira. In 1989 he received the SDSU Gamma Sigma Delta Award for excellence in research.

He retired to emeritus status in 1989. In retirement he continued to write, and published a series of JVDI manuscripts that summarized his diagnostic findings while a veterinary diagnostician at the SDSU Animal Disease Research and Diagnostic Laboratory - that series is still frequently referenced by researchers working in the field of livestock reproductive wastage.

David Zeman
## Contents

Contributors ix  
Preface xi  
Editor’s Acknowledgements xiii  

1 General Approach to Fetal and Neonatal Loss 1  
*R. Flint Taylor and Bradley L. Njaa*  

2 Disorders of Cattle 13  
*Mark L. Anderson*  

3 Disorders of Sheep and Goats 49  
*Robert B. Moeller Jr.*  

4 Disorders of Pigs 89  
*Michael J. Yaeger*  

5 Disorders of Horses 147  
*Neil M. Williams*  

6 Disorders of Dogs and Cats 173  
*Claus D. Buergelt*  

7 Disorders of Nondomestic Mammals 201  
*Bruce A. Rideout*  

Appendix A Gestational Age Estimation Based on Fetal Measures and Phenotypic Characteristics 221  

Appendix B Summary Tables of Diagnostic Tests for Infectious Causes of Abortion and Neonatal Loss 225  

Index 233  

### Companion website

This book is accompanied by a companion website:  
[www.wiley.com/go/njaa](http://www.wiley.com/go/njaa)  
The website includes powerpoints of all figures from the book for downloading.
Contributors

Mark L. Anderson, DVM, PhD, DACVP
Professor of Clinical Diagnostic Pathology, California Animal Health & Food Safety Laboratory, DAHFS–Davis Lab, School of Veterinary Medicine, University of California, Davis, CA

Claus D. Buergelt, DVM, PhD, DACVP
Professor, Emeritus, Department of Infectious Diseases and Pathology, University of Florida, Gainesville, FL

Darin M. Madson, DVM, PhD, DACVP (Porcine Circovirus, only)
Assistant Professor, Department of Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University, Ames, IA

Robert B. Moeller Jr., DVM, PhD, DACVP
Professor of Clinical Diagnostic Pathology, California Animal Health & Food Safety Laboratory, CAHFS–Tulare Lab, School of Veterinary Medicine, University of California, Turlock, CA

Bradley L. Njaa, DVM, MVSc, DACVP
Associate Professor of Pathology, Department of Veterinary Pathobiology, Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, OK

Tanja Opriessnig, Dr Med Vet, PhD (Porcine Circovirus, only)
Associate Professor, Department of Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University, Ames, IA

Bruce A. Rideout, DVM, PhD, DACVP
Director, Wildlife Disease Laboratories, Institute for Conservation Research, San Diego Zoo Global, San Diego, CA

R. Flint Taylor, DVM, MS
Director, New Mexico Veterinary Diagnostic Services, New Mexico Department of Agriculture, Albuquerque, NM
Contributors

Neil M. Williams, DVM, PhD, DACVP
Professor, Associate Director, Veterinary Diagnostic Laboratory, College of Agriculture, University of Kentucky, Lexington, KY

Michael J. Yaege, DVM, PhD, DACVP
Associate Professor, Department of Veterinary Pathology, College of Veterinary Medicine, Iowa State University, Ames, IA
Preface

The first edition of this text was the result of an American Association of Veterinary Laboratory Diagnosticians (AAVLD) committee that formed nearly 40 years ago. Dr. Clyde Kirkbride was the committee chairperson for more than 17 years guiding the first and two subsequent editions of this work. What initially began as a 1974 book covering bovine abortions morphed into a food animal text in 1983 with the addition of sheep and swine. The third edition was the most complete, published in 1990, including cattle, small ruminants, pigs, and horses.

Similarly, this new edition came out of discussions in the AAVLD Pathology Committee. Initially, authors were selected to write about abortion diagnostics based on interest or expertise of a particular species, and their manuscripts were to be placed on a Web site linked to AAVLD. It was later decided that a published manuscript would be a better option.

The previous edition had 43 chapters, each devoted to a particular aspect of abortion diagnostics or a particular pathogen. It was roughly organized into species sections. This new edition has fewer chapters with each one devoted to one or two species. It covers conditions affecting cattle, sheep, goats, pigs, and horses, plus newly added chapters covering general approaches to abortion diagnostics and conditions affecting dogs and cats, and, finally, a chapter devoted to the broad topic of abortion and neonatal loss in nondomestic mammalian species.

The intended audience of this new edition includes veterinary diagnosticians around the world, veterinary pathologists, veterinary practitioners, veterinary educators, animal and public health workers, veterinary students, and veterinary technicians. The format for each chapter begins with an introductory section outlining the pathogenesis of abortions and neonatal loss, a section of special diagnostic techniques, a section of fetal and placental anatomy and physiology, and then detailed descriptions of the various causes of abortion or neonatal loss. In the diseases section, the format is as follows: viruses, bacteria and fungal, nutritional and toxic etiologies, and, finally, miscellaneous causes. The focus for each chapter is disease recognition as well as proper sampling necessary to make a definitive diagnosis.

It is my sincere hope that this publication will enhance our understanding of reproductive disease in animals, will build upon the reputation of previous editions, and will become an invaluable reference that helps decipher abortion and neonatal loss around the world.
Editor’s Acknowledgements

Firstly, I would like to thank members of the AAVLD Pathology Committee for entrusting this project to me. In particular, thank you to Matti Kiupel and Donal O’Toole for continually believing in me throughout the process.

Secondly, I would like to express my deepest gratitude to each of the authors and contributors. Each of you contributed greatly to this effort and have built upon the foundation laid by Dr. Kirkbride and the previous authors.

Thirdly, I wish to thank Erica Judisch, Susan Engelken, and all the staff at Wiley-Blackwell as well as Peggy Hazelwood for their professionalism, hard work, and belief in this project.

Fourthly, I wish to thank all of you who have been a professional mentor to me. In particular, I wish to thank Edward G. (“Ted”) Clark, Craig Riddell, Greg Stevenson, Evan Janovitz, Sandy de Lahunta (“Dr. D”), Edward Dubovi, Tony Confer, and Roger Panciera for your encouragement, advice, and constructive criticism through the years.

Finally, thank you Leanne, Brynne, Layne, and Brooke Anna, for all of your patience and continued support. I love you all!

Sincerely,
Bradley L. Njaa