Advanced Monitoring and Procedures for **Small Animal Emergency and Critical Care**

Edited by: **Jamie M. Burkitt Creedon and Harold Davis**

WILEY-BLACKWELL

with website

Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care

Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care

Editors

Jamie M. Burkitt Creedon, DVM, DACVECC

Chief, Emergency and Critical Care Service
Red Bank Veterinary Hospital, Cherry Hill
Cherry Hill, New Jersey

Harold Davis, BA, RVT, VTS (ECC) (Anesth)

Manager, Emergency and Critical Care Service
William R. Pritchard Veterinary Medical Teaching Hospital
University of California, Davis
Davis, California

WILEY-BLACKWELL

A John Wiley & Sons, Inc., Publication

Wiley-Blackwell is an imprint of John Wiley & Sons, formed by the merger of Wiley's global Scientific, Technical and Medical business with Blackwell Publishing.

Registered office: John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial offices: 2121 State Avenue, Ames, Iowa 50014-8300, USA
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK
9600 Garsington Road, Oxford, OX4 2DQ, UK

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com/wiley-blackwell.

Library of Congress Cataloging-in-Publication Data
Advanced monitoring and procedures for small animal emergency and critical care / editors, Jamie M. Burkitt Creedon, Harold Davis.
p. ; cm.
Includes bibliographical references and index.
ISBN 978-0-8138-1337-0 (pbk. : alk. paper)
I. Creedon, Jamie M. Burkitt. II. Davis, Harold, 1958–
[DNLM: 1. Emergency Treatment–veterinary. 2. Critical Care–methods. 3. Monitoring, Physiologic–veterinary. 4. Therapeutics–veterinary. SF 778]
636.089'6028–dc23
2011036425

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Set in 10.5/12.5 pt Minion by Toppan Best-set Premedia Limited

1 2012

To Dr. Janet Aldrich, who taught me that thinking and knowing are different, and that the former is far more important.

To Dr. Steve Haskins, who showed me that listening is the teacher's most important skill.

To my parents, Robbie and Mike, who taught me that caring is always worth it.

And to my husband Mike, who gives selflessly over and over and over again.

I love and thank you all.

–Jamie M. Burkitt Creedon

First and foremost this book is dedicated to my parents, Dr. Harold Davis, Sr., and Barbara Davis, and my sister, Deborah Davis-Gillespie, for their love, support and guidance. To Thomas J. Bulgin, DVM, for giving me my start as a veterinary assistant and Gary L. Reinhardt, DVM, and Steve C. Haskins, DVM, DACVECC, for their mentorship. To each current and past member that I have served with on the board of directors for the Veterinary Emergency and Critical Care Society. To the veterinary technicians and nurses that I have talked to around the world and former veterinary students of U.C. Davis: I have enjoyed sharing my knowledge and experiences with you. Finally, to the co-founding and charter members of the Academy of Veterinary Emergency, and Critical Care Technicians: it was an honor, pleasure, and a joy to work with you in developing the first veterinary technician speciality academy.

–Harold Davis

Contents

This book has a companion website including images and protocols from the book available at www.wiley.com/go/burkittcreedon.

Contributors

Amanda Adams, LVT, VTS (ECC)
Critical Care/Dialysis Technician
VCA Veterinary Specialty Center of Seattle
Seattle, Washington

Janet Aldrich, DVM, DACVECC
Formerly Clinical Veterinarian
Veterinary Medical Teaching Hospital
University of California
Davis, California

Lori Baden Atkins, AAS, LVT, VTS (ECC)
Small Animal ICU/ER Coordinator
Veterinary Medical Teaching Hospital
Texas A&M University
College Station, Texas

Devon A. Ayres, RVT, BS
Intensive Care Unit Technician
Veterinary Specialty Hospital
San Diego, California

Linda S. Barter, MVSc, BSc (Vet), PhD, DACVA
Assistant Professor of Veterinary Anesthesiology
University of California
Davis, California

Linda Barton, DVM, DACVECC
Staff Veterinarian
Department of Critical Care
VCA Veterinary Specialty Center
Lynnwood, Washington

Elana Moss Benasutti, CVT
Critical Care Nurse
Intensive Care Unit
Matthew J. Ryan Veterinary Hospital
University of Pennsylvania
Philadelphia, Pennsylvania

Amanda K. Boag, MA, VetMB, DACVIM, DACVECC, FHEA, MRCVS
Clinical Director
Vets Now
Scotland, United Kingdom

Jennifer Boyle, RVT, VTS (ECC)
CE Relationships Manager
Veterinary Information Network
Davis, CA

Benjamin M. Brainard, VMD, DACVA, DACVECC
Associate Professor, Critical Care
Department of Small Animal Medicine and Surgery
College of Veterinary Medicine
University of Georgia
Athens, Georgia

Yekaterina Buriko, DVM, DACVECC
Staff Doctor
Animal Medical Center
New York, New York

Jamie M. Burkitt Creedon, DVM, DACVECC
Chief, Emergency and Critical Care Service
Red Bank Veterinary Hospital, Cherry Hill
Cherry Hill, New Jersey

Christopher G. Byers, DVM, DACVECC, DACVIM
Faculty Internist / Criticalist
MidWest Veterinary Specialty Hospital
Omaha, Nebraska

Mary Tefend Campbell, CVT, VTS (ECC)
Nursing Manager
Carriage Hills Referral Hospital
Montgomery, Alabama

Scott Campbell, BVSc (Hons), MACVSc, DACVN
Senior Lecturer in Clinical Nutrition
Clinical Nutrition Support Service
School of Veterinary Science
University of Queensland
Brisbane, Australia

Vicki L. Campbell, DVM, DACVA, DACVECC
Assistant Professor
Clinical Care Unit
Department of Clinical Sciences
Colorado State University
Fort Collins, Colorado

Daniel L. Chan, DVM, DACVECC, DACVN, FHEA, MRCVS
Senior Lecturer in Emergency and Critical Care
Clinical Nutritionist
Department of Veterinary Clinical Sciences
The Royal Veterinary College
University of London
Hertfordshire, United Kingdom

Rosalind S. Chow, VMD, DACVECC
Criticalist
Veterinary Medical and Surgical Group
Ventura, California

Monica C. Clare, VMD, DACVECC
Director of the ICU
Intensive Care Unit
Veterinary Specialty Hospital
San Diego, California

Edward Cooper, VMD, MS, DACVECC
Assistant Professor, Small Animal Emergency and Critical Care
Department of Veterinary Clinical Sciences
Ohio State University
Columbus, Ohio

Stacey Cooper, RVT, VTS (ECC)
Veterinary Medical Center
Ohio State University
Columbus, Ohio

Craig Cornell, BA, RVT, VTS (ECC) (Anesthesia)
Department of Small Animal Anesthesia
University of California
Davis, California

Meredith L. Daly, VMD, DACVECC
Bluepearl Veterinary Partners
New York, New York

Harold Davis, BA, RVT, VTS (ECC) (Anesthesia)
Manager, Emergency and Critical Care Service
William R. Pritchard Veterinary Medical Teaching Hospital
University of California
Davis, California

Julie Denton-Schmiedt, CVT, BA
Large and Small Animal Anesthesia Veterinary Technician
Hull, Georgia

Jennifer Devey, DVM, DACVECC
Department Head, Emergency and Critical Care Service
Director of Education
Lauderdale Veterinary Specialists
Fort Lauderdale, Florida

Pamela Dilley, RVT, CCRA
Veterinary Medical and Surgical Group
Ventura, California

Katherine Dobbs, RVT, CVPM, PHR
interFace Veterinary HR Systems, LLC
Appleton, Wisconsin

Jeni Dohner, CVT, VTS (ECC)
Emergency Service
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Julie A. Eveland-Baker RVT, VTS (ECC)
Shift Supervisor, Small Animal Intensive Care Unit
Veterinary Medical Teaching Hospital
University of California
Davis, California

Mary M. Flanders, RVT, VTS (ECC)
Veterinary Medical Teaching Hospital
University of Missouri
Columbia, Missouri

Daniel J. Fletcher, PhD, DVM, DACVECC
Assistant Professor of Emergency and Critical Care
Department of Clinical Sciences
College of Veterinary Medicine
Cornell University
Ithaca, New York

Adrian Ford, BS, LVT, VTS (ECC)
Chief Operations Officer, Hospital Administrator
Emergency Pet Center Hospitals
Emergency Pet Clinic INC
San Antonio, Texas

Sharon Fornes, RVT, VTS (Anesthesia)
Program Director
Veterinary Technology
Carrington College California
San Leandro, California

Robert Goggs, BVSc, DACVECC, MRCVS
Wellcome Trust Research Training Fellow
School of Physiology and Pharmacology
University of Bristol
Bristol, United Kingdom

Sarah Gray, DVM, DACVECC
Criticalist
Veterinary Medical and Surgical Group
Ventura, California

Rebecca J. Greer, DVM, MS, DACVECC
Staff Criticalist
Veterinary Specialty Services
Manchester, Missouri

Sarah L. Haldane, BVSc, BAnSc, MACVSc, DACVECC
Senior Lecturer
Department of Emergency and Critical Care
University of Melbourne
Melbourne, Victoria, Australia

Natalie Harvey, BApSc (VT)
Nutrition Technician
Clinical Nutrition Support Service
School of Veterinary Science
University of Queensland
Brisbane, Australia

Steve C. Haskins, DVM, MS, DACVA, DACVECC
Professor Emeritus
University of California
Davis, California

Cindy Hauser, MBA, CVT, VTS (ECC)
Wheat Ridge Animal Hospital
Wheat Ridge, Colorado

Marie K. Holowaychuk, DVM, DACVECC
Assistant Professor, Emergency and Critical Care Medicine
Department of Clinical Studies
Ontario Veterinary College
University of Guelph
Guelph, Ontario, Canada

Kate Hopper, BVSc, PhD, DACVECC
Assistant Professor, Small Animal Emergency and Critical Care
Department of Veterinary Surgical and Radiological Sciences
University of California
Davis, California

Katherine Jayne Howie, VN, VTS (ECC)
Senior Veterinary Nurse
Vets-Now Farnham
Farnham, United Kingdom

Karl E. Jandrey, DVM, MAS, DACVECC
Assistant Professor of Clinical Small Animal Emergency and Critical Care
Department of Surgical and Radiological Sciences
William R. Pritchard Veterinary Medical Teaching Hospital
University of California
Davis, California

Michael S. Kent, DVM, DACVIM (Oncology), DACVR (Radiation Oncology), MAS
Assistant Professor
Department of Surgical and Radiological Sciences
School of Veterinary Medicine
University of California
Davis, California

Lesley G. King, MVB, DACVECC, DACVIM
Department of Clinical Studies
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Casey J. Kohen, BA
Research Assistant, Mellema Lab
School of Veterinary Medicine
University of California
Davis, California

Timothy Koors, DVM
Resident
Veterinary Specialty Services
Manchester, Missouri

Mary Anna Labato, DVM, ACVIM
Clinical Professor
Section Head, Small Animal Medicine
Cummings School of Veterinary Medicine
Tufts University
North Grafton, Massachusetts

Michael S. Lagutchik, DVM, MS, DACVECC
Medical Director
Emergency Pet Center Hospitals
San Antonio, Texas

Cathy Langston, DVM, DACVIM
Staff Veterinarian, Head of Nephrology, Urology, and Hemodialysis Unit
Department of Renal Medicine and Hemodialysis
Animal Medical Center
New York, New York

Carine Laporte, VMD
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Jennifer Larsen, DVM, PhD, DACVN
Assistant Professor of Clinical Nutrition
Department of Molecular Biosciences
School of Veterinary Medicine
University of California
Davis, California

Stephanie Leone, BS, RVT
Emergency Service Manager
Pet Emergency & Specialty Center
La Mesa, California

Rosemary Lombardi, CVT, VTS (ECC)
Director of Nursing
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Bridget Lyons, BA, CVT
ICU Nurse, VHD Candidate
Intensive Care Unit
University of Pennsylvania School of Veterinary Medicine
Philadelphia, Pennsylvania

Elisa M. Mazzaferro, MS, DVM, PhD, DACVECC
Director of Emergency Services
Wheat Ridge Animal Hospital
Wheat Ridge, Colorado

Douglass K. Macintire, DVM, MS, DACVECC
Professor of Acute Medicine and Critical Care
Department of Clinical Sciences
College of Veterinary Medicine
Auburn University
Auburn, Alabama

F. A. (Tony) Mann, DVM, MS, DACVS, DACVECC
Director of Small Animal Emergency and Critical Care Services
Small Animal Soft Tissue Surgery Service Chief
Veterinary Medical Teaching Hospital
University of Missouri
Columbia, Missouri

Margo Mehl, DVM, DACVS
San Francisco Veterinary Specialists
San Francisco, California

Megan Patterson Melcher, RVT
ICU Technician
VCA Veterinary Referral Associates
Gaithersburg, Maryland

Matthew S. Mellema, DVM, PhD, DACVECC
Assistant Professor, Small Animal Emergency and Critical Care
School of Veterinary Medicine
University of Califronia
Davis, California

Martin D. Miller
Operations Manager
AVETS
Monroeville, Pennsylvania

Elizabeth Olmstead, CVT, BS
Blood Donor Supervisor, ICU Technician
Department of Small Animal Medicine
College of Veterinary Medicine
University of Minnesota
St. Paul, Minnesota

Joao Orvalho, DVM, DACVIM (Cardiology)
Veterinary Medical Center
School of Veterinary Medicine
University of California
San Diego, California

Carl A. Osborne, DVM, PhD, DACVIM
Professor of Veterinary Internal Medicine
College of Veterinary Medicine
University of Minnesota
St. Paul, Minnesota

Sara M. Ostenkamp
Veterinary Technician
ICU Department
North Carolina State University
Raleigh, North Carolina

Romain Pariaut, DVM, DACVIM (Cardiology), ECVIM-CA (Cardiology)
Assistant Professor of Cardiology
Department of Veterinary Clinical Sciences
School of Veterinary Medicine
Louisiana State University
Baton Rouge, Louisiana

Sally C. Perea, DVM, MS, DACVN
Senior Nutritionist
Department of Research and Development
P&G Pet Care
Mason, Ohio

Karen Poeppel, BS, LVT
Head Technician, Hemodialysis Unit
Department of Internal Medicine
Animal Medical Center
New York, New York

David J. Polzin, DVM, PhD, DACVIM
Professor of Veterinary Internal Medicine
College of Veterinary Medicine
University of Minnesota
St. Paul, Minnesota

Lisa L. Powell, DVM, DACVECC
Clinical Professor, Emergency and Critical Care
Small Animal ICU Director
College of Veterinary Medicine
University of Minnesota
St. Paul, Minnesota

Paul Primas, RVT
Supervisor, Radiation and Medical Oncology
William R. Pritchard Veterinary Medical Teaching Hospital
University of California, Davis
Davis, California

Jennifer E. Prittie, DVM, DACVIM, DACVECC
Criticalist
Department of Emergency and Critical Care
Animal Medical Center
New York, New York

Jane Quandt, DVM, MS, DACVA, DACVECC
Associate Professor in Anesthesia
Department of Small Animal Medicine
College of Veterinary Medicine
University of Georgia
Athens, Georgia

Marc R. Raffe, DVM, MS, DACVA, ACVECC
Associate Director
Pfizer Animal Health

Louisa J. Rahilly, DVM, DACVECC
Medical Director of Emergency and Critical Care
Cape Cod Veterinary Specialists
Buzzards Bay, Massachusetts

Erica L. Reineke, VMD, DACVECC
Assistant Professor, Emergency and Critical Care Medicine
Department of Clinical Studies
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Angel Rivera, AHT, VTS (ECC)
Animal Emergency Center and Specialty Services
Glendale, Wisconsin

Joris H. Robben, PhD, DECVIM CA
Assistant Professor
Head of the ICU
Department of Clinical Sciences of Companion Animals
Faculty of Veterinary Medicine
Utrecht University
Utrecht, The Netherlands

Amy Rodriguez, CVT, VTS (Anesthesia)
Anesthesia Nurse
Department of Anesthesia
Colorado State University
Fort Collins, Colorado

Elizabeth Rozanski, DVM, DACVECC, DACVIM
Associate Professor
Section of Critical Care
Cummings School of Veterinary Medicine
Tufts University
North Grafton, Massachusetts

Elke Rudloff, DVM, DACVECC
Director of Education
Animal Emergency Center and Specialty Services
Glendale, Wisconsin

Emily Savino, BA, AAS, CVT, VTS (ECC)
ICU Nursing Supervisor
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Jessica Schavone, BS, CVT
Blood Bank Technician Supervisor and Emergency and Critical Care Technician
Section of Critical Care
Department of Clinical Sciences
Cummings School of Veterinary Medicine
Tufts University
North Grafton, Massachusetts

Connie M. Schmidt, CVT
Training/Education Coordinator, Senior Technician
Fox Valley Animal Referral
Appleton, Wisconsin

Lila K. Sierra, CVT, VTS (ECC)
Assistant Nursing Supervisor/Intensive Care Unit
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Deborah Silverstein, DVM, DACVECC
Assistant Professor of Critical Care
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Carolyn A. Sink, MS, MT(ASCP)
Supervisor, Diagnostic and Support Services
Veterinary Teaching Hospital
Virginia- Maryland Regional College of Veterinary Medicine
Blacksburg, Virginia

Sean D. Smarick, VMD, DACVECC
Hospital Director
Emergency and Critical Care Specialist
AVETS
Monroeville, Pennsylvania

Lisa Smart, BVSc (Hons), DACVECC
Senior Lecturer in Veterinary Emergency and Critical Care
Department of Veterinary Clinical Sciences
School of Veterinary and Biomedical Sciences
Murdoch University
Murdoch, WA, Australia

Michelle Storay, CVN DipECC
Animal Emergency Centre Nursing Director
Mount Waverley, Australia

Rebecca S. Syring, DVM, DACVECC
Staff Criticalist
Veterinary Specialty and Emergency Center
Levittown, Pennsylvania

Chiara Valtolina, DVM, DACVECC
Department of Clinical Sciences of Companion Animals
Faculty of Veterinary Medicine
Utrecht University
Utrecht, The Netherlands

Lori S. Waddell, DVM, DACVECC
Adjunct Assistant Professor, Critical Care
Department of Clinical Studies
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Nicole M. Weinstein, DVM, DACVP
Assistant Professor, Clinical Pathology
Department of Biomedical Sciences and Pathobiology
Virginia- Maryland Regional College of Veterinary Medicine
Blacksburg, Virginia

Diane M. Welsh, CVT
Cummings School of Veterinary Medicine
Tufts University
North Grafton, Massachusetts

Janelle R. Wierenga, DVM, DACVECC
Seattle, Washington

Jill A. Williamson, DVM, DACVECC
Animal Internal Medicine and Specialty Services
San Francisco, California

Monika L. Wright, CVT
Intensive Care Unit Staff
Matthew J. Ryan Veterinary Hospital
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Brian C. Young, VMD, DACVIM, DACVECC
Staff Criticalist
Department of Emergency and Critical Care
Animal Specialty Group
Los Angeles, California

Preface

The disciplines of small animal emergency medicine and critical care have grown significantly in the past decade. There are many references available that describe the diagnosis and medical treatment of problems encountered in small animal emergency and critical care practice. However, none is dedicated specifically to the daily hands-on practice of the specialties: for instance, the placement and maintenance of arterial catheters and the interpretation of direct pressure waveforms they provide, or the nursing care required to maintain a patient on long-term mechanical ventilation (what do all those buttons on the ventilator do, anyway?). We believe the veterinary community would benefit from a single reference written by informed, experienced people to improve and expand the standard of care, and we hope this textbook serves that purpose. The experienced veterinarian and veterinary technician contributors to *Advanced Procedures and Monitoring for Small Animal Emergency and Critical Care* have provided herein a well-referenced textbook that we believe contains useful information on the "non-medicine" aspects of ECC practice, from practice design to technical procedures and nursing care to interpretation of monitoring results.

There is no small animal specialty in which cooperation between all healthcare team members is more important than in emergency and critical care. Thus, some chapters are authored by a veterinarian, others by a veterinary technician, and some by pairs. The interdependence of all members of the ECC healthcare team requires that veterinary technicians understand why clinicians ask them to do what they do, and that veterinarians understand proper ECC nursing care and technical procedures. The book's contributors come from around the world, from both university and private practice. We aimed to provide the best-referenced, highest-quality textbook that we could. Contributors congenially answered our frequent "Do you have a reference for this?" inquiries and high-quality image requests, so that the reader could have confidence in the recommendations contained herein and see illustrations of how to perform procedures or interpret results. When high-quality references or guidelines were unavailable, these qualified authors made recommendations based on their experience; in such cases, such personal recommendation is noted in the text for transparency.

The textbook is organized roughly by organ system or general topic, but there is considerable overlap in some areas. For instance, some authors of device insertion chapters included a maintenance section, and maintenance of that device may also be covered in another chapter specifically on insertion site maintenance or artificial airway maintenance, and so on. **Standardized protocols** are included for procedures for which they were deemed useful and appropriate. These protocols are based on best-available evidence and guidelines, and where such citations were unavailable or inappropriate, they are based on author experience. We hope these protocols will help raise and equalize the standard of care across our profession, and serve as the backbone for a protocol book to use in your emergency or critical care practice.

We welcome corrections and ideas for future versions of this textbook. Should further editions follow, we are committed to their currency and relevancy, and thus will continue to push for best-practice, evidence- and guideline-based recommendations. Lastly, we would like to thank each contributor; we believe they did an amazing job stepping up to the challenges that this unique textbook posed.

Jamie M. Burkitt Creedon
Harold Davis

Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care

SECTION I

Introduction

1

Triage

Harold Davis

The concept of triage finds its origin in the French military. The word comes from the French verb *trier*, meaning to sort. In human medicine the goals of triage have varied over the years depending upon the situation. After World War II triage came to mean the process of identifying those soldiers most likely to return to battle after medical care. Following the Korean and Vietnam conflicts the goals of triage came to mean the greatest good for the greatest number of wounded.[1] In times of disaster, the goals of triage are similar to the military. Daily human emergency room triage began in the 1960s and has evolved into a method to separate efficiently those patients stable enough to wait for treatment from those who require immediate medical attention. In veterinary medicine we have adopted the goals of our counterparts in the human emergency room. Thus, we prioritize cases by medical urgency when presented with multiple emergencies at the same time.

Triage occurs both by telephone and in the hospital. A client often calls the hospital seeking advice for the care of his or her pet; the receptionist or veterinary technician must ascertain useful information about the pet in a short period of time. In addition the receptionist or technician should have the knowledge required to provide the appropriate advice. The information obtained during the telephone conversation will also be useful in preparing for patient arrival. On initial presentation to the hospital the veterinary technician is usually first to receive the patient and therefore to perform basic triage. This person must determine whether the patient needs immediate care and, in the case of simultaneous patient arrivals, prioritize treatment based on medical need.

Telephone triage

In theory, telephone triage requires clinic staff to determine the urgency of a pet's problem and to provide advice based on that determination. However, because the client may not possess the training to give an accurate account of the pet's problem(s), it is generally safest to recommend the client take the pet to a veterinarian for evaluation. Particularly, any patient experiencing breathing difficulty, seizures, inability or unwillingness to rise, or traumatic injury should be seen by a veterinarian without question.

At the beginning of the telephone conversation staff should establish the animal's signalment (breed, sex, age, and weight) if possible. Questions asked of the owner should be basic and straightforward. They should address the patient's level of consciousness, whether or not the patient is breathing, experiencing seizures, or has obviously broken or exposed bones (see Table 1.1). Based on the owner's responses, advice can be given on first aid, assuming that the problem can be clearly defined and is simple. See Table 1.2 for a list of problems requiring attention by the veterinary health care team without delay.

Information gathered during the phone conversation can aid the veterinary technician in preparation for the arrival of the patient at the hospital. Simply knowing the animal's breed or approximate weight can enable the technician to pre-select appropriate sizes for vascular catheters, fluid bags, and endotracheal tubes.

Owners should be instructed on safe transport for the animal. Animals that have suffered trauma are often in pain, and owners should be instructed on how to

Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care, First Edition. Edited by Jamie M. Burkitt Creedon, Harold Davis.

Figure 1.1 (a) Placing a dog in a box for transport. (b) Using a blanket as a stretcher. The animal is placed on a blanket and the edges of the blanket used to lift the patient.

Table 1.1 Questions useful in telephone triage, and suggested responses

1. Is the animal breathing and conscious?
   a. If neither, institute mouth-to-snout; if yes to either of these, do not.
2. Is the animal actively experiencing a seizure?
   a. If yes, remove from danger of falling or any sharp objects. Take to veterinarian immediately after seizure ends, or if it lasts longer than 1–2 minutes, bring during seizure. Watch out for the mouth; don't get bit.
3. For people who live a distance from medical assistance or cannot/will not come in: Has the animal ingested something that you know or suspect is poisonous in the last 2 hours?
   a. In some situations, at–home emesis may be recommended.
4. Is there active bleeding, an obvious fracture, or exposed bone?
   a. Recommend clean towel over the site, pressure if spurting blood. Warn clients to be VERY CAREFUL not to get bitten.

approach the pet and place a makeshift muzzle using a neck tie, belt, or strips of cloth. If the animal is nonambulatory, owners may be told to place the animal in a box or carrier, or to use a blanket or towel as a stretcher (see Fig. 1.1). The use of a blanket stretcher makes it easier to get an animal in and out of a car.

When the caller is not a regular client of the facility, the staff member should obtain the client's phone number in case of disconnection and make the caller aware of the address, location, or easiest directions to the clinic. The client should be informed of the clinic's payment policy.

Table 1.2 Problems requiring immediate attention by the veterinary health care team

Respiratory distress	Bleeding from body orifices
Pale mucous membranes	Weakness
Neurological abnormalities	Rapid abdominal distension
Protracted vomiting	Inability to urinate
Severe coughing	Ingestion of toxins

Hospital triage

Three major body systems are assessed during the initial triage: respiratory, cardiovascular, and neurological. Triage begins when approaching the patient. Visually assess breathing effort and pattern; presence of blood or other foreign material on or around the patient; and the patient's posture and level of consciousness (LOC). Note if there are airway sounds audible without a stethoscope. Note whether or not the animal responds as you approach. If the animal is conscious, ask the owner about the patient's temperament and take the appropriate precautions regarding physical restraint or muzzling. The veterinary technician cannot rely on the client's statement that an animal "never bites," but if he or she is told that the patient is aggressive, the patient should definitely be muzzled. Physical restraint and muzzling should be performed with extreme caution in patients with respiratory distress, as such steps can cause acute decompensation and respiratory arrest. If time permits, a brief history should be obtained.

The ABCDEs

A reasonable and systematic approach to triage is the use of the ABCDEs of emergency care, which are: (A) airway,

(B) breathing, (C) circulation, (D) dysfunction of the central nervous system, and (E) examination (see Fig. 1.2). Patients with respiratory distress or arrest, signs of hypovolemic shock or cardiac arrest, altered LOC, or ongoing seizure activity should be immediately taken to the treatment area for rapid medical attention. Conditions that affect other body systems are generally not life-threatening in and of themselves, but their effects on the three major body systems may be life-threatening. For example, a fractured femur bleeding into a limb can lead to life-threatening hypovolemia. The following is a list of problems that also require immediate medical attention:

- Exposure to toxins (ingested or topical)
- Excessive bleeding
- Open fractures
- Snake bite
- Burns
- Prolapsed organs
- Wound dehiscence
- Dystocia
- Trauma

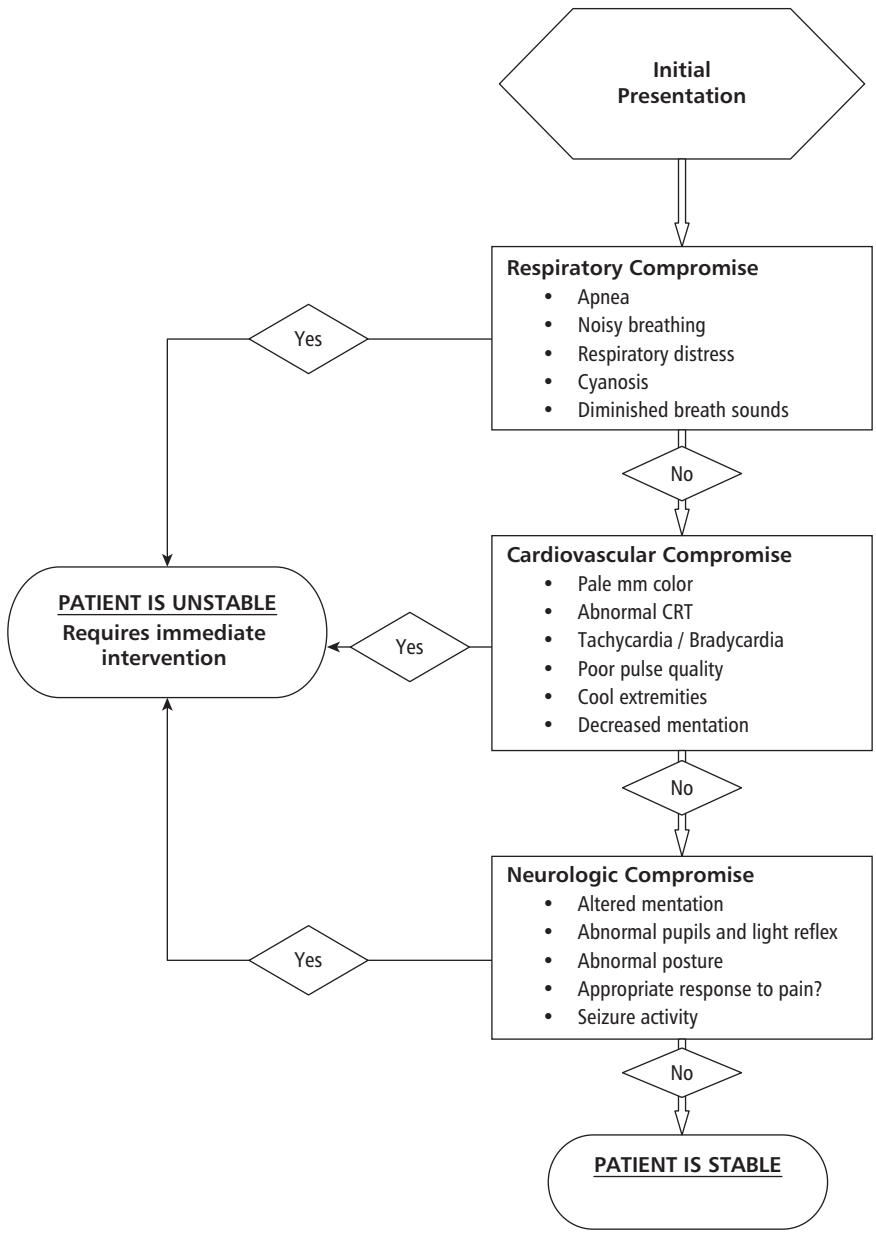

Figure 1.2 Triage Algorithm.

Airway and breathing

Expedient respiratory system assessment and rapid correction of abnormalities is critical. First, patency of airway and breathing effort should be assessed. This is done by visualization, auscultation, and palpation. When looking at the animal, an experienced individual can determine if the animal has increased breathing rate or effort. Some animals with respiratory distress may assume a posture with the head and neck extended and the elbows abducted (held away from the body). Additional concerning signs include absent chest wall motion, exaggerated breathing effort, flaring of the nares, open mouth breathing and paradoxical breathing. When sustained high breathing effort leads to respiratory fatigue, paradoxical breathing can occur, which is characterized by opposing movements of the chest and abdominal walls during inspiration and expiration. Cyanosis, a blue or purplish tint to the mucous membranes, usually indicates hypoxemia and warrants immediate medical intervention. The chest wall may be palpated to assess chest wall integrity. Crepitus about the body may indicate subcutaneous emphysema, which can be caused by tracheal tears or chest wall defects.

Some assessment questions the triage technician should consider:

- Is the patient having difficulty breathing?
- Are breath sounds auscultable?
- Are facial injuries interfering with the airway?
- Has a bite wound disrupted the larynx or trachea?
- Is subcutaneous emphysema present?
- What color are the mucous membranes?
- Does respiratory distress get worse with patient position change?
- Is there evidence of thoracic penetration or a flail chest?

Circulation

Many of the signs suggestive of decreased cardiac output are a result of a compensatory sympathetic reflex, which helps maintain arterial blood pressure. Clinical signs suggestive of decreased cardiac output include: tachycardia, pale or gray mucous membranes, prolonged capillary refill time, poor pulse quality, cool extremities, and decreased mentation. Decreased cardiac output may be due to hypovolemia as a result of blood or other fluid loss (internally or externally; active or historical), trauma, or cardiac disease.

Circulation is assessed by visualization, palpation, and auscultation. The focus of the cardiovascular assessment is the six perfusion parameters (see Table 1.3).

Table 1.3 The six perfusion parameters

- Mucous membrane color
- Capillary refill time
- Heart rate
- Pulse quality
- Extremity temperature
- Mentation

Figure 1.3 Assessing a patient's mucous membrane color.

Mucous membrane color

After assuring it is safe to do so, evaluate the mucous membranes by examining the color of the gums (see Fig. 1.3). As an alternative in the fractious animal or patients with pigmented gums examine the conjunctiva, penis, or the vulva. The normal color of pink is a result of oxygenated hemoglobin in red blood cells in the capillary bed. Mucous membrane color may vary with circulatory related problems. Mucous membrane color may be pale or white due to blood loss anemia or vasoconstriction. Brick red or injected mucous membranes are a result of vasodilation and can be seen with hyperthermia or sepsis. Cyanotic or blue mucous membranes are an indicator of severe hypoxemia. The absence of cyanosis does not rule out hypoxemia. Icteric or yellow mucous membranes are due to the breakdown of red cells (hemolysis) or liver disease. Methemoglobinemia results in brown or chocolate-colored mucous membranes.

Capillary refill time (CRT)

Evaluation of CRT is done by applying digital pressure to the surface of the mucous membranes and forcing the blood from the capillary bed and observing the return

of color. Normal CRT is 1–2 seconds. A shortened CRT (<1/2 second) is suggestive of vasodilation. A prolonged capillary refill time (>2 seconds) is also a result of peripheral vasoconstriction and causes decreased peripheral perfusion.

Heart rate

Heart rate is a nonspecific parameter. It is usually measured by auscultation of the heart, palpation of the apex beat, or palpation of an artery. Increase in heart rate (tachycardia) may be caused by hypovolemia (the tachycardia is a compensatory mechanism), hypoxemia, hypotension, drugs, fever, excitement, exercise, and pain. Tachycardia is generally defined as a heart rate >160 beats per minutes (bpm) in the dog or 200 bpm in the cat. Decrease in heart rate (bradycardia) may be caused by increased vagal tone, severe electrolyte disturbances and hypothermia, drugs, or disturbances of the cardiac conduction system. Bradycardia is generally defined as a heart rate <60 bpm in the dog and 140 bpm in the cat. Auscultation of the heart also provides information about rhythm and murmurs. Auscultation of the heart and palpation of an artery should occur simultaneously, so that pulse deficits (the difference between heart and pulse rate; they should be the same) can be determined. Pulse deficits are suggestive of arrhythmias.

Pulse quality

Palpation of the artery provides information about the animal's heart rate and rhythm. The femoral or dorsal pedal arteries are the commonly palpated arteries. In addition, pulse quality is an indicator of stroke volume, the amount of blood pumped out of the heart with each beat. Palpating a peripheral pulse is feeling the difference between the systolic and diastolic pressures and duration of the waveform. Ideally, the pulse should be full, regular, and strong, indicating a normal stroke volume. A thready pulse is defined as a narrow waveform and a weak pulse refers to a small amplitude pulse difference, both of which are indicative of a decreased stroke volume. Bounding pulses have a large pulse pressure difference and wide waveforms usually associated with increased stroke volume and vasodilation.

Extremity temperature

The paws, limbs, or ears should normally feel warm to the touch. Cool extremities are a result of vasoconstriction.

Mentation

As previously mentioned, evaluation of mentation starts from afar. Observe the attitude of the patient without stimulation. If the patient has an altered mental state, it is assessed for its response to touch, sound, and painful stimuli. An inappropriate mental state can be a result of inadequate perfusion or a primary brain problem.

Some assessment questions the triage technician should consider:

- Is the patient's mentation normal?
- Is there evidence of hemorrhage?
- Is there swelling associated with an extremity or evidence of a fracture?
- Are the mucous membranes pale?
- Is the capillary refill time prolonged?
- Are the pulses weak and rapid?
- Is the heart rate abnormal?
- Are the extremities cold?

Dysfunction or disability of the neurological system

Dysfunction or disability refers to the neurological status of the patient. This may be assessed through visualization and palpation. A cursory neurologic exam is performed focusing on the patient's LOC, pupillary light reflex, posture, and response to pain (superficial and deep). Depressed mentation may be a result of poor oxygen delivery or trauma to the brain. Seizure activity may be due to intra- or extracranial causes.

A patient that is recumbent, has an abnormal posture, or is not seen to ambulate or make voluntary movements should be assumed to have spinal trauma and stabilized on a backboard (see Fig. 1.4) until proven otherwise.

Figure 1.4 A patient with suspected head and spinal trauma restrained on a backboard. The cranial end of the board is elevated slightly because of suspected increased intracranial pressure.

Some assessment questions the triage technician should consider:

- Is the animal bright, alert, and responsive or obtunded (depressed but rousable), stuporous (roused only with painful stimulation), or comatose?
- Are the pupils dilated, constricted, of equal size, and responsive to light?
- What is the posture of the animal?
- Are there any abnormal breathing patterns?
- Does the animal respond to painful stimuli?
- Is there obvious seizure activity?

Examination

Finally, a rapid whole-body examination is performed. The goal is to determine and address any additional problems.

Some assessment questions the triage technician should consider:

- Are there lacerations, wounds, or punctures?
- Is there bruising and is it getting worse?
- Are there any fractures?
- Is the abdomen painful or distended?
- Is there evidence of debilitation or other signs of disease?

Summary

In some emergencies, minutes count. The triage performed by the veterinary technician should be rapid and efficient. The goal is rapid recognition of and intervention for life-threatening conditions such as hypoxemia and inadequate perfusion. A systematic approach to patient assessment is essential for the best possible patient outcome.

Reference

1. Bracken JE. Triage. In: Newberry L, ed. Sheehy's Emergency Nursing Principles and Practice. St. Louis: Mosby 1998;105–111.

2

The small animal emergency room

Martin D. Miller and Sean D. Smarick

Emergency medicine can be defined as "the diagnosis and treatment of unforeseen illness or injury."[1] The practice of emergency medicine takes place in primary care clinics during regular business hours or when veterinarians are on call, in dedicated "after-hours" free-standing emergency clinics, and in multispecialty referral hospitals. No clinical veterinary practice is immune to the realms of emergency medicine, as vaccines can cause anaphylactic reactions, anesthesia-related cardiopulmonary arrests can occur, and without warning clients may present a pet with a traumatic injury or critical illness.

The Veterinary Emergency and Critical Care Society (www.veccs.org), whose mission includes "To promote the advancement of knowledge and high standards of practice in veterinary emergency medicine and critical patient care," provides guidelines for emergency practice.[2] In looking to these standards along with applicable state board regulations, a practice should define for its patients, clients, the public, and for itself expectations for its *emergency* practice.

The practice of emergency medicine differs from primary care and other specialty practices by the urgency and breadth of the patients' conditions. Depending on the degree a practice wishes to diagnose and treat unforeseen illnesses and injuries, varying degrees of adaptations in the physical plant, equipment, inventory, staffing, and hospital systems are needed.

Physical plant

The facility requirements for an emergency practice at the most basic level do not differ significantly from a modern primary care practice. The differences between a dedicated emergency practice and that of primary care or specialty practice can be found in the layout and organization of space and equipment. The space needed ranges from a minimum of 2000–3000 square feet for a free-standing off-hours emergency clinic compared with 5000–10,000 square feet for a 24-hour emergency and critical care center either as a stand-alone facility or part of a multispecialty hospital (see Tables 2.1 and 2.2).

Hospital design and flow

When creating a floor plan concept for an emergency facility, a great deal of thought should be given to the specific aspects of the emergency practice. Good "flow" is essential to good design. Flow represents the natural movements of patients, clients, doctors, and staff in the daily activity of the practice;[3] arranging for such movement is almost like choreographing a dance. Thought should be given to dynamic situations such as how best to move clients from the lobby to examination rooms to discharge, and how most efficiently to move a large dog from x-ray to a surgical preparation area and then into a surgical suite.

In larger facilities the idea of a hub and spoke concept[4] can be applied to the flow of a practice. The hub can be a centralized space such as the treatment area. The spokes from the hub may be clinical areas such as the in-house laboratory, radiology, surgery, patient wards, isolation ward, and pharmacy. In even larger facilities, multiple hub and spoke areas may exist, such as one for the intensive care unit (ICU) and one for the emergency service. Industry-specific publications such as *Veterinary Economics* commonly address veterinary and emergency facility design.

Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care, First Edition. Edited by Jamie M. Burkitt Creedon, Harold Davis.

Table 2.1 Area approximation for a small dedicated emergency clinic

Space	Dimensions	Area (Sq Ft)
Lobby	15′ × 20′	300
Client bathroom	8′ × 8′	64
Reception area	10′ × 10′	100
Triage area	8′ × 10′	80
Exam room 1	10′ × 11′	110
Exam room 2	10′ × 11′	110
Exam room 3	10′ × 11′	110
Treatment room	30′ × 20′	600
Isolation ward	10′ × 10′	100
Surgical suite	15′ × 10′	150
Radiology	10′ × 8′	80
Staff bathroom	10′ × 9′	90
Staff break area	12′ × 10′	120
Administrative office	12′ × 10′	120
Utility/laundry room/storage	14′ × 8′	112
Total		**~2200 sq.ft.**

Table 2.2 Area approximation for a 24-hour emergency practice

Space	Dimensions	Area (Sq Ft)
Lobby	35′ × 25′	875
Client bathroom	8′ × 8′	64
Reception area	15′ × 10′	150
Check out area	10′ × 12′	120
Check out lobby	12′ × 15′	180
Triage area	8′ × 10′	80
Exam room 1	10′ × 11′	110
Exam room 2	10′ × 11′	110
Exam room 3	10′ × 11′	110
Exam room 4	10′ × 11′	110
Exam room 5	10′ × 11′	110
Consultation room	12′ × 12′	144
Treatment room	30′ × 40′	1200
Wards	15′ × 25′	375
Isolation ward	12′ × 12′	144
Laboratory	15′ × 20′	300
Surgical suite	15′ × 10′	150
Surgical preparation area	20′ × 12′	240
Radiology	12′ × 11′	121
Staff break area	12′ × 10′	120
Staff bathroom	10′ × 10′	100
Administrative office 1	10′ × 10′	100
Administrative office 2	10′ × 10′	100
Administrative office 3	10′ × 10′	100
Conference room	25′ × 15′	375
Doctors′ office/library	15′ × 20′	300
Server room	8′ × 8′	64
Utility/laundry room	14′ × 12′	168
Storage room	10′ × 12′	120
Total		**~6250**

Lobby

Accessible to the (emergency) entrance of the facility, the client waiting area must be large enough to accommodate a simultaneous influx of many clients and their pets. While benches or more utilitarian styles of seating may work well in a primary care practice where wait times are short, the client presenting a pet for an emergency may spend hours in the emergency practice lobby. Comfortable, well-padded chairs, a beverage service in the form of a water cooler or vending machine, and a restroom that is easily accessible to the client should be considered (see Fig. 2.1).

Reception area

This is the area where clients are initially received and usually discharged. Ideally, some degree of privacy should exist for the discharge area where financial or sensitive communication is taking place.

Security

Emergency practices have more security concerns than day practices because they are open during non-business hours and may be perceived to be rich in cash and narcotics. To provide a safe environment for staff and clients, enhanced security measures should be considered.

An alarm system can be installed in the facility that can notify a monitoring service or the police if the alarm is triggered. In continuous operations, "panic" buttons can be placed, whereas door, window, motion, and other

Figure 2.1 Lobby. Since clients may spend hours in an emergency practice lobby, it should be furnished with comfortable, well-padded chairs, beverage service, and an easily accessible restroom.