MEDICAL ASPECTS OF BIOLOGICAL WARFARE
The Coat of Arms
1818
Medical Department of the Army

The first line of medical defense in wartime is the combat medic. Although in ancient times medics carried the caduceus into battle to signify the neutral, humanitarian nature of their tasks, they have never been immune to the perils of war. They have made the highest sacrifices to save the lives of others, and their dedication to the wounded soldier is the foundation of military medical care.
The TMM Series

Published Textbooks

- Medical Consequences of Nuclear Warfare (1989)
- Conventional Warfare: Ballistic, Blast, and Burn Injuries (1991)
- Military Dermatology (1994)
- Military Psychiatry: Preparing in Peace for War (1994)
- Anesthesia and Perioperative Care of the Combat Casualty (1995)
- War Psychiatry (1995)
- Medical Aspects of Chemical and Biological Warfare (1997)
- Rehabilitation of the Injured Soldier, Volume 2 (1999)
- Ophthalmic Care of the Combat Casualty (2003)
- Military Medical Ethics, Volume 1 (2003)
- Military Medical Ethics, Volume 2 (2003)
- Military Preventive Medicine, Volume 1 (2003)
- Military Preventive Medicine, Volume 2 (2005)
- Recruit Medicine (2006)
- Medical Aspects of Biological Warfare (2007)
On October 12, 2007, during a planned exercise conducted by the Aeromedical Isolation Team of the US Army Medical Research Institute of Infectious Diseases at Fort Detrick, Maryland, a patient who has notionally been exposed to a biological agent is being contained in the stretcher transit isolator and being prepared for transport via helicopter to be given medical care in the biosafety level-4 containment care suite (“the slammer”).

Photograph by Bruce Maston, 2007.
MEDICAL ASPECTS OF BIOLOGICAL WARFARE

Senior Editor

Zygmunt F. Dembek, PhD, MS, MPH
Colonel, MSC, US Army Reserve
US Army Medical Research Institute of Infectious Diseases

Office of The Surgeon General
United States Army
Falls Church, Virginia

Borden Institute
Walter Reed Army Medical Center
Washington, DC

2007
This volume was prepared for military medical educational use. The focus of the information is to foster discussion that may form the basis of doctrine and policy. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

Dosage Selection:
The authors and publisher have made every effort to ensure the accuracy of dosages cited herein. However, it is the responsibility of every practitioner to consult appropriate information sources to ascertain correct dosages for each clinical situation, especially for new or unfamiliar drugs and procedures. The authors, editors, publisher, and the Department of Defense cannot be held responsible for any errors found in this book.

Use of Trade or Brand Names:
Use of trade or brand names in this publication is for illustrative purposes only and does not imply endorsement by the Department of Defense.

Neutral Language:
Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.
Contents

Section Editors xi
Contributors xiii
Peer Reviewers xvii
Foreword by The Surgeon General xix
Preface xxi

1. History of Biological Weapons: From Poisoned Darts to Intentional Epidemics
   James W. Martin, George W. Christopher, and Edward M. Eitzen, Jr. 1

2. Food, Waterborne, and Agricultural Diseases
   Zygmunt F. Dembek and Edwin L. Anderson 21

3. Epidemiology of Biowarfare and Bioterrorism
   Zygmunt F. Dembek, Julie A. Pavlin, and Mark G. Kortepeter 39

4. Anthrax
   Bret K. Purcell, Patricia L. Worsham, and Arthur M. Friedlander 69

5. Plague
   Patricia L. Worsham, Thomas W. McGovern, Nicholas J. Vietri, and Arthur M. Friedlander 91

6. Glanders
   Bridget Carr Gregory and David M. Waag 121

7. Melioidosis
   Nicholas J. Vietri and David Deshazer 147

8. Tularemia
   Matthew J. Hepburn, Arthur M. Friedlander, and Zygmunt F. Dembek 167

9. Brucellosis
   Bret K. Purcell, David L. Hoover, and Arthur M. Friedlander 185

10. Q Fever
    David M. Waag 199

11. Smallpox and Related Orthopoxviruses
    Peter B. Jahrling, John W. Huggins, M. Sofi Ibrahim, James V. Lawler, and James W. Martin 215

12. Alphavirus Encephalitides
    Keith E. Steele, Douglas S. Reed, Pamela J. Glass, Mary Kate Hart, George V. Ludwig,
    William D. Pratt, Michael D. Parker, and Jonathan F. Smith 241

13. Viral Hemorrhagic Fevers
    Peter B. Jahrling, Aileen M. Marty, and Thomas W. Geisbert 271

14. Staphylococcal Enterotoxin B and Related Toxins
    Robert G. Ulrich, Catherine L. Wilhelmsen, and Teresa Krakauer 311
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Ricin</td>
<td>Mark A. Poli, Chad Roy, Kermit D. Huebner, David R. Franz, and Nancy K. Jaax</td>
<td>323</td>
</tr>
<tr>
<td>16</td>
<td>Botulinum Toxin</td>
<td>Zygmunt F. Dembek, Leonard A. Smith, and Janice M. Rusnak</td>
<td>337</td>
</tr>
<tr>
<td>17</td>
<td>Additional Toxins of Clinical Concern</td>
<td>Kermit D. Huebner, Robert W. Wannemacher, Jr., Bradley G. Stiles, Michel R. Popoff, and Mark A. Poli</td>
<td>355</td>
</tr>
<tr>
<td>18</td>
<td>Laboratory Identification of Biological Threats</td>
<td>Erik A. Henchal, George V. Ludwig, Chris A. Whitehouse, and John M. Scherer</td>
<td>391</td>
</tr>
<tr>
<td>19</td>
<td>Consequence Management: The National and Local Response</td>
<td>Kermit D. Huebner and James W. Martin</td>
<td>415</td>
</tr>
<tr>
<td>20</td>
<td>Medical Management of Potential Biological Casualties: A Stepwise Approach</td>
<td>Theodore J. Cieslak and George W. Christopher</td>
<td>443</td>
</tr>
<tr>
<td>21</td>
<td>Medical Countermeasures</td>
<td>Janice M. Rusnak, Ellen F. Boudreau, Matthew J. Hepburn, James W. Martin, and Sina Bavari</td>
<td>465</td>
</tr>
<tr>
<td>22</td>
<td>Biosafety</td>
<td>Catherine L. Wilhelmsen and Robert J. Hawley</td>
<td>515</td>
</tr>
<tr>
<td>23</td>
<td>Biosurety</td>
<td>Gretchen L. Demmin</td>
<td>543</td>
</tr>
<tr>
<td>24</td>
<td>Ethical and Legal Dilemmas in Biodefense Research</td>
<td>Jeffrey E. Stephenson and Arthur O. Anderson</td>
<td>559</td>
</tr>
<tr>
<td>25</td>
<td>Emerging Infectious Diseases and Future Threats</td>
<td>Chris A. Whitehouse, Alan L. Schmaljohn, and Zygmunt F. Dembek</td>
<td>579</td>
</tr>
</tbody>
</table>

Abbreviations and Acronyms  xxv
Index  xxix
Section Editors

KERMIT D. HUEBNER, MD, FACEP
Major, Medical Corps, US Army; Chief, Education and Training, Department of Operational Medicine, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

M. SOFI IBRAHIM, MSc, PhD
Lieutenant Colonel, Medical Service Corps, US Army Reserve; Microbiologist, Division of Virology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

MARK A. POLI, PhD
Research Chemist, Department of Cell Biology and Biochemistry, Division of Integrated Toxicology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

CHRIS A. WHITEHOUSE, PhD
Microbiologist, Diagnostic Systems Division, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Microbiologist, US Army Dugway Proving Ground, Dugway, Utah
Contributors

ARTHUR O. ANDERSON, MD
Colonel, Medical Corps, US Army (Ret); Director, Office of Human Use and Ethics, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

EDWIN L. ANDERSON, MD
Colonel, Medical Corps, US Army; Physician, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Deputy Chief, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

SINA BAVARI, PhD
Chief, Department of Immunology, Target Identification and Translational Research, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

GEORGE W. CHRISTOPHER, MD, FACP
Lieutenant Colonel, Medical Corps, US Air Force; Discovery Biology Team Leader, Transformational Medical Technologies Initiative, Chemical-Biological Medical Defense Division, Defense Threat Reduction Agency, 8725 John J. Kingman Road Stop 6201, Fort Belvoir, Virginia 22060; formerly, Chief, Containment Care Department, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

THEROPE J. CIESLAK, MD
Defense Department Liaison Officer to the Centers for Disease Control and Prevention, 1600 Clifton Road NE, Atlanta, Georgia 30333; formerly, Chief, Department of Operational Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

ZYGMUNT F. DEMBEK, PhD, MS, MPH
Colonel, Medical Service Corps, US Army Reserve; Chief, Biodefense Epidemiology and Education & Training Programs, Operational Medicine Department, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

GRETCHEN L. DEMMIN, PhD
Lieutenant Colonel, Medical Service Corps, US Army; Deputy Commander, Safety, Biosurety, Operations Plans and Security, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

DAVID DESHAZER, PhD
Microbiologist, Division of Bacteriology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, MD 21702; formerly, Microbiologist, Postdoctoral Fellow, Department of Microbiology and Infectious Diseases, University of Calgary, Calgary, Alberta, Canada

EDWARD M. EITZEN, Jr, MD, MPH
Senior Partner, Biodefense Programs, Edward Martin and Associates Consulting, 5309 North 1st Place, Arlington, Virginia 22203; formerly, Commander, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

DAVID R. FRANZ, DVM, PhD
Colonel, US Army Veterinary Corps (Ret); Vice President and Chief Biological Scientist, Midwest Research Institute, 365 West Patrick Street, Suite 223, Frederick, Maryland 21701; formerly, Commander, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

ARTHUR M. FRIEFLANDER, MD
Colonel, Medical Corps, US Army (Ret); Senior Scientist, Division of Bacteriology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; and Adjunct Professor of Medicine, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland 20814

THOMAS W. GEISBERG, PhD
Chief, Department of Viral Pathology and Ultrastructure, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

PAMELA J. GLASS, PhD
Microbiologist, Division of Virology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

BRIDGET CARR GREGORY, DVM, MPH
Lieutenant Colonel, US Air Force, Biomedical Sciences Corps; Public Health Flight Commander, 435 MDG/SGPM, Unit 3215, APO AE 09094; formerly, Chief, Education and Training, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

MARY KATE HART, PhD
Director, Nonclinical Research, Dynport Vaccine Company, 64 Thomas Johnson Drive, Frederick, Maryland 21702; formerly, Chief, Division of Virology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

ROBERT J. HAWLEY, PhD, RBP, CBSP
Senior Advisor, Science, Midwest Research Institute, 365 West Patrick Street, Suite 223, Frederick, Maryland 21701; formerly, Chief, Safety and Radiation Protection, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

ERIK A. HENCHAL, PhD
Colonel, US Army (Ret); formerly, Commander, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

MATTHEW J. HEPBURB, MD
Major, Medical Corps, US Army; Infectious Diseases Physician, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702
DAVID L. HOOVER, MD
Colonel (Ret), Medical Corps, US Army; Medical Director, Dynport Vaccine Company LLC, A CSC Company, 64 Thomas Johnson Drive, Frederick, Maryland 21702; formerly, Scientific Coordinator, Brucella Program, Department of Bacterial Diseases, Walter Reed Army Institute of Research, Silver Spring, Maryland

KERMIT D. HUEBNER, MD, FACEP
Major; Medical Corps, US Army; Chief, Education and Training, Operational Medicine Department, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

JOHN W. HUGGINS, PhD
Chief, Viral Therapeutics Branch, US Army Medical Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

M. SOFI IBRAHIM, MS, PhD
Lieutenant Colonel, Medical Service Corps, US Army Reserve; Microbiologist, Department of Virology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

NANCY K. JAAK, DVM
Colonel, US Army Veterinary Corps (Ret); Special Projects Officer, National Agricultural Biosecurity Center, 203 Fairchild Hall, Kansas State University, Manhattan, Kansas 66506; formerly, Chief, Division of Pathology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

PETER B. JAHRLING, PhD
Director, National Institute of Allergies and Infectious Diseases, Integrated Research Facility, National Institutes of Health, 6700A Rockledge Drive, Bethesda, Maryland 20892; formerly, Senior Research Scientist, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

MARK G. KORTEPETER, MD, MPH
Colonel, Medical Corps, US Army; Fellow, Department of Infectious Diseases, Walter Reed Army Medical Center, 6900 Georgia Avenue NW, Washington, DC 20307; formerly, Chief, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

TERESA KRAKAUER, PhD
Microbiologist, Department of Immunology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

JAMES V. LAWLER, MD
Lieutenant Commander, Medical Corps, US Navy Reserve; Director for Biodefense Policy, Homeland Security Council, The White House, Washington, DC 20520; formerly, Infectious Diseases Physician, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

GEORGE V. LUDWIG, PhD
Deputy Principal Assistant for Research and Technology, US Army Medical Research and Materiel Command, 504 Scott Street, Suite 204, Fort Detrick, Maryland 21702; formerly, Science Director, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

JAMES W. MARTIN, MD, FACP
Colonel, Medical Corps, US Army; Chief, Operational Medicine Department, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

AILEEN M. MARTY, MD
Senior National Security Advisor, Medical Instructor, Battelle Office of Homeland Security, Battelle Memorial Institute, Suite 601, 1500 Crystal Drive, Arlington, Virginia 22202; formerly, Professor, Pathology and Emerging Infections, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland

THOMAS W. MCGOVERN, MD, FAAD
Major, Medical Corps, US Army (Ret); Dermatologist, Fort Wayne Dermatology Consultants, 11123 Parkview Plaza Drive #203, Fort Wayne, Indiana 46845, and Assistant Clinical Professor of Dermatology, Indiana University School of Medicine, 1120 South Drive, Indianapolis, Indiana 46202

MARK A. POLI, PhD
Research Chemist, Department of Cell Biology and Biochemistry, Division of Integrated Toxicology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

MICHEL R. POPOFF, PhD, DVM
Section Chief, Anaerobie Bacteriology and Toxins Unit, CNR Anaerobies et Botulisme, Unite Bacteries Anaerobies et Toxines, Institut Pasteur, 28 rue du Dr Roux, 75724 Paris, France

WILLIAM D. PRATT, DVM, PhD
Microbiologist, Division of Viral Biology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

BRET K. PURCELL, PhD, MD
Lieutenant Colonel, Medical Corps, US Army; Chief, Bacterial Therapeutics, Division of Bacteriology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

DOUGLAS S. REED, PhD
Microbiologist, Center for Aerobiological Sciences, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

CHAD ROY, PhD
Principal Investigator, Center for Aerobiological Sciences, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland
JANICE M. RUSNAK, MD
Lieutenant Colonel, US Air Force (Ret); Research Physician, Special Immunizations Program, Division of Medicine, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Deputy Director of Special Immunizations Program, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

JOHN M. SCHERER, PhD
Lieutenant Colonel, Medical Service Corps, US Army; Chief, Division of Diagnostic Systems, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Chief, Biological Threat Assessment, 520th Theater Army Medical Laboratory, Aberdeen Proving Ground, Maryland

ALAN L. SCHMALJOHN, PhD
Branch Chief, Department of Viral Pathogenesis and Immunology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

LEONARD A. SMITH, PhD
Chief, Department of Molecular Biology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

KEITH E. STEELE, DVM, PhD
Colonel, US Army; Director, Division of Pathology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

JEFFREY E. STEPHENSON, PhD
Regulatory Compliance Specialist, US Army Medical Research and Materiel Command, Telemedicine and Advanced Technology Research Center, Fort Detrick, Maryland 21702; formerly, Institutional Review Board Administrator, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

BRADLEY G. STILES, PhD
Research Microbiologist, Division of Integrated Toxicology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

ROBERT G. ULRICH, PhD
Microbiologist, Department of Immunology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

NICHOLAS J. VIETRI, MD
Major, Medical Corps, US Army; Infectious Diseases Physician and Principal Investigator, Division of Bacteriology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Infectious Diseases Fellow, Department of Medicine, Brooke Army Medical Center, San Antonio, Texas

DAVID M. WAAG, PhD
Microbiologist, Division of Bacteriology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702

ROBERT W. WANNEMACHER, Jr, PhD
Consultant, Department of Integrated Toxicology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Research Chemist, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

CHRIS A. WHITEHOUSE, PhD
Microbiologist, Diagnostic Systems Division, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Microbiologist, US Army Dugway Proving Ground, Dugway, Utah

CATHERINE L. WILHELMSEN, DVM, PhD, CBSP
Lieutenant Colonel, Veterinary Corps, US Army (Ret); Biosafety Officer, Office of Safety, Radiation Protection, and Environmental Health, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702; formerly, Chief, Division of Toxicology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland

PATRICIA L. WORSHAM, PhD
Deputy Chief, Division of Bacteriology, US Army Medical Research Institute of Infectious Diseases, 1425 Porter Street, Fort Detrick, Maryland 21702
Peer Reviewers

GERARD P. ANDREWS, PhD
Assistant Professor/Pathogenic Bacteriologist, Department of Veterinary Sciences, University of Wyoming, Wyoming State Veterinary Laboratory, 1174 Snowy Range Road, Laramie, Wyoming 82070

K. ROGER AOIKI, PhD
Professor, Department of Biological Sciences RD-2C, Allergan, Inc, Irvine, California 92623

ANDREW ARTENSTEIN, MD, FACP
Physician-in-Chief, Department of Medicine, Director, Center for Biodefense and Emerging Pathogens, Memorial Hospital of Rhode Island, Associate Professor of Medicine and Community Health, Brown Medical School, 111 Brewster Street, Pawtucket, Rhode Island 02860

GREGORY BOHACH, PhD
Professor, Associate Dean and Director, Idaho Agricultural Experiment Station, Microbiology, Molecular Biology and Biochemistry Department, University of Idaho, Moscow, Idaho 83844

PHILIP S. BRACHMAN, MD
Professor, Department of Global Health, Rollins School of Public Health, Emory University, 1518 Clifton Road, NE, Atlanta, Georgia 30322

CORRIE BROWN, DVM, PhD, DACVP
Josiah Meigs Distinguished Professor, Department of Pathology, College of Veterinary Medicine, University of Georgia, Athens, Georgia 30602

R. MARK BULLER, PhD
Professor, Department of Molecular Microbiology and Immunology, Saint Louis University, 1402 South Grand Blvd, St. Louis, Missouri 63104

CDR DUANE CANEVA, MD, FACEP

KATHLEEN CARR, DVM, MS, PhD, DACVP
Colonel, US Army Veterinary Corps, Walter Reed Army Institute of Research, 503 Robert Grant Avenue, Silver Spring, Maryland 20910

W. SETH CARUS, PhD
Deputy Director, Center for the Study of Weapons of Mass Destruction, National Defense University, Ft. Lesley J. McNair, 300 5th Avenue SW, Washington, DC 20319

DEAN O. CLIVER, PhD
Professor, Food Safety Laboratory and World Health Organization Collaborating Center for Food Virology, Department of Population Health and Reproduction, School of Veterinary Medicine, University of California, Davis One Shields Avenue, Davis, California 95616

BRIAN W. COOPER, MD
Director, Division of Infectious Disease, Allergy & Immunology, Hartford Hospital, Hartford, Connecticut; and Professor of Clinical Medicine, University of Connecticut School of Medicine, Farmington, Connecticut 06030

RANDALL C. CULPEPPER, MD, MPH
Commander, US Navy; Chief, Infectious Diseases, Armed Forces Medical Intelligence Center, Defense Intelligence Agency, Building 6000, Washington, DC 20341

ROBERT DARLING, MD, FACEP
CAPT, MC, US Navy; Director, Navy Medicine Office of Homeland Security, Bureau of Medicine and Surgery, Washington, DC; and Adjunct Assistant Professor of Military and Emergency Medicine, The Uniformed Services School of the Health Sciences, F. Edward Hebert School of Medicine, 4301 Jones Bridge Road, Bethesda, Maryland 20814

TIMOTHY P. ENDY, MD, MPH
Colonel, US Army; Director, Communicable Diseases and Immunology, Walter Reed Army Institute of Research, Room 3528, 503 Robert Grant Avenue, Silver Spring, Maryland 20910

HEINZ FELDMANN, MD
Chief, Health Canada, Special Pathogens Program, Associate Professor, Department of Medical Microbiology, University of Manitoba, 1015 Arlington Street, Winnipeg, Manitoba, Canada R3E 3R2

VINCENT A. FULGINITI, MD
Professor Emeritus, University of Arizona, Dean’s Office, Room 3020, 1501 North Campbell Avenue, Tucson, Arizona 85724

KENNETH L. GAGE, DVM, PhD
Plague Section Chief, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, Georgia 30333

ANTONIO E. GARMENDIA, DMV, PhD
Associate Professor, Department of Pathobiology and Veterinary Science, University of Connecticut, Storrs, Connecticut 06268

MARIA Y. GIOVANNI, PhD
Assistant Director for Microbial Genomics and Advanced Technologies, Division of Microbiology and Infectious Diseases, National Institutes of Health, Department of Health and Human Services, 6610 Rockledge Drive MSC 6603 Room 6007, Bethesda, Maryland 20892-6603

PHILIP C. HANNA, DVM, PhD
Professor, Department of Microbiology and Immunology, University of Michigan Medical School, 1300 East Medical Center Drive, Ann Arbor, Michigan 48109

FRED HENRETIG, MD
Children’s Hospital of Philadelphia, Professor of Pediatrics and Emergency Medicine, University of Pennsylvania School of Medicine, 3400 Civic Center Boulevard, Philadelphia, Pennsylvania 19104

JERRY JAAX, DVM, ACLAM
Associate Vice Provost for Research, Compliance and University Veterinarian, Kansas State University, Manhattan, Kansas 66506
Foreword

Our world was dramatically altered by the terrorist attacks of September 11, 2001. This assault, the yet unsolved mailings of anthrax, and other threats oblige a renewed national attention to the threat of biological weapons. The term “warfare” is no longer limited to conventional battlefields. Now we are concerned about the more likely scenario—wanton acts of biological terrorism inflicted on unsuspecting citizens anywhere in the world.

We must counter this threat with vigilance and maximize our response to attack with our best medical practices to identify agents involved, minimize casualties, and expedite the treatment of survivors. Our Nation charges the Armed Forces to guard against bioattack—overt or covert—as well as managing recovery efforts. This new groundbreaking volume in the Textbooks of Military Medicine series, devoted to biological warfare and terrorism, responds to that charge.

Since the publication of Medical Aspects of Chemical and Biological Warfare more than a decade ago, the editors at Borden Institute and the respective medical leaders across the Army Medical Command concluded that this essential new information required stand-alone textbooks. This affords the specific medical hazards a more detailed assessment and attention. I believe they succeeded in that effort.

Grounded in a historical perspective, this new volume, Medical Aspects of Biological Warfare, addresses weaponization of biological agents. It categorizes potential agents as food, waterborne, or agricultural toxins and discusses the respective epidemiology. A description of individual agents includes recent advances in the knowledge base and the illnesses induced. The authors present familiar (anthrax, plague, smallpox) and less often discussed biotoxins (alphaviruses, staphylococcal enterotoxins) and explain methods for early agent identification. To maximize understanding, authors used case studies and research along with successful management practices, treatments, and antidotes.

The description of the practical issues related to civil defense and the inherent differences between national, state, and metropolitan priorities with regard to biosurety, quarantine, crisis management, public affairs, and legal considerations is clear. The potential dangers of emerging infectious diseases and their threat to public safety did not interfere with clear presentation of “here-and-now” risks. The editors conscientiously present the ethical aspects of preparing for scenarios that by their nature are unknowable, unethical, or unforeseen.

The publication of this volume establishes best practices in the field of biohazard management, thus making those best practices available to healthcare practitioners, policy makers, and planners, in and out of uniform. Some will challenge our release of a textbook on the topic of bioweapons—they claim it is wiser, safer, and more prudent to withhold this information in the interest of better safeguarding our citizens. We maintain that in any analysis, the strongest safeguard of a free society is the open forum and free exchange of science, ideas, and theory. Regardless of your perspective, this text is excellent and I am extremely proud of the professionals who devoted their time and talents to it.

Major General Gale S. Pollock
Acting, The Surgeon General
US Army

Washington, DC
November 2007
Preface

Medical defense against biological pathogens used in terrorism or warfare has emerged over the past decade from the workings of a few select research laboratories to an expansive undertaking by the federal government. Largely the domain of military medical defense facilities, events post-2001 have led to tremendous investments in infrastructure, public health response, and basic research to medically defend against these identified threats. The Department of Defense efforts have been eclipsed to a degree by the scope of investments by the Department of Health and Human Services and the Department of Homeland Security. One area, however, that remains critical is the need to transfer the resulting information and best medical practices to the medical practitioners. The Department of the Army has maintained a leadership role in this crucial enterprise.

The history of biological weapons use by nations and terrorist groups necessitates a high level of preparedness for uniformed healthcare providers and scientists. Much of what is understood as standards of practice served the United States well during the events related to the 2001 anthrax mailings, yet important lessons were learned from that unique experience. The continued threat of biological weapons dictates that all Department of Defense medical personnel become conversant with state-of-the art treatment for biological casualties. What may have been perceived merely as useful information in the past is now a requirement for medical providers.

The previous edition of *Medical Aspects of Chemical and Biological Warfare* in the Borden Institute’s Textbooks of Military Medicine series was both innovative and much needed at the time of publication in 1997. In his foreword, then Army Surgeon General Ronald Blanck stated that “world events have conspired to increase the threat of use of chemical and biological weapons.” A decade later, the complexity of the threat has increased beyond the boundaries of state-sponsored programs and to the terrorist use of novel pathogens. The need for a revised version of this work has never been greater. It is with great pride that I introduce the reader to the new edition of *Medical Aspects of Biological Warfare*. The scientists and physicians who are responsible for this text have endeavored to provide the best possible biomedical reference.

Colonel George W. Korch
Medical Service Corps, US Army
Commander, US Army Medical Research Institute of Infectious Diseases

Fort Detrick, Maryland
July 2007
The current medical system to support the US Army at war is a continuum from the forward line of troops through the continental United States; it serves as a primary source of trained replacements during the early stages of a major conflict. The system is designed to optimize the return to duty of the maximum number of trained combat soldiers at the lowest possible level. Far-forward stabilization helps to maintain the physiology of injured soldiers who are unlikely to return to duty and allows for their rapid evacuation from the battlefield without needless sacrifice of life or function.