

TENTH EDITION



ATLS[®]

Advanced Trauma Life Support[®]

Student Course Manual

New to this edition ▶

mATLS[™]
MOBILE ADVANCED TRAUMA LIFE SUPPORT



AMERICAN COLLEGE OF SURGEONS

*Inspiring Quality:
Highest Standards, Better Outcomes*

100+years

TENTH EDITION

ATLS[®]

Advanced Trauma Life Support[®]

Student Course Manual



AMERICAN COLLEGE OF SURGEONS
*Inspiring Quality:
Highest Standards, Better Outcomes*

100+years

Chair of Committee on Trauma: Ronald M. Stewart, MD, FACS
Medical Director of Trauma Program: Michael F. Rotondo, MD, FACS
ATLS Committee Chair: Sharon M. Henry, MD, FACS
ATLS Program Manager: Monique Drago, MA, EdD
Executive Editor: Claire Merrick
Project Manager: Danielle S. Haskin
Development Editor: Nancy Peterson
Media Services: Steve Kidd and Alex Menendez, Delve Productions
Designer: Rainer Flor
Production Services: Joy Garcia
Artist: Dragonfly Media Group

Tenth Edition

Copyright© 2018 American College of Surgeons
633 N. Saint Clair Street
Chicago, IL 60611-3211

Previous editions copyrighted 1980, 1982, 1984, 1993, 1997, 2004, 2008, and 2012 by the American College of Surgeons.

Copyright enforceable internationally under the Bern Convention and the Uniform Copyright Convention. All rights reserved. This manual is protected by copyright. No part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the American College of Surgeons.

The American College of Surgeons, its Committee on Trauma, and contributing authors have taken care that the doses of drugs and recommendations for treatment contained herein are correct and compatible with the standards generally accepted at the time of publication. However, as new research and clinical experience broaden our knowledge, changes in treatment and drug therapy may become necessary or appropriate. Readers and participants of this course are advised to check the most current product information provided by the manufacturer of each drug to be administered to verify the recommended dose, the method and duration of administration, and contraindications. It is the responsibility of the licensed practitioner to be informed in all aspects of patient care and determine the best treatment for each individual patient. Note that cervical collars and spinal immobilization remain the current Prehospital Trauma Life Support (PHTLS) standard in transporting patients with spine injury. If the collars and immobilization devices are to be removed in controlled hospital environments, this should be accomplished when the stability of the injury is assured. Cervical collars and immobilization devices have been removed in some of the photos and videos to provide clarity for specific skill demonstrations. The American College of Surgeons, its Committee on Trauma, and contributing authors disclaim any liability, loss, or damage incurred as a consequence, directly or indirectly, of the use and application of any of the content of this 10th edition of the ATLS Program.

Advanced Trauma Life Support® and the acronym ATLS® are marks of the American College of Surgeons.

Printed in the United States of America.

Advanced Trauma Life Support® Student Course Manual
Library of Congress Control Number: 2017907997
ISBN 78-0-9968262-3-5

DEDICATION

We dedicate the Tenth Edition of ATLS to the memory of Dr. Norman E. McSwain Jr. His dynamic, positive, warm, friendly, and uplifting approach to getting things done through his life's work is a constant inspiration to those whose lives he touched. His tenure with the American College of Surgeons Committee on Trauma (COT) spanned almost exactly the same 40 years of the ATLS course.

Dr. McSwain's time with the COT led him down a path where, without a doubt, he became the most important surgical advocate for prehospital patient care. He first worked to develop, and then led and championed, the Prehospital Trauma Life Support Course (PHTLS) as a vital and integral complement to ATLS. Combined, these two courses have taught more than 2 million students across the globe.

Dr. McSwain received every honor the COT could bestow, and as a last tribute, we are pleased to dedicate this edition of ATLS to his memory. The creators of this Tenth Edition have diligently worked to answer Dr. McSwain's most common greeting: "What have you done for the good of mankind today?" by providing you with the Advanced Trauma Life Support Course, 10th Edition, along with our fervent hope that you will continue to use it to do good for all humankind. Thank you, Dr. McSwain.

Sharon Henry, MD

Karen Brasel, MD

Ronald M. Stewart, MD, FACS



FOREWORD

My first exposure to Advanced Trauma Life Support® (ATLS®) was in San Diego in 1980 while I was a resident. The instructor course was conducted by Paul E. “Skip” Collicott, MD, FACS, and fellow students included a young surgeon in San Diego, A. Brent Eastman, MD, FACS, and one from San Francisco, Donald D. Trunkey, MD, FACS. Over the next year or two, we trained everyone in San Diego, and that work became the language and glue for the San Diego Trauma System. The experience was enlightening, inspiring, and deeply personal. In a weekend, I was educated and had my confidence established: I was adept and skilled in something that had previously been a cause of anxiety and confusion. For the first time, I had been introduced to an “organized course,” standards for quality, validated education and skills training, and verification of these skills. It was a life-transforming experience, and I chose a career in trauma in part as a result. During that weekend, I also was introduced to the American College of Surgeons—at its very best.

The Tenth Edition of ATLS continues a tradition of innovation. It takes advantage of electronic delivery and by offering two forms of courses (traditional and electronic) to increase the reach and effectiveness of this landmark course. Just about to celebrate its 40th anniversary and currently used in over 60 countries, the ATLS program and its delivery through the Tenth Edition will continue to foster safe trauma practices for the world at large.

Under the leadership of Sharon Henry, MD, FACS, the ATLS Committee Chair, and Monique Drago, MA, EdD, the Trauma Education Program Manager, along with excellent college staff, we have been able to evolve the program, building on the foundation laid in the Ninth Edition by Karen Brasel, MD, FACS, and Will Chappleau, EMT-P, RN, TNS. The Tenth Edition of the ATLS program takes the finest achievements of the American College of Surgeons and its Fellows to the next level, and ultimately patient care is the greatest beneficiary.

David B. Hoyt, MD, FACS
Executive Director
American College of Surgeons
Chicago, Illinois
United States

The year 1976 was key for improving the care of the injured patient. In that year, orthopedic surgeon Dr. James Styner and his family were tragically involved in a plane crash in a Nebraska cornfield. The largely unprepared medical response by those caring for Dr. Styner and his family subsequently compelled him to action. Dr. Styner joined forces with his colleague, Dr. Paul “Skip” Collicott MD, FACS, and began a course entitled Advanced Trauma Life Support (ATLS). Today this initially small course has become a global movement. ATLS was quickly adopted and aggressively promulgated by the Committee on Trauma. The first course was held in 1980, and since that time ATLS has been diligently refined and improved year after year, decade after decade. More than a million students have been taught in more than 75 countries. From Nebraska to Haiti, more than 60% of ATLS courses are now taught outside North America.

It was also in 1976 that Don Trunkey, MD, FACS and the Committee on Trauma (COT) published *Optimal Hospital Resources for Care of the Injured*, the first document aimed at defining and developing trauma centers and trauma systems. This document led directly to the COT’s Verification Review and Consultation (VRC) program and its 450 verified trauma centers across the United States. These two programs have transformed the care of injured patients across the globe, resulting in hundreds of thousands of lives saved. In an interesting twist, ATLS was intended as an educational program, and the VRC was intended to be a set of standards. But in real ways, ATLS standardized the care of trauma patients, and the VRC educated the trauma community on how to provide optimal care for trauma patients.

Thus 1976 heralded radical and positive change in the care of trauma patients. The Tenth Edition of ATLS is the most innovative and creative update since the inception of the ATLS course. I believe this edition is a fitting testament to the memory of those pioneers who, in their mind’s eye, could see a path to a better future for the care of the injured. I congratulate the modern pioneers of this Tenth Edition. The development of this edition was led by a team with a similar commitment, zeal, and passion to improve. My hope is that all those taking and teaching ATLS will boldly continue this search to improve the care of the injured. In so doing, we may appropriately honor those pioneers of 1976.

Ronald M. Stewart, MD, FACS
Chair of the ACS Committee on Trauma

PREFACE

ROLE OF THE AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA

The American College of Surgeons (ACS) was founded to improve the care of surgical patients, and it has long been a leader in establishing and maintaining the high quality of surgical practice in North America. In accordance with that role, the ACS Committee on Trauma (COT) has worked to establish guidelines for the care of injured patients.

Accordingly, the COT sponsors and contributes to continued development of the Advanced Trauma Life Support (ATLS) program. The ATLS Student Course does not present new concepts in the field of trauma care; rather, it teaches established treatment methods. A systematic, concise approach to the early care of trauma patients is the hallmark of the ATLS Program.

This Tenth Edition was developed for the ACS by members of the ATLS Committee and the ACS COT, other individual Fellows of the College, members of the international ATLS community, and nonsurgical consultants to the Committee who were selected for their special competence in trauma care and their expertise in medical education. (The Preface and Acknowledgments sections of this book contain the names and affiliations of these individuals.) The COT believes that the people who are responsible for caring for injured patients will find the information extremely valuable. The principles of patient care presented in this manual may also be beneficial to people engaged in the care of patients with nontrauma-related diseases.

Injured patients present a wide range of complex problems. The ATLS Student Course is a concise approach to assessing and managing multiply injured patients. The course supplies providers with comprehensive knowledge and techniques that are easily adapted to fit their needs. Students using this manual will learn one safe way to perform each technique. The ACS recognizes that there are other acceptable approaches. However, the knowledge and skills taught in the course are easily adapted to all venues for the care of these patients.

The ATLS Program is revised by the ATLS Committee approximately every four years to respond to changes

in available knowledge and incorporate newer and perhaps even safer skills. ATLS Committees in other countries and regions where the program has been introduced have participated in the revision process, and the ATLS Committee appreciates their outstanding contributions.

NEW TO THIS EDITION

This Tenth Edition of the Advanced Trauma Life Support Student Course Manual reflects several changes designed to enhance the educational content and its visual presentation.

CONTENT UPDATES

All chapters were rewritten and revised to ensure clear coverage of the most up-to-date scientific content, which is also represented in updated references. New to this edition are:

- Completely revised skills stations based on unfolding scenarios
- Emphasis on the trauma team, including a new Teamwork section at the end of each chapter and a new appendix focusing on Team Resource Management in ATLS
- Expanded Pitfalls features in each chapter to identify correlating preventive measures meant to avoid the pitfalls
- Additional skills in local hemorrhage control, including wound packing and tourniquet application
- Addition of the new Glasgow Coma Scale (GCS)
- An update of terminology regarding spinal immobilization to emphasize restriction of spinal motion
- Many new photographs and medical illustrations, as well as updated management algorithms, throughout the manual

MYATLS MOBILE APPLICATION



The course continues to make use of the MyATLS mobile application with both Universal iOS and Android compatibility. The app is full of useful reference content for retrieval at the hospital bedside and for review at your leisure. Content includes:

- Interactive visuals, such as treatment algorithms and x-ray identification
- Just in Time video segments capturing key skills
- Calculators, such as pediatric burn calculator to determine fluid administration
- Animations, such as airway management and surgical cricothyroidotomy

Students, instructors, coordinators, and educators are encouraged to access and regularly use this important tool.

SKILLS VIDEO

As part of the course, video is provided via the MyATLS.com website to show critical skills that providers should be familiar with before taking the course. Skill Stations during the course will allow providers the opportunity to fine-tune skill performance in preparation for the practical assessment. A review of the demonstrated skills before participating in the skills stations will enhance the learner's experience.

EDITORIAL NOTES

The ACS Committee on Trauma is referred to as the ACS COT or *the Committee*, and the State/Provincial Chair(s) is referred to as *S/P Chair(s)*.

The international nature of this edition of the ATLS Student Manual may necessitate changes in the commonly used terms to facilitate understanding by all students and teachers of the program.

Advanced Trauma Life Support® and ATLS® are proprietary trademarks and service marks owned by the American College of Surgeons and cannot be used by individuals or entities outside the ACS COT organization for their goods and services without ACS approval. Accordingly, any reproduction of either or both marks in direct conjunction with the ACS ATLS Program within the ACS Committee on Trauma organization

must be accompanied by the common law symbol of trademark ownership.

AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA

Ronald M. Stewart, MD, FACS

Committee on Trauma, Chair
Chair of the American College of Surgeons Committee on Trauma
Witten B. Russ Professor and Chair of the Department of Surgery
UT Health San Antonio
San Antonio, Texas
United States

Michael F. Rotondo, MD, FACS

Trauma Program, Medical Director
CEO, University of Rochester Medical Faculty Group
Vice Dean of Clinical Affairs–School of Medicine
Professor of Surgery–Division of Acute Care Surgery
Vice President of Administration–Strong Memorial Hospital
President-Elect–American Association for the Surgery of Trauma
University of Rochester Medical Center
Rochester, New York
United States

COMMITTEE ON ADVANCED TRAUMA LIFE SUPPORT OF THE AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA

Sharon M. Henry, MD, FACS

ATLS Committee Chair
Anne Scalea Professor of Surgery
University of Maryland School of Medicine
University of Maryland Medical Center RA
Cowley Shock Trauma Center
Baltimore, Maryland
United States

Saud A. Al Turki, MD, FACS

Ministry of National Guard Health Affairs, King Abdulaziz Medical City
King Saud Bin Abdulaziz University for Health Sciences

Riyadh
Saudi Arabia

Col. (Ret.) Mark W. Bowyer, MD, FACS

Ben Eiseman Professor of Surgery
Chief, Trauma and Combat Surgery
Surgical Director of Simulation, Department of Surgery
The Uniformed Services University
Walter Reed National Military Medical Center
Bethesda, Maryland
United States

Kimberly A. Davis MD, MBA, FACS, FCCM

Professor of Surgery, Trauma
Vice Chairman for Clinical Affairs
Yale School of Medicine
Chief of General Surgery, Trauma and Surgical Critical Care
Trauma Medical Director
Yale New Haven Hospital
New Haven, Connecticut
United States

Julie A. Dunn, MD, MS, FACS

Medical Director, Trauma Research and Education
UC Health Northern Colorado
Loveland, Colorado
United States

Peter F. Ehrlich, MD, FACS

Professor
C S Mott Children's Hospital
Ann Arbor, Michigan
United States

James R. Ficke, MD, FACS

Professor of Orthopaedic Surgery
Johns Hopkins Hospital
Baltimore, Maryland
United States

Glen A. Franklin, MD FACS

Professor
University of Louisville School of Medicine
Louisville, Kentucky
United States

Maria Fernanda Jimenez, MD, FACS

General Surgeon
Hospital Universitario MEDERI
Bogotá, Distrito Capital
Colombia

Martin S. Keller, MD, FACS, FAAP

Associate Professor of Surgery
St. Louis Children's Hospital
Washington University School of Medicine
St. Louis, Missouri
United States

Gilberto K. K. Leung, MBBS, FRCS, PhD

Clinical Associate Professor
The University of Hong Kong Queen Mary University
Pok Fu Lam
Hong Kong

R. Todd Maxson, MD, FACS

Professor of Surgery
University of Arkansas for Medical Sciences
Trauma Medical Director
Arkansas Children's Hospital
Little Rock, Arkansas
United States

Daniel B. Michael, MD, PhD, FACS, FAANS

Director of Neurosurgical Education
William Beaumont Hospital Royal Oak
Professor of Neurosurgery
Oakland University William Beaumont School of
Medicine
Royal Oak, Michigan
United States
Director, Michigan Head and Spine Institute
Southfield, Michigan
United States

Neil G. Parry, MD, FACS, FRCS

Medical Director, Trauma Program
Associate Professor of Surgery and Critical Care
London Health Sciences Center
Schulich School of Medicine, Western University
London, Ontario
Canada

Bruce Potenza, MD, FACS

Critical Care Surgeon, Trauma
UCSD Medical Center
San Diego, California
United States

Martin A. Schreiber MD, FACS

Professor and Chief, Division of Trauma, Critical Care & Acute Surgery
Oregon Health & Science University
Portland, Oregon
United States

Gary A. Vercruyse, MD, FACS

Director of Burn Services
Associate Professor of Surgery, Division of Trauma, Burns,
Acute Care Surgery and Surgical Critical Care
 University of Arizona School of Medicine
 Tucson, Arizona
 United States

Robert J. Winchell, MD, FACS

Chief, Division of Trauma, Burn, Acute and Critical Care
Director of the Trauma Center
 Weill Cornell Medicine
 New York–Presbyterian Weill Cornell Medical Center
 New York, New York
 United States

ASSOCIATE MEMBERS TO THE
 COMMITTEE ON ADVANCED
 TRAUMA LIFE SUPPORT OF
 THE AMERICAN COLLEGE
 OF SURGEONS COMMITTEE
 ON TRAUMA

Mary-Margaret Brandt, MD, MHSA, FACS

Trauma Director
 St. Joseph Mercy Health System
 Ann Arbor, Michigan
 United States

Megan L. Brenner, MD FACS

Assistant Professor of Surgery
 University of Maryland Medical Center
 Baltimore, Maryland
 United States

Frederic J. Cole, Jr., MD, FACS

Associate Medical Director, Trauma Clinic and Patient
Outcomes
 Legacy Emanuel Medical Center
 Portland, Oregon
 United States

Oscar D. Guillamondegui, MD, MPH, FACS

Professor of Surgery
Trauma Medical Director
 Vanderbilt University Medical Center
 Nashville, Tennessee
 United States

Lewis E. Jacobson, MD, FACS

Chair, Department of Surgery
Director, Trauma and Surgical Critical Care
 St. Vincent Indianapolis Hospital
 Indianapolis, Indiana
 United States

Newton Djin Mori, MD, PhD, FACS

General and Trauma Surgeon
 Hospital das Clinicas–University of São Paulo
 São Paulo, São Paulo
 Brazil

John P. Sutyak, EdM, MD, FACS

Director, Southern Illinois Trauma Center
Associate Professor of Surgery
 Southern Illinois University School of Medicine
 Springfield, Illinois
 United States

LIAISONS TO THE
 COMMITTEE ON ADVANCED
 TRAUMA LIFE SUPPORT OF
 THE AMERICAN COLLEGE
 OF SURGEONS COMMITTEE
 ON TRAUMA

Michael Murray, MD

General Surgery
 Banner Churchill Community Hospital
 Sparks, Nevada
 United States

Clark West, MD FACR

Co-Course Director
 The University of Texas Health Science
 Houston Medical School
 Houston, Texas
 United States

INTERNATIONAL LIAISON
TO THE COMMITTEE ON
ADVANCED TRAUMA LIFE
SUPPORT OF THE AMERICAN
COLLEGE OF SURGEONS
COMMITTEE ON TRAUMA

Karen J. Brasel, MD, FACS
Professor and Program Director
Oregon Health and Science University
Portland, Oregon
United States

AMERICAN SOCIETY OF
ANESTHESIOLOGISTS LIAISON
TO THE COMMITTEE ON
ADVANCED TRAUMA LIFE
SUPPORT OF THE AMERICAN
COLLEGE OF SURGEONS
COMMITTEE ON TRAUMA

Richard P. Dutton, MD, MBA

Michael Murray, MD
General Surgery
Banner Churchill Community Hospital
Sparks, Nevada
United States

ADVANCED TRAUMA CARE
FOR NURSES LIAISON TO THE
COMMITTEE ON ADVANCED
TRAUMA LIFE SUPPORT OF
THE AMERICAN COLLEGE OF
SURGEONS COMMITTEE ON
TRAUMA

Jan Howard, MSN, RN, Chair, ATCN Committee
South Bend, Indiana
United States

AMERICAN COLLEGE OF
EMERGENCY PHYSICIANS
LIAISONS TO THE COMMITTEE
ON ADVANCED TRAUMA LIFE
SUPPORT OF THE AMERICAN
COLLEGE OF SURGEONS
COMMITTEE ON TRAUMA

Christopher Cribari, MD
*Medical Director, Acute Care Surgery, Medical Center of
the Rockies, University of Colorado Health*
Loveland, CO
United States

Christopher S. Kang, MD, FACEP
*Attending Physician, Emergency Medicine, Madigan Army
Medicine Center*
Tacoma, Washington
United States

ADVANCED TRAUMA LIFE
SUPPORT SENIOR EDUCATOR
ADVISORY BOARD

Debbie Paltridge, MHIthSc (ED)
Senior Educator Advisory Board, Chair
Principal Educator
Royal Australasian College of Surgeons
Melbourne, Victoria
Australia

Joe Acker, EMT-P, MPH (Term completed April 2017)
Executive Director, Birmingham Regional EMS System
University of Alabama at Birmingham
Birmingham, Alabama
United States

Wesam Abuznadah, MD, MEd, FRCS(C), FACS, RPVI
*Assistant Professor, Consultant Vascular and Endovascular
Surgery*
*Associate Dean, Academic and Student Affairs, College
of Medicine*
King Saud Bin Abdulaziz University for Health Sciences
Jeddah
Saudi Arabia

Jacqueline Bustraan, MSc
Educational Advisor, Trainer and Researcher
 Leiden University Medical Center/BOAT (Bustraan
 Organisation, Advice and Training)
 Leiden
 The Netherlands

Marzellus Hofmann, MD, MME
Dean of Medical Education and Student Affairs
 Witten/Herdecke University, Faculty of Health
 Witten, NRW
 Germany

Elizabeth Vallejo de Solez
National Education, COT Ecuador
 Quito
 Ecuador

Claus Dieter Stobaus, ME, ED
Postgraduate Program in Education
 Pontifical Catholic University of Rio Grande do Sul
 Porto Alegre, Rio Grande do Sul
 Brazil

John P. Sutyak, EdM, MD, FACS
Director, Southern Illinois Trauma Center
Associate Professor of Surgery
 Southern Illinois University School of Medicine
 Springfield, Illinois
 United States

Prof. Heba Youssef Mohamed Sayed, MD
*Professor and Head of Forensic Medicine and Clinical
 Toxicology Department*
 Port Said University
 Port Said, Egypt
 Arab Republic of Egypt

Kum Ying Tham, MBBS, FRCSE, EDD
Senior Consultant
 Tan Tock Seng Hospital
 Singapore

ADVANCED TRAUMA LIFE SUPPORT COORDINATOR COMMITTEE

Lesley Dunstall, RN
ATLS Coordinator Committee, Chair
National Coordinator, EMST/ATLS Australasia
 Royal Australasian College of Surgeons
 North Adelaide, South Australia
 Australia

Catherine Wilson, MSN, ACNP-BC, CEN
ATLS Coordinator Committee, Vice Chair
Trauma Outreach Coordinator
 Vanderbilt University Medical Center
 Nashville, Tennessee
 United States

Mary Asselstine, RN
Sunnybrook Health Sciences Centre
 Toronto, Ontario
 Canada

Ryan Bales, RN
ATLS Coordinator
 CNIII Trauma Program
 Sacramento, California
 United States

Vilma Cabading
Trauma Courses Office, Deanship of Postgraduate Education
 King Saud Bin Abdulaziz University for Health Sciences
 Riyadh
 Saudi Arabia

Sally Campbell, RN, BA
ATLS Course Coordinator
 Kaiser Medical Center, Vacaville, California
 David Grant Medical Center, Travis Air Force Base,
 California
 United States

Cristiane de Alencar Domingues, RN, MSN, PhD
Professor
 Faculdade das Américas (FAM)
 São Paulo, São Paulo
 Brazil

Agienszka Gizzi
Regional and International Programmes Coordinator
 The Royal College of Surgeons of England
 London
 United Kingdom

Betty Jean Hancock, MD, FRCSC, FACS
Associate Professor, Pediatric Surgery and Critical Care
University of Manitoba
Children's Hospital of Winnipeg/Health Sciences Centre
Winnipeg, Manitoba
Canada

Sherri Marley, BSN, RN, CEN, TCRN
Clinical Educator for Trauma Services
Eskenazi Health
Indianapolis, Indiana
United States

Martha Romero
ATLS Coordinator
AMDA-Bolivia
Santa Cruz de la Sierra
Bolivia

ACKNOWLEDGMENTS

It is clear that many people are responsible for development of the Tenth Edition, but the outstanding staff in the ATLS Program Office deserves special mention. Their dedication and hard work not only produced the new edition while ensuring that each one is better than the last but also facilitates its use in hundreds of courses around the world each year.

Monique Drago, MA, EdD
Trauma Education Programs Manager
The American College of Surgeons
Chicago, Illinois
United States

Ryan Hieronymus, MBA, PMP
Trauma Education Projects Manager
The American College of Surgeons
Chicago, Illinois
United States

Pascale Leblanc
Trauma Education Projects Manager
The American College of Surgeons
Chicago, Illinois
United States

Kathryn Strong
Program Manager, Trauma Education Programs (LMS)
The American College of Surgeons
Chicago, Illinois
United States

Autumn Zarlengo
Program Manager, Trauma Education Programs (CME/CE)
The American College of Surgeons
Chicago, Illinois
United States

Emily Ladislas
Program Coordinator, Trauma Education Programs (CME/CE)
The American College of Surgeons
Chicago, Illinois
United States

Marlena Libman
Trauma Education Program Coordinator
The American College of Surgeons
Chicago, Illinois
United States

Freddie Scruggs
Trauma Education Program Coordinator
The American College of Surgeons
Chicago, Illinois
United States

Germaine Suiza
Program Coordinator, Trauma Education Programs (LMS)
The American College of Surgeons
Chicago, Illinois
United States

CONTRIBUTORS

While developing this revision, we received a great deal of assistance from many individuals—whether they were reviewing information at meetings, submitting images, or evaluating research. ATLS thanks the following contributors for their time and effort in development of the Tenth Edition.

Wesam Abuznadah, MD, MEd, FRCS(C), FACS, RPVI
Assistant Professor, Consultant Vascular and Endovascular Surgery; Associate Dean, Academic and Student Affairs, College of Medicine
King Saud Bin Abdulaziz University for Health Sciences
Jeddah
Saudi Arabia

Joe Acker, EMT-P, MPH
Executive Director, Birmingham Regional EMS System
University of Alabama at Birmingham
Birmingham, Alabama
United States

Suresh Agarwal, MD, FACS

Professor of Surgery
University of Wisconsin
Madison, Wisconsin
United States

Jameel Ali, MD, MMedEd, FRCSC, FACS

Professor of Surgery
University of Toronto
Toronto, Ontario
Canada

Hayley Allan, BA(hons), Dip Ed, MEd, MRes

National Educator, ATLS UK
The Royal College of Surgeons of England
London
England

Saud Al Turki, MD, FACS

Ministry of National Guard Health Affairs, King Abdulaziz Medical City
King Saud Bin Abdulaziz University for Health Sciences
Riyadh
Kingdom of Saudi Arabia

Mary Asselstine, RN

Sunnybrook Health Sciences Centre
Toronto, Ontario
Canada

Mahmood Ayyaz, MBBS, FCPS, FRCS, FACS

Professor of Surgery, Services Institute of Medical Sciences; Councillor and Director, National Residency Programme; National Course Director, ATLS Pakistan Services Hospital
College of Physicians and Surgeons Pakistan
Lehore
Pakistan

Mark Bagnall, BMedSc(Hons), MBChB(Hons), MSc, PhD, MRCS(Eng)

Specialist Registrar in General Surgery; General Surgery Representative ATLS UK
Steering Group
United Kingdom

Andrew Baker, MBChB, FRCS(Orth), FCS(Orth), SA

Senior Consultant
Entabeni Hospital
Durban
South Africa

Ryan Bales, RN

ATLS Coordinator
CNIII Trauma Program
Sacramento, California
United States

Raphael Bonvin, MD, MME

Head of Educational Unit
Faculty of Biology and Medicine
Lausanne
Switzerland

Bertil Bouillon, MD

Professor and Chairman Department of Trauma and Orthopaedic Surgery
University of Witten/Herdecke, Cologne Merheim Medical Center
Cologne
Germany

Mark W. Bowyer, MD, FACS

ATLS Board Member Germany Col. (Ret.)
Ben Eiseman Professor of Surgery; Chief, Trauma and Combat Surgery; Surgical Director of Simulation Department of Surgery
The Uniformed Services University; Walter Reed National Military Medical Center
Bethesda, Maryland
United States

Mary-Margaret Brandt, MD, MHSA, FACS

Trauma Director
St. Joseph Mercy Health System
Ann Arbor, Michigan
United States

Frank Branicki, MB, BS, DM, FRCS, FRCS(Glasg), FRACS, FCSHK, FHKAM, FCSECSA, FACS

Professor and Chair, Department of Surgery
United Arab Emirates University
Al Ain
United Arab Emirates

Susan Briggs, MD, MPH, FACS

Director, International Trauma and Disaster Institute
Massachusetts General Hospital
Boston, Massachusetts
United States

George Brighton, MBBS, BSc Honors, MSc, PGCE Med Ed.

Clinical Entrepreneur Fellow NHS England
Royal Devon and Exeter NHS Foundation Trust
Exeter
England

Bertil Bouillon, MD

Professor and Chairman Department of Trauma and Orthopaedic Surgery
University of Witten/Herdecke, Cologne Merheim Medical Center
Cologne
Germany

Guy Brisseau, MD, MEd, FACS

Director, Pediatric Trauma; Director, Surgical Education
Sidra Medical and Research Center
Doha
Qatar

Troy Browne, MBChB, FCA(SA), FANZCA, FCICM

Medical Leader—Anaesthesia, Radiology and Surgical Services; Director of Intensive Care/High Dependency Unit
Bay of Plenty District Health Board
Tauranga
New Zealand

Shane Brun, MD, M.Trauma, M.Ed, FFSEM(UK), FACRRM, FRACGP

Associate Professor
James Cook University
Queensland
Australia

Stephen Bush, MA(Oxon), FRCS, FRCEM

Consultant in Emergency Medicine
Leeds Teaching Hospitals
Trust Leeds, West Yorkshire
United Kingdom

Jacqueline Bustraana, MSc

Educational Advisor, Trainer, and Researcher
Leiden University Medical Center/BOAT (Bustraana Organisation, Advice and Training)
Leiden
The Netherlands

Vilma Cabading

Trauma Courses Office, Deanship of Postgraduate Education
King Saud Bin Abdulaziz University for Health Sciences
Riyadh
Kingdom of Saudi Arabia

Sally Campbell, RN, BA

ATLS Course Director
Kaiser Medical Center/David Grant Medical Center
Vacaville/Travis Air Force Base, California
United States

Juan Carlos Puyana, MD, FACS

Professor of Surgery, Critical Care Medicine and Clinical Translational Medicine
University of Pittsburgh
Pittsburgh, Pennsylvania
United States

Narain Chotirosniramit, MD, FACS, FICS, FRCST

Chief, Trauma and Critical Care Unit; Department of Surgery, Faculty of Medicine
Chiangmai University
Chiangmai
Thailand

Ian Civil, MBChB, FRACS, FACS

Director of Trauma Services
Auckland City Hospital
Auckland
New Zealand

Keith Clancy, MD, MBA, FACS

Trauma Medical Director
Geisinger Wyoming Valley Medical Center
Wilkes-Barre, Pennsylvania
United States

Peter Clements**Frederic J. Cole, Jr., MD, FACS**

Legacy Emanuel Medical Center
Portland, Oregon
United States

Jaime Cortes-Ojeda, MD, FACS

Chief Department of Surgery
Hospital Nacional de Niños "Dr. Carlos Sáenz Herrera"
San José
Costa Rica

Renn J. Crichlow, MD MBA

Orthopaedic Trauma Surgeon
St. Vincent Indianapolis Trauma Center
OrthoIndy Hospital
Indianapolis, Indiana
United States

Scott D'Amours, MD, FRCS(C), FRACS, FRCS(Glasg)

Trauma Surgeon, Director of Trauma
Liverpool Hospital
Sydney, New South Wales
Australia

Marc DeMoya, MD, FACS
Associate Professor of Surgery
 Massachusetts General Hospital/Harvard Medical School
 Boston, Massachusetts
 United States

Newton Djin Mori, MD, PhD, FACS
General and Trauma Surgeon
 Hospital das Clinicas–University of São Paulo
 São Paulo, São Paulo
 Brazil

Cristiane de Alencar Domingues, RN, MSN, PhD
Professor
 Faculdade das Américas (FAM)
 São Paulo, São Paulo
 Brazil

Jay Doucet, MD, FRCS, FACS
Professor of Surgery
 University of California, San Diego
 San Diego, California
 United States

Julia A. Dunn, MD, MS, FACS
Medical Director, Trauma Research and Education
 UC Health Northern Colorado
 Loveland, Colorado
 United States

Lesley Dunstall, RN
National Coordinator; EMST/ATLS Australasia
 Royal Australasian College of Surgeons
 North Adelaide, South Australia
 Australia

David Efron, MD, FACS
Professor of Surgery; Chief, Division of Acute Care Surgery;
Director of Adult Trauma
 The Johns Hopkins University School of Medicine
 Baltimore, Maryland
 United States

Froilan Fernandez, MD, FACS
Chair, ACS-COT Chile; Associate Senior Surgical Staff
 Hospital Del Trabajador
 Santiago
 Chile

John Fildes, MD, FACS
Foundation Professor; Chair, Surgery; Chief, Division of Acute
Care Surgery; Program Director, Acute Care Surgery Fellowship
 University of Nevada, Reno School of Medicine
 Las Vegas, Nevada
 United States

Esteban Foianini, MD, FACS
Medical Director
 Clinica Foianini
 Santa Cruz de la Sierra
 Bolivia

Adam Fox, DPM, DO, FACS
Assistant Professor of Surgery and Section Chief, Trauma
Division of Trauma Surgery and Critical Care, Rutgers NJMS;
Associate Trauma Medical Director, NJ Trauma Center
 Newark, New Jersey
 United States

Robert Michael Galler, DO, FACS, FACOS
Associate Professor, Neurosurgery and Orthopedics;
Co-Director, Comprehensive Spine Center, Institute for
Advanced Neurosciences
 Stony Brook University Medical Center
 Long Island, New York
 United States

Raj Gandhi, MD
Trauma Medical Director
 JPS Health Network
 Fort Worth, Texas
 United States

Naisan Garraway, CD, FRCS, FACS
Medical Director, Trauma Program
 Vancouver General Hospital
 Vancouver, British Columbia
 Canada

Subash Gautam, MB, FRCS(Eng, Edn, and Glasg), FACS
Head of Department
 Fujairah Hospital
 Fujairah
 United Arab Emirates

Julie Gebhart, PA-C
Lead Orthopedic Trauma Physician; Assistant Manager,
Orthopedic Advanced Practice Providers
 OrthoIndy Hospital
 Indianapolis, Indiana
 United States

Agieszka Gizzi
Regional and International Programmes Coordinator
 The Royal College of Surgeons of England
 London
 United Kingdom

Oscar Guillamondegui, MD, MPH, FACS
Professor of Surgery, Trauma Medical Director
 Vanderbilt University Medical Center
 Nashville, Tennessee
 United States

Betty Jean (B. J.) Hancock, MD, FRCSC, FACS
Associate Professor, Pediatric Surgery and Critical Care
 University of Manitoba; Children's Hospital of
 Winnipeg/Health Sciences Centre
 Winnipeg, Manitoba
 Canada

Paul Harrison, MD, FACS
Trauma Medical Director HCA Continental Division;
Associate Medical Director, Clinical Professor of Surgery
 Wesley Medical Center/KU School of Medicine
 Wichita, Kansas
 United States

Col. (Ret.) Walter Henny, MD
 University Hospital and Medical School
 Rotterdam
 The Netherlands

Sharon M. Henry, MD, FACS
Anne Scalea Professor of Surgery
 University of Maryland School of Medicine; University
 of Maryland Medical Center RA Cowley Shock Trauma
 Center
 Baltimore, Maryland
 United States

Fergal Hickey, FRCS, FRCSEd, DA(UK), FRCER, FIFEM
National Director, ATLS Ireland; Consultant in Emergency
Medicine
 Sligo University Hospital
 Sligo
 Ireland

Marzellus Hofmann, MD, MME
Dean of Medical Education and Student Affairs
 Witten/Herdecke University, Faculty of Health
 Witten, NRW
 Germany

Annette Holian
Clinical Director-Surgery and Perioperative Services
 Royal Australian Air Force

Roxolana Horbowyj, MD, MSChE, FACS
Assistant Professor of Surgery, Department of Surgery
 Uniformed Services University of the Health Sciences/
 Walter Reed National Military Medical Center
 Bethesda, Maryland
 United States

David B. Hoyt, MD, FACS
Executive Director
 American College of Surgeons
 Chicago, Illinois
 United States

Eliesa Ing, MD
Staff Ophthalmologist, Portland VA HSC
 Assistant Professor, Casey Eye Institute/OHSU
 Portland, Oregon
 United States

Lewis Jacobson, MD, FACS
Chair, Department of Surgery; Director, Trauma and
Surgical Critical Care
 St. Vincent Indianapolis Hospital
 Indianapolis, Indiana
 United States

Randeep Jawa, MD, FACS
Clinical Professor of Surgery
 Stony Brook University School of Medicine
 Stony Brook, New York
 United States

Maria Fernanda Jimenez, MD, FACS
General Surgeon
 Hospital Universitario MEDERI
 Bogotá, Distrito Capital
 Colombia

Aaron Joffe, DO, FCCM
Associate Professor of Anesthesiology
 University of Washington, Harborview Medical Center
 Seattle, Washington
 United States

Kimberly Joseph, MD, FACS, FCCM
Division Chair, Trauma Critical Care and Prevention
Department, Department of Trauma and Burns
 John H. Stoger Hospital of Cook County
 Chicago, Illinois
 United States

Haytham Kaafarani, MD, MPH, FACS

Patient Safety and Quality Director; Director of Clinical Research, Trauma, Emergency Surgery and Surgical Critical Care

Massachusetts General Hospital and Harvard Medical School

Boston, Massachusetts
United States

Martin Keller, MD, FACS, FAAP

Associate Professor of Surgery

St. Louis Children's Hospital; Washington University School of Medicine

St. Louis, Missouri
United States

John Kortbeek, MD, FRCSC, FACS

Professor, Department of Surgery, Critical Care and Anaesthesia

Cumming School of Medicine, University of Calgary
Calgary, Alberta

Canada

Deborah A. Kuhls, MD, FACS

Professor of Surgery

University of Nevada School of Medicine
Las Vegas, Nevada

United States

Sunir Kumar, MD

Cleveland Clinic

Cleveland, Ohio

United States

Eric Kuncir, MD, MS, FACS

Chief, Division of Emergency General Surgery; Clinical Professor of Surgery

University of California, Irvine

Orange, California

United States

Claus Falck Larsen, DMSc,MPA

consultant,

Clinic at TraumaCentre

Rigshospitalet

University of Southern Denmark

Copenhagen

Denmark

Gilberto K. K. Leung, MBBS, FRCS, PhD

Clinical Associate Professor

The University of Hong Kong Queen Mary University

Pok Fu Lam

Hong Kong

Sarvesh Logsetty, MD, FACS, FRCS(C)

Associate Professor, Director, Manitoba Firefighters Burn Unit

University of Manitoba

Winnipeg, Manitoba

Canada

Siew Kheong Lum, MBBS, FRCSEd, FACS, FRACS (Hon), FAMM, FAMS

Professor of Surgery and ATLS Program Director

Sungai Buloh Hospital

Kuala Lumpur

Malaysia

Patrizio Mao, MD, FACS

Azienda Ospedaliero-Universitaria

San Luigi Gonzaga

Orbassano, Torino

Italy

Sherri Marley, BSN, RN, CEN, TCRN

Clinical Educator for Trauma Services

Eskenazi Hospital

Indianapolis, Indiana

United States

Katherine Martin, MBBS, FRACS

Trauma Surgeon

Alfred Hospital

Melbourne, Victoria

Australia

Sean P. McCully, MD, MS

Surgical Critical Care Fellow

Department of Surgery

Oregon Health and Science University

Portland, Oregon

United States

Chad McIntyre, BS, NRP, FP-C

Manager, Trauma and Flight Services

UF Health Jacksonville

Jacksonville, Florida

United States

Daniel B. Michael, MD, PhD, FACS, FAANS

Director of Neurosurgical Education

William Beaumont Hospital Royal Oak

Professor of Neurosurgery

Oakland University William Beaumont School of Medicine

Royal Oak, Michigan

United States

Director, Michigan Head and Spine Institute

Southfield, Michigan

United States

Mahesh Misra, MD, FACS

Director
All India Institute of Medical Sciences
New Delhi
India

Soledad Monton

Médico en Servicio Navarro de Salud
Servicio Navarro de Salud
Pamplona
Spain

Hunter Moore, MD

Trauma Research Fellow
University of Colorado
Denver, Colorado
United States

John Ng, MD, MS, FACS

Chief, Division of Oculofacial Plastics, Orbital and Reconstructive Surgery; Professor, Departments of Ophthalmology and Otolaryngology/Head and Neck Surgery
Casey Eye Institute–Oregon Health and Science University
Portland, Oregon
United States

Nnamdi Nwauwa, MScEM, MPH, MBBS

Director, Training and Clinical Services
Emergency Response International
Port Harcourt, Nigeria

James V. O'Connor MD, FACS

Professor of Surgery, University of Maryland School of Medicine
Chief, Thoracic and Vascular Trauma
R Adams Cowley Shock Trauma Center
Baltimore, Maryland
United States

Roddy O'Donnell, MBBS, MA, PhD, FRCPCH, MRCP, FFICM

Consultant Paediatrician and Director of PICU
Addenbrookes Hospital
Cambridge
United Kingdom

Giorgio Olivero, MD, FACS

ATLS Program Director; Professor of Surgery
Department of Surgical Sciences, University of Torino
Torino
Italy

Debbie Paltridge, MHLthSc (ED)

Principal Educator
Royal Australasian College of Surgeons
Melbourne, Victoria
Australia

Neil Parry, MD, FACS, FRCS

Medical Director, Trauma Program; Associate Professor of Surgery and Critical Care
London Health Sciences Center; Schulich School of Medicine, Western University
London, Ontario
Canada

Albert Pierce

Hermanus Jacobus Christoffel Du Plessis, MB, ChB, MMed(Surg), FCS(SA), FACS

Travis Polk, MD, FACS

Commander, Medical Corps, U.S. Navy; Surgical Director, Healthcare Simulation and Bioskills Training Center
Naval Medical Center Portsmouth
Portsmouth, Virginia
United States

Bruce Potenza, MD, FACS

Critical Care Surgeon, Trauma
UCSD Medical Center
San Diego, California
United States

Tarek Razek, MD, FRCS, FACS

Chief, Division of Trauma Surgery
McGill University Health Centre
Montreal, Quebec
Canada

Martin Richardson, MBBS, MS, FRACS

Associate Clinical Dean
Epworth Hospital, University of Melbourne
Melbourne, Victoria
Australia

Avraham Rivkind, MD, FACS

Head, Division of Emergency Medicine and Shock Trauma Unit
Hadassah Medical Center
Jerusalem
Israel

Rosalind Roden, BA(Cambridge), FRCEM
Consultant in Emergency Medicine
 Leeds Teaching Hospitals
 Trust Leeds, West Yorkshire
 United Kingdom

Jakob Roed, MD, MPA, DLS
Chief Anesthetist, Department of Anesthesiology and Intensive Care
 Zealand University Hospital
 Roskilde
 Denmark

Dan Rutigliano, DO
Assistant Professor of Surgery
 Stony Brook University School of Medicine
 Stony Brook, New York
 United States

Kennith Sartorelli, MD, FACS
Department of Surgery
 University of Vermont College of Medicine
 Burlington, Vermont
 United States

Patrick Schoettker, MD
Professor of Anesthesiology
 University Hospital CHUV
 Lausanne, VD
 Switzerland

David Schultz, MD, FACS
Theadacare Regional Medical Center Neenah
 Neenah, Wisconsin
 United States

Kristen C. Sihler, MD, MS, FACS
Maine Medical Center
 Portland, Maine
 United States

Preecha Siritongtaworn, FRCST, FACS.
Department of Surgery
 Faculty of Medicine
 Siriraj Hospital
 Bangkok, Thailand

David Skarupa, MD, FACS
Assistant Professor of Surgery, Department of Surgery/ Division of Acute Care Surgery
 University of Florida College of Medicine-Jacksonville
 Jacksonville, Florida
 United States

Elizabeth Vallejo de Solezio
National Education, Committee on Trauma Ecuador
 Quito, Ecuador

Ronald Stewart, MD, FACS
Chair, American College of Surgeons Committee on Trauma
 Witten B. Russ Professor and Chair of the Department of Surgery
 UT Health San Antonio
 San Antonio, Texas
 United States

Claus Stobaus, ME, ED
Postgraduate Program in Education
 Pontifical Catholic University of Rio Grande do Sul
 Porto Alegre, Rio Grande do Sul
 Brazil

John Sutyak, EdM, MD, FACS
Director, Southern Illinois Trauma Center
Associate Professor of Surgery
 Southern Illinois University School of Medicine
 Springfield, Illinois
 United States

Gonzalo Tamayo

Kum-Ying Tham, MBBS, FRCSE, EDD
Senior Consultant
 Tan Tock Seng Hospital
 Singapore

Phil Truskett
Surgeon at SESIH
 SESIH
 Sydney, Australia

Gary Vercruyse, MD, FACS
Director of Burns Services; Associate Professor of Surgery, Division of Trauma, Burns, Acute Care Surgery and Surgical Critical Care
 University of Arizona School of Medicine
 Tucson, Arizona
 United States

Eric Voiglio, MD, FACS
Emergency Surgery Unit
 University Hospitals of Lyon
 Pierre-Bénite
 France

James Vosswinkel, MD, FACS
Chief, Division of Trauma
 Stony Brook University School of Medicine
 Stony Brook, New York
 United States

Bob Yellowe, MD, MSc Sport Medicine
Consultant Orthopedic and Trauma Surgeon
 University of Port Harcourt Teaching Hospital
 Port Harcourt
 Nigeria

Dany Westerband, MD, FACS
Medical Director of Trauma Services; Chief, Section of Trauma and Emergency Surgery; Chairman, Department of Surgery
 Suburban Hospital–Johns Hopkins Medicine
 Bethesda, Maryland
 United States

Garry Wilkes, MBBS, FACEM
Director, Emergency Medicine
 Monash Medical Centre
 Melbourne, Victoria
 Australia

Catherine Wilson, MSN, ACNP-BC, CEN
Trauma Outreach Coordinator
 Vanderbilt University Medical Center
 Nashville, Tennessee
 United States

Robert Winchell, MD, FACS
Chief, Division of Trauma, Burn, Acute Care and Critical Care, Director of Trauma Center
 Weill Cornell Medicine; New York–Presbyterian Weill Cornell Medical Center
 New York, New York
 United States

Bob Winter, FRCP, FRCA, FFICM, DM
Medical Director, East Midlands Ambulance Services
 Horizon Place
 Nottingham
 United Kingdom

Christoph Wöelfl, MD, PhD
Head of Department, Department of Orthopedic and Trauma Surgery
 Krankenhaus Hetzelstift
 Neustadt a. d. Weinstrasse
 Germany

Jay A. Yelon, DO, FACS, FCCM
Professor of Surgery; Medical Director of Surgical Services
 Hofstra Northwell School of Medicine; Southside Hospital/Northwell Health
 Bay Shore, New York
 United States

Heba Youssef Mohamed Sayed, MD
Professor and Head of Forensic Medicine and Clinical Toxicology Department
 Faculty of Medicine–Port Said University
 Port Said
 Arab Republic of Egypt

Laura Zibners, MD
Honorary Consultant, Pediatric Emergency Medicine
 Imperial College, St. Mary's Hospital
 London
 United Kingdom

HONOR ROLL

Over the past 30 years, ATLS has grown from a local course training of Nebraska doctors to care for trauma patients to a family of trauma specialists from more than 60 countries who volunteer their time to ensure that our materials reflect the most current research and that our course is designed to improve patient outcomes. The Tenth Edition of ATLS reflects the efforts of the individuals who contributed to the first nine editions, and we honor them here:

Georges Abi Saad
 Sabas F. Abuabara, MD, FACS
 Joe E. Acker, II, MS, MPH, EMT
 Fatimah Albarracin, RN
 Celia Aldana
 Raymond H. Alexander, MD, FACS
 Omar Al Ghanimi
 Abdullah Al-Harthi
 Jameel Ali, MD, MMed Ed, FRCS(C), FACS
 Saud Al-Turki, MD, FRCS, ODTS, FACA, FACS
 Donna Allerton, RN
 Heri Aminuddin, MD
 John A. Androulakis, MD, FACS
 Charles Aprahamian, MD, FACS
 Guillermo Arana, MD, FACS
 Marjorie J. Arca, MD, FACS
 Ana Luisa Argomedo Manrique
 John H. Armstrong, MD, FACS
 John L.D. Atkinson, MD, FACS
 Ivar Austlid
 Gonzalo Avilés
 Mahmood Ayyaz, MD

Richard Baillot, MD
 Andrew Baker, MD
 Barbara A. Barlow, MA, MD, FACS
 James Barone, MD, FACS
 John Barrett, MD, FACS
 Pierre Beaumont, MD
 Margareta Behrbohm Fallsberg, PhD, BSc
 Richard M. Bell, MD, FACS
 Eugene E. Berg, MD, FACS
 Richard Bergeron, MD
 François Bertrand, MD
 Renato Bessa de Melo, MD
 Mike Betzner, MD
 Emidio Bianco, MD, JD
 David P. Blake, MD, FACS
 Ken Boffard, MB BCh, FRCS, FRCS(Ed), FACS
 Mark W. Bowyer, MD, FACS, DMCC
 Don E. Boyle, MD, FACS
 Marianne Brandt
 Mary-Margaret Brandt, MD, FACS
 Frank J. Branicki, MBBS, DM, FRCS, FRACS, FCS(HK),
 FHKAM(Surg)
 Karen Brasel, MPH, MD, FACS
 Fred Brenneman, MD, FRCSC, FACS
 George Brighton, MD
 Åse Brinchmann-Hansen, PhD
 Peter Brink, MD, PhD
 Karim Brohi, MD
 James Brown, MA
 Rea Brown, MD, FACS
 Allen F. Browne, MD, FACS
 Laura Bruna, RN
 Gerry Bunting, MD
 Andrew R. Burgess, MD, FACS
 Richard E. Burney, MD, FACS
 David Burris, MD, FACS
 Reginald A. Burton, MD, FACS
 Jacqueline Bustraan, MSc
 Vilma Cabading
 Sylvia Campbell, MD, FACS
 C. James Carrico, MD, FACS
 Carlos Carvajal Hafemann, MD, FACS
 Gustavo H. Castagneto, MD, FACS
 Candice L. Castro, MD, FACS
 C. Gene Cayten, MD, FACS
 June Sau-Hung Chan
 Zafar Ullah Chaudhry, MD, FRCS, FCPS, FACS
 Peggy Chehardy, EdD, CHES
 Regina Sutton Chennault, MD, FACS
 Robert A. Cherry, MD, FACS
 Diane Chetty
 Wei Chong Chua, MD
 Emmanuel Chrysos, MD, PhD, FACS
 Chin-Hung Chung, MB BS, FACS
 David E. Clark, MD, FACS
 Raul Coimbra, MD, PhD, FACS
 Francisco Collet e Silva, MD, FACS, PhD(Med)
 Paul E. Collicott, MD, FACS
 Arthur Cooper, MD, FACS
 Jaime Cortes Ojeda, MD
 Clay Cothren Burlew, MD, FACS
 Ronald D. Craig, MD
 Doug Davey, MD
 Kimberly A. Davis, MD, FACS
 Cristiane de Alencar Domingues, RN, MSN, PhD
 Subrato J. Deb, MD
 Alejandro De Gracia, MD, FACS, MAAC
 Laura Lee Demmons, RN, MBA
 Ronald Denis, MD
 Elizabeth de Solezio, PhD
 Jesus Díaz Portocarrero, MD, FACS
 Mauricio Di Silvio-Lopez, MD, FACS
 Frank X. Doto, MS
 Jay J. Doucet, MD, FACS
 Anne-Michèle Droux
 Julia A. Dunn, MD, FACS
 Hermanus Jacobus Christoffel Du Plessis, MB, ChB,
 MMed(Surg), FCS(SA), FACS
 Marguerite Dupré, MD
 Candida Durão
 Ruth Dyson, BA(Hons)
 Martin Eason, MD, JD
 A. Brent Eastman, MD, FACS
 Frank E. Ehrlich, MD, FACS
 Martin R. Eichelberger, MD, FACS
 Abdelhakim Talaat Elkholy, MBChB
 David Eduardo Eskenazi, MD, FACS
 Vagn Norgaard Eskesen, MD
 Denis Evoy, MCH, FRCSI
 William F. Fallon, Jr., MD, FACS
 David V. Feliciano, MD, FACS
 Froilan Fernandez, MD
 Carlos Fernandez-Bueno, MD
 John Fildes, MD, FACS
 Ronald P. Fischer, MD, FACS
 Stevenson Flanigan, MD, FACS
 Lewis M. Flint, Jr, MD, FACS
 Cornelia Rita Maria Getruda Fluit, MD, MedSci
 Joan Foerster
 Esteban Foianini, MD, FACS
 Jorge E. Foianini, MD, FACS
 Heidi Frankel, MD, FACS
 Knut Fredriksen, MD, PhD
 Susanne Fristeen, RN
 Richard Fuehling, MD
 Christine Gaarder, MD
 Sylvain Gagnon, MD
 Richard Gamelli, MD, FACS
 Subash C. Gautam, MD, MBBS, FRCS, FACS
 Paul Gebhard

James A. Geiling, MD, FCCP
 Thomas A. Gennarelli, MD, FACS
 John H. George, MD
 Aggelos Geranios, MD
 Michael Gerazounis, MD
 Roger Gilbertson, MD
 Robert W. Gillespie, MD, FACS
 Marc Giroux, MD
 Gerardo A. Gomez, MD, FACS
 Hugo Alfredo Gomez Fernandez, MD, FACS
 Khalid Masood Gondal
 Javier González-Uriarte, MD, PhD, EBSQ, FSpCS
 John Greenwood
 Russell L. Gruen, MBBS, PhD, FRACS
 Niels Gudmundsen-Vestre
 Oscar D. Guillaumondegui, MD, FACS
 Enrique A. Guzman Cottallat, MD, FACS
 J. Alex Haller, Jr., MD, FACS
 Betty Jean (B. J.) Hancock, MD, FACS
 Burton H. Harris, MD, FACS
 Michael L. Hawkins, MD, FACS
 Ian Haywood, FRCS(Eng), MRCS, LRCP
 James D. Heckman, MD, FACS
 June E. Heilman, MD, FACS
 David M. Heimbach, MD, FACS
 Richard Henn, RN, BSN, M.ED
 Walter Henny, MD
 Sharon M. Henry, MD, FACS
 David N. Herndon, MD, FACS
 Grace Herrera-Fernandez
 Fergal Hickey, FRCS, FRCS Ed(A&E), DA(UK), FCEM
 Erwin F. Hirsch, MD, FACS
 Francisco Holguin, MD
 Michael Hollands, MB BS, FRACS, FACS
 Scott Holmes
 Roxolana Horbowyj, MD, FACS
 David B. Hoyt, MD, FACS
 Arthur Hsieh, MA, NREMT-P
 Irvine K. Hughes, RN
 Christopher M. Hulst, MD, FACS, CDR, USN
 Richard C. Hunt, MD, FACEP
 John E. Hutton, Jr, MD, FACS
 Miles H. Irving, FRCS(Ed), FRCS(Eng)
 Randeep S. Jawa, MD, FACS
 José María Jover Navalon, MD, FACS
 Richard Judd, PhD, EMSI
 Gregory J. Jurkovich, MD, FACS
 Aage W. Karlson
 Christoph R. Kaufmann, MD, FACS
 Howard B. Keith, MD, FACS
 James F. Kellam, MD, FRCS, FACS
 Steven J. Kilkenny, MD, FACS
 Darren Kilroy, FRCS(Ed), FCEM, M.Ed
 Lena Klarin, RN
 Peggy Knudson, MD, FACS
 Amy Koestner, RN, MSN
 Radko Komadina, MD, PhD
 Digna R. Kool, MD
 John B. Kortbeek, MD, FACS
 Roman Kosir, MD
 Brent Krantz, MD, FACS
 Jon R. Krohmer, MD, FACEP
 Eric J. Kuncir, MD, FACS
 Roslyn Ladner
 Ada Lai Yin Kwok
 Maria Lampi, BSc, RN
 Katherine Lane, PhD
 Francis G. Lapiana, MD, FACS
 Pedro Larios Aznar
 Claus Falck Larsen, MD, PhD(Med), MPA, FACS
 Anna M. Ledgerwood, MD, FACS
 Dennis G. Leland, MD, FACS
 Frank Lewis, MD, FACS
 Wilson Li, MD
 Helen Livanios, RN
 Chong-Jeh Lo, MD, FACS
 Sarvesh Logsetty, MD, FACS
 Nur Rachmat Lubis, MD
 Edward B. Lucci, MD, FACEP
 Eduardo Luck, MD, FACS
 Thomas G. Luerssen, MD, FACS
 Ka Ka Lui
 J.S.K. Luitse, MD
 Siew-Kheong Lum
 Douglas W. Lundy, MD, FACS
 Arnold Luterman, MD, FACS
 Fernando Machado, MD
 Fernando Magallanes Negrete, MD
 Jaime Manzano, MD, FACS
 Patrizio Mao, MD, FACS
 Donald W. Marion, MD, FACS
 Michael R. Marohn, DO, FACS
 Barry D. Martin, MD
 Salvador Martin Mandujano, MD, FACS
 Kimball I. Maull, MD, FACS
 R. Todd Maxson, MD, FACS
 Mary C. McCarthy, MD, FACS
 Gerald McCullough, MD, FACS
 John E. McDermott, MD, FACS
 James A. McGehee, DVM, MS
 Chad McIntyre, NREMT-P, FP-C
 William F. McManus, MD, FACS
 Norman E. McSwain, Jr., MD, FACS
 Philip S. Metz, MD, FACS
 Cynthia L. Meyer, MD
 Daniel B. Michael, MD, PhD, FACS
 Salvijus Milasius, MD
 Frank B. Miller, MD, FACS
 Sidney F. Miller, MD, FACS

LEO Pien Ming, MBBS, MRCS (Edin), M.Med (Orthopaedics)
 Mahesh C. Misra, MD, FACS
 Soledad Monton, MD
 Ernest E. Moore, MD, FACS
 Forrest O. Moore, MD, FACS
 Newton Djin Mori, MD
 Johanne Morin, MD
 Charles E. Morrow, Jr., MD, FACS
 David Mulder, MD, FACS
 Stephen G. Murphy, MD
 Kimberly K. Nagy, MD, FACS
 Raj K. Narayan, MD, FACS
 James B. Nichols, DVM, MS
 Nicolaos Nicolau, MD, FACS
 Martín Odriozola, MD, FACS
 Han Boon Oh
 Giorgio Olivero, MD, FACS
 Franklin C. Olson, EdD
 Steve A. Olson, MD, FACS
 Osama Ali Omari, MD
 Hock Soo Ong, MD, FACS
 Gonzalo Ostria P., MD, FACS
 Arthur Pagé, MD
 José Paiz Tejada
 Rattaplee Pak-Art, MD
 Fatima Pardo, MD
 Steven N. Parks, MD, FACS
 BiPinchandra R. Patel, MD, FACS
 Chester (Chet) Paul, MD
 Jasmeet S. Paul, MD
 Andrew Pearce, BScHons, MBBS, FACEM PG Cert
 Aeromed retrieval
 Mark D. Pearlman, MD
 Andrew B. Peitzman, MD, FACS
 Nicolas Peloponissios, MD
 Jean Péloquin, MD
 Philip W. Perdue, MD, FACS
 Pedro Moniz Pereira, MD
 Neil G. Perry, MD, FRCS, FACS
 J.W. Rodney Peyton, FRCS(Ed), MRCP
 Lawrence H. Pitts, MD, FACS
 Renato Sergio Poggetti, MD, FACS
 Alex Poole, MD, FACS
 Galen V. Poole, MD, FACS
 Danielle Poretti, RN
 Ernest Prigent, MD
 Raymond R. Price, MD, FACS
 Richard R. Price, MD, FACS
 Sonia Primeau
 Herbert Proctor, MD, FACS
 Jacques Provost, MD
 Paul Pudimat, MD
 Cristina Quintana
 Max L. Ramenofsky, MD, FACS
 Jesper Ravn, MD
 Tarek S. A. Razek, MD, FACS
 Marcelo Recalde Hidrobo, MD, FACS
 John Reed, MD
 Marleta Reynolds, MD, FACS
 Stuart A. Reynolds, MD, FACS
 Peter Rhee, MD, MPH, FACS, FCCM, DMCC
 Bo Richter
 Bernard Riley, FFARCS
 Charles Rinker, MD, FACS
 Avraham Rivkind, MD
 Rosalind Roden, FFAEM
 Diego Rodriguez, MD
 Vicente Rodriguez, MD
 Jakob Roed, MD
 Olav Røise, MD, PhD
 Martha Romero
 Ronald E. Rosenthal, MD, FACS
 Michael F. Rotondo, MD, FACS
 Grace Rozycki, MD, FACS
 Daniel Ruiz, MD, FACS
 J. Octavio Ruiz Speare, MD, MS, FACS
 James M. Ryan, MCh, FRCS(Eng), RAMC
 Majid Sabahi, MD
 James M. Salander, MD, FACS
 Gueider Salas, MD
 Jeffrey P. Salomone, MD, FACS
 Rocio Sanchez-Aedo Linares, RN
 Mårten Sandberg, MD, PhD
 Thomas G. Saul, MD, FACS
 Nicole Schaapveld, RN
 Domenic Scharplatz, MD, FACS
 William P. Schechter, MD, FACS
 Inger B. Schipper, MD, PhD, FACS
 Patrick Schoettker, MD, M.E.R.
 Martin A. Schreiber, MD, FACS
 Kari Schrøder Hansen, MD
 Thomas E. Scott, MD, FACS
 Stuart R. Seiff, MD, FACS
 Estrellita C. Serafico
 Bolivar Serrano, MD, FACS
 Juan Carlos Serrano, MD, FACS
 Steven R. Shackford, MD, FACS
 Marc J. Shapiro, MD, FACS
 Thomas E. Shaver, MD, FACS
 Mark Sheridan, MBBS, MMedSc, FRACS
 Brian Siegel, MD, FACS
 Richard C. Simmonds, DVM, MS
 Richard K. Simons, MB, BChir, FRCS, FRCS, FACS
 Preecha Siritongtaworn, MD, FACS
 Diana Skaff
 Nils Oddvar Skaga, MD
 David V. Skinner, FRCS(Ed), FRCS(Eng)
 Peter Skippen, MBBS, FRCPC, FJFICM, MHA
 Arnold Sladen, MD, FACS

Tone Slåke
 R. Stephen Smith, MD, RDMS, FACS
 Birgitte Soehus
 Ricardo Sonneborn, MD, FACS
 Anne Sorvari
 Michael Stavropoulos, MD, FACS
 Spyridon Stergiopoulos, MD
 Gerald O. Strauch, MD, FACS
 Luther M. Strayer, III, MD
 James K. Styner, MD
 LAM Suk-Ching, BN, MHM
 Paul-Martin Sutter, MD
 John Sutyak, MD, FACS
 Lars Bo Svendsen, MD, DMSci
 Vasso Tagkalakis
 Wael S. Taha, MD
 Kathryn Tchorz, MD, FACS
 Joseph J. Tepas, III, MD, FACS
 Stéphane Tétraeault, MD
 Gregory A. Timberlake, MD, FACS
 Wei Ting Lee
 Gustavo Tisminetzky, MD, FACS, MAAC
 Peter G. Trafton, MD, FACS
 Stanley Trooksin, MD, FACS
 Julio L. Trostchansky, MD, FACS
 Philip Truskett, MB BS, FRACS
 David Tuggle, MD, FACS
 Wolfgang Ummenhofer, MD, DEAA
 Jeffrey Upperman, MD, FACS
 Jay Upright
 Yvonne van den Ende
 Armand Robert van Kanten, MD
 Endre Varga, MD, PhD
 Edina Várkonyi
 Panteleimon Vassiliu, MD, PhD
 Eugenia Vassilopoulou, MD
 Antigoni Vavarouta
 Allan Vennike
 Antonio Vera Bolea
 Alan Verdant, MD
 Tore Vikström, MD, PhD
 J. Leonel Villavicencio, MD, FACS
 Eric Voiglio, MD, PhD, FACS, FRCS
 Franklin C. Wagner, MD, FACS
 Raymond L. Warpeha, MD, FACS
 Clark Watts, MD, FACS
 John A. Weigelt, MD, FACS
 Leonard J. Weireter Jr., MD, FACS
 John West, MD, FACS
 Nicholas M. Wetjen, MD
 Robert J. White, MD, FACS
 Richard L. Wigle, MD, FACS
 Stephen Wilkinson, MBBS, MD, FRACS
 Daryl Williams, MBBS, FANZCA, GDipBusAd, GdipCR
 Robert J. Winchell, MD, FACS
 Robert Winter, FRCP, FRCA, DM
 Fremont P. Wirth, MD, FACS
 Bradley D. Wong, MD, FACS
 Nopadol Wora-Urai, MD, FACS
 Peter H. Worlock, DM, FRCS(Ed), FRCS(Eng)
 Jay A. Yelon, MD, FACS
 Bang Wai-Key Yuen, MB BS, FRCS, FRACS, FACS
 Ahmad M. Zarour, MD, FACS

COURSE OVERVIEW: PURPOSE, HISTORY, AND CONCEPTS OF THE ATLS PROGRAM

PROGRAM GOALS

The Advanced Trauma Life Support (ATLS) course supplies its participants with a safe and reliable method for the immediate treatment of injured patients and the basic knowledge necessary to:

1. Assess a patient's condition rapidly and accurately.
2. Resuscitate and stabilize patients according to priority.
3. Determine whether a patient's needs exceed the resources of a facility and/or the capability of a provider.
4. Arrange appropriately for a patient's interhospital or intrahospital transfer.
5. Ensure that optimal care is provided and that the level of care does not deteriorate at any point during the evaluation, resuscitation, or transfer process.

COURSE OBJECTIVES

The content and skills presented in this course are designed to assist doctors in providing emergency care for trauma patients. The concept of the "golden hour" emphasizes the urgency necessary for successful treatment of injured patients and is not intended to represent a fixed time period of 60 minutes. Rather, it is the window of opportunity during which doctors can have a positive impact on the morbidity and mortality associated with injury. The ATLS course provides the essential information and skills for doctors to identify and treat life-threatening and potentially life-threatening injuries under the extreme pressures associated with the care of these patients in the fast-paced environment and anxiety of a trauma room. The ATLS course is applicable to clinicians in a variety of situations. It is just as relevant to providers in a large teaching facility in North America or Europe as it is in a developing nation with rudimentary facilities.

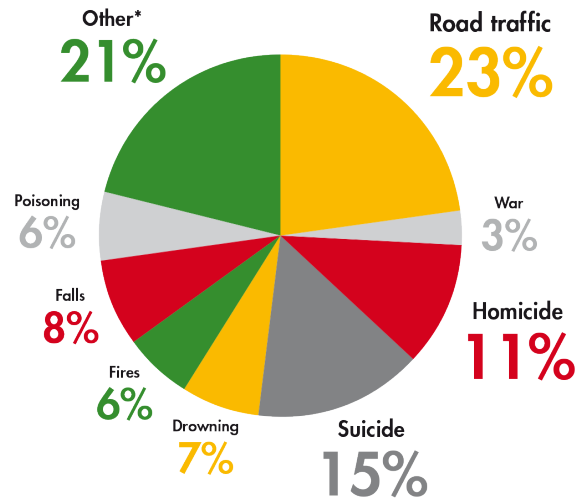
Upon completing the ATLS student course, the participant will be able to:

1. Demonstrate the concepts and principles of the primary and secondary patient assessments.
2. Establish management priorities in a trauma situation.
3. Initiate primary and secondary management necessary for the emergency management of acute life-threatening conditions in a timely manner.
4. In a given simulation, demonstrate the following skills, which are often required during initial assessment and treatment of patients with multiple injuries:
 - a. Primary and secondary assessment of a patient with simulated, multiple injuries
 - b. Establishment of a patent airway and initiation of assisted ventilations
 - c. Orotracheal intubation on adult and infant manikins
 - d. Pulse oximetry and carbon dioxide detection in exhaled gas
 - e. Cricothyroidotomy
 - f. Assessment and treatment of a patient in shock, particularly recognition of life-threatening hemorrhage
 - g. Intraosseous access
 - h. Pleural decompression via needle or finger and chest tube insertion
 - i. Recognition of cardiac tamponade and appropriate treatment
 - j. Clinical and radiographic identification of thoracic injuries
 - k. Use of peritoneal lavage, ultrasound (FAST), and computed tomography (CT) in abdominal evaluation
1. Evaluation and treatment of a patient with brain injury, including use of the new Glasgow Coma Scale score and CT of the brain

- m. Protection of the spinal cord and radiographic and clinical evaluation of spine injuries
- n. Musculoskeletal trauma assessment and management

THE NEED

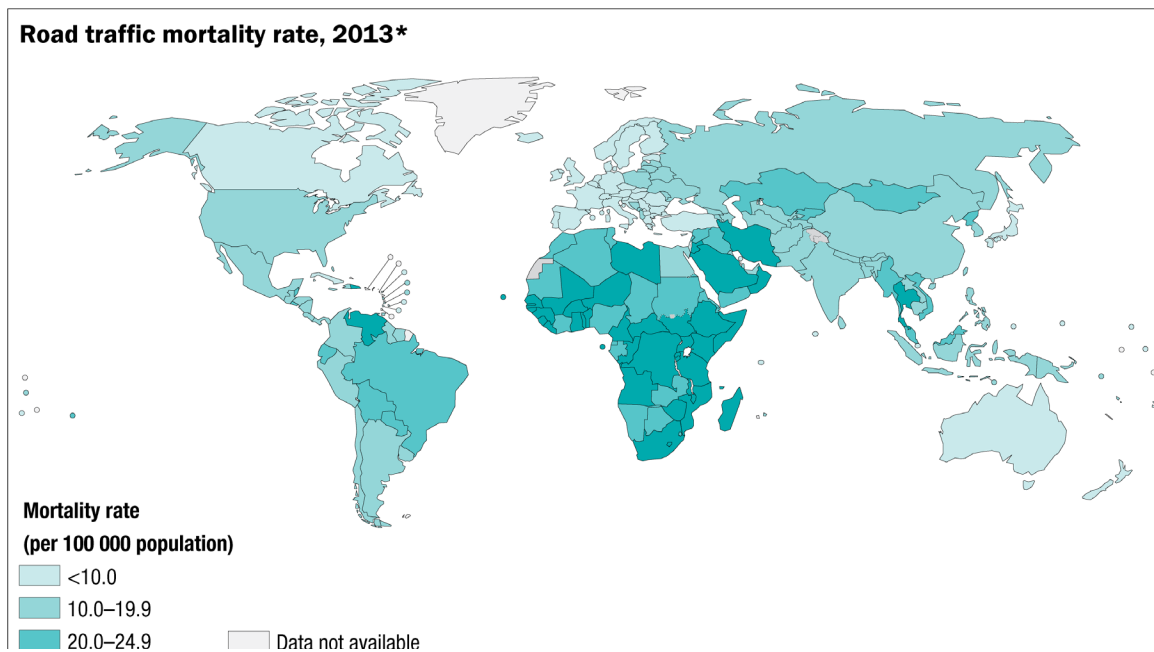
According to the most current information from the World Health Organization (WHO) and the Centers for Disease Control (CDC), more than nine people die every minute from injuries or violence, and 5.8 million people of all ages and economic groups die every year from unintentional injuries and violence (■ FIGURE 1). The burden of injury is even more significant, accounting for 18% of the world’s total diseases. Motor vehicle crashes (referred to as road traffic injuries in ■ FIGURE 2) alone cause more than 1 million deaths annually and an estimated 20 million to 50 million significant injuries; they are the leading cause of death due to injury worldwide. Improvements in injury control efforts are having an impact in most developed countries, where trauma remains the leading cause of death in persons 1 through 44 years of age. Significantly, more than 90% of motor vehicle crashes occur in the developing world. Injury-related deaths are expected to rise dramatically by 2020, and deaths due to motor vehicle crashes are projected to increase by 80% from current rates in low- and middle-income countries.



■ FIGURE 2 Distribution of global injury mortality by cause. “Other” category includes smothering, asphyxiation, choking, animal and venomous bites, hypothermia, and hyperthermia as well as natural disasters. Data from *Global Burden of Disease, 2004*. Reproduced with permission from *Injuries and Violence: The Facts*. Geneva: World Health Organization Department of Injuries and Violence Prevention; 2010.

TRIMODAL DEATH DISTRIBUTION

First described in 1982, the trimodal distribution of deaths implies that death due to injury occurs in one of three periods, or peaks. *The first peak* occurs within



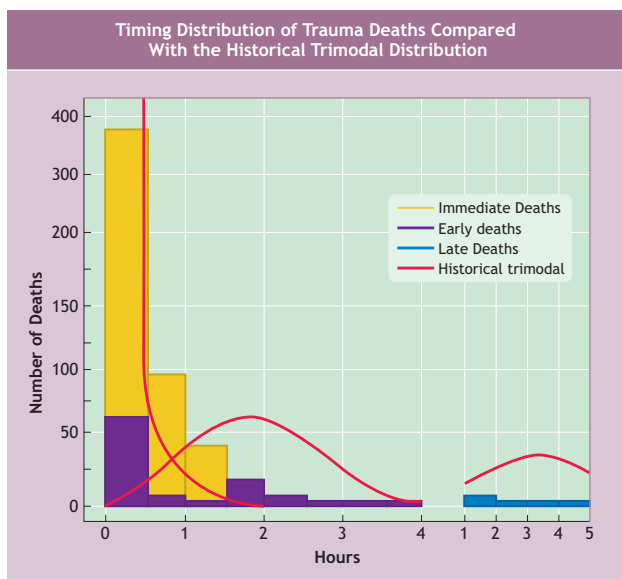
■ FIGURE 1 Road traffic mortality rate, 2013. Reproduced with permission from *Global Health Observatory Map Gallery*. Geneva: World Health Organization Department of Injuries and Violence Prevention; 2016.

seconds to minutes of injury. During this early period, deaths generally result from apnea due to severe brain or high spinal cord injury or rupture of the heart, aorta, or other large blood vessels. Very few of these patients can be saved because of the severity of their injuries. Only prevention can significantly reduce this peak of trauma-related deaths.

The *second peak* occurs within minutes to several hours following injury. Deaths that occur during this period are usually due to subdural and epidural hematomas, hemopneumothorax, ruptured spleen, lacerations of the liver, pelvic fractures, and/or multiple other injuries associated with significant blood loss. The golden hour of care after injury is characterized by the need for rapid assessment and resuscitation, which are the fundamental principles of Advanced Trauma Life Support.

The *third peak*, which occurs several days to weeks after the initial injury, is most often due to sepsis and multiple organ system dysfunctions. Care provided during each of the preceding periods affects outcomes during this stage. The first and every subsequent person to care for the injured patient has a direct effect on long-term outcome.

The temporal distribution of deaths reflects local advances and capabilities of trauma systems. The development of standardized trauma training, better prehospital care, and trauma centers with dedicated trauma teams and established protocols to care for injured patients has altered the picture. ■ **FIGURE 3** shows



■ **FIGURE 3** Timing distribution of trauma deaths compared with the historical trimodal distribution. The black line represents the historical trimodal distribution, and the bars represent 2010 study data. Reprinted with permission from Gunst M, Ghaemmaghami V, Gruszecki A, et al. Changing epidemiology of trauma deaths leads to a bimodal distribution. *Proc (Baylor Univ Med Cent)*, 2010;23(4):349–354.

the timing distribution of trauma deaths compared with the historical trimodal distribution.

HISTORY

The delivery of trauma care in the United States before 1980 was at best inconsistent. In February 1976, tragedy occurred that changed trauma care in the “first hour” for injured patients in the United States and in much of the rest of the world. An orthopedic surgeon was piloting his plane and crashed in a rural Nebraska cornfield. The surgeon sustained serious injuries, three of his children sustained critical injuries, and one child sustained minor injuries. His wife was killed instantly. The care that he and his family subsequently received was inadequate by the day’s standards. The surgeon, recognizing how inadequate their treatment was, stated: “When I can provide better care in the field with limited resources than what my children and I received at the primary care facility, there is something wrong with the system, and the system has to be changed.”

A group of private-practice surgeons and doctors in Nebraska, the Lincoln Medical Education Foundation, and the Lincoln area Mobile Heart Team Nurses, with the help of the University of Nebraska Medical Center, the Nebraska State Committee on Trauma (COT) of the American College of Surgeons (ACS), and the Southeast Nebraska Emergency Medical Services identified the need for training in advanced trauma life support. A combined educational format of lectures, lifesaving skill demonstrations, and practical laboratory experiences formed the prototype ATLS course.

A new approach to providing care for individuals who suffer major life-threatening injury premiered in 1978, the year of the first ATLS course. This prototype ATLS course was field-tested in conjunction with the Southeast Nebraska Emergency Medical Services. One year later, the ACS COT, recognizing trauma as a surgical disease, enthusiastically adopted the course under the imprimatur of the College and incorporated it as an educational program.

This course was based on the assumption that appropriate and timely care could significantly improve the outcome of injured patients. The original intent of the ATLS Program was to train doctors who do not manage major trauma on a daily basis, and the primary audience for the course has not changed. However, today the ATLS method is accepted as a standard for the “first hour” of trauma care by many who provide care for the injured, whether the patient is treated in an isolated rural area or a state-of-the-art trauma center.

ATLS AND TRAUMA SYSTEMS

As mentioned earlier, Advanced Trauma Life Support (ATLS) was developed in 1976 following a plane crash in which several children were critically injured. They received injury care, but the resources and expertise they needed were not available. This was, unfortunately, typical of the way injury care was provided in most areas of the country. The creators of ATLS had seen how the coordinated efforts of well-trained providers improved survival of the seriously injured on the battlefields of Vietnam and at inner-city hospitals. Since then, ATLS-trained providers have been instrumental in the ongoing development of trauma systems. ATLS has played a major role in bringing together a core group of providers that are trained and focused on injury care. This core group has provided the leadership and the front-line clinical care that have enabled the growth and maturation of coordinated regional trauma systems.

Before the second half of the 20th century, trauma centers did not exist. Injury was thought to be unpredictable instead of something that could be anticipated and include treatment plans to care for injuries. Some large public hospitals, especially those located in areas with high rates of poverty and urban violence, began to demonstrate that focused experience and expertise—among providers as well as facilities—led to better outcomes after injury. Outside of these centers, injury care remained haphazard; it was provided by the closest facility and by practitioners who happened to be available. As a result, the quality of injury care received was largely a matter of chance. However, clear and objective data now show improved outcomes in designated trauma centers. The importance of trauma centers has been a core element of ATLS from its inception, and the dissemination of ATLS principles has contributed significantly to the general acceptance of this concept.

At about the same time, sweeping changes were also occurring in the emergency medical services (EMS) system. Before the 1960s, there were few standards regarding ambulance equipment or training of attendants. The ambulance was seen as a means of transporting patients, not an opportunity for practitioners to initiate care. Aided by the passage of the 1973 Emergency Medical Services Act, which established guidelines and provided funding for regional EMS development, EMS systems rapidly developed and matured over the next 25 years. The wartime experiences of Korea and Vietnam clearly demonstrated the advantages of rapid evacuation and early definitive treatment of casualties, and it became increasingly apparent how crucial it was to coordinate field treatment and transportation to ensure that injured

patients arrived at a capable trauma care facility. The notion of a trauma system began to take shape.

Initially, the conception of a trauma system focused on the large urban trauma centers. Drawing on the experience at Cook County Hospital in Chicago, the State of Illinois passed legislation establishing a statewide coordinated network of trauma centers in 1971. When the Maryland Institute for Emergency Medicine was established in 1973, it was the first operational statewide trauma system. Maryland's small size allowed for a system design in which all severely injured patients within the state were transported to a single dedicated trauma facility. Other regions used this model to establish cooperative networks of trauma centers that were connected by a coordinated EMS system and linked by shared quality improvement processes.

These efforts were driven by the finding that a large proportion of deaths after injury in nontrauma hospitals were due to injuries that could have been better managed and controlled. The implementation of such systems led to dramatic decreases in what was termed "preventable death," as well as overall improvements in postinjury outcome that were duplicated in widely varying geographic settings. Following the models established in Illinois and Maryland, these regional systems were founded on the premise that all critically injured patients should be transported to a trauma center and that other acute care facilities in a region would not have a role in the care of the injured. This pattern fit well with the core ATLS paradigm of the small, poorly resourced facility seeking to stabilize and transfer patients. Based on the "exclusion" of undesigned hospitals from the care of the injured, this approach is frequently referred to as the exclusive model of trauma system design.

The exclusive model works well in urban and suburban settings, where there are a sufficient number of trauma centers. Although often described as a regional system, it does not use the resources of all healthcare facilities in a region. This focuses patient volume and experience at the high-level centers, but it leads to attenuation of skills in undesigned centers and results in loss of flexibility and surge capacity. The only way to increase the depth of coverage in an exclusive system is to recruit or build additional trauma centers in areas of need. This theory has largely proven impossible in practice, due to the high startup costs for new trauma centers as well as a widely varying motivation and commitment to injury care across the spectrum of healthcare facilities. The limitations of the exclusive model, and the difficulties in deploying the model on a large scale, were experienced throughout the 1990s. Despite clear evidence of the benefit of trauma systems, very few states and regions were able to establish a system as a matter of governmental policy, and fewer still were able

to fulfill a set of eight criteria that had been proposed as cornerstones of exclusive system design. Consequently, inclusive models began to be implemented.

The inclusive model, as the name suggests, proposes that all healthcare facilities in a region be involved with the care of injured patients, at a level commensurate with their commitment, capabilities, and resources. Ideally, through its regulations, rules, and interactions with EMS, the system functions to efficiently match an individual patient's needs with the most appropriate facility, based on resources and proximity. Based on this paradigm, the most severely injured would be either transported directly or expeditiously transferred to the top-level trauma care facilities. At the same time, there would be sufficient local resources and expertise to manage the less severely injured, thus avoiding the risks and resource utilization incurred for transportation to a high-level facility. The notion that personnel highly skilled in trauma care would ever exist outside of the trauma center was not envisioned at the time that ATLS was created. Largely due to the success of ATLS, relatively sophisticated trauma capability is now commonly found outside of a traditional large urban center. This changing landscape has led to modifications in the content and focus of the ATLS course and its target audience. The inclusive system model has been the primary guiding framework for systems development over the last 10 years.

Despite its relatively universal acceptance at the theoretical level, the inclusive model is often misconstrued and misapplied in practice: it is viewed as a *voluntary* system in which all hospitals that wish to participate are *included* at whatever level of participation they choose. This approach fails to fulfill the primary mission of an inclusive trauma system: to ensure that the needs of the patient are the primary driver of resource utilization. An inclusive system ensures that all hospitals participate in the system and are prepared to care for injured patients at a level commensurate with their resources, capabilities, and capacity; but it does not mean that hospitals are free to determine their level of participation based on their own perceived best interest. The needs of the patient population served—objectively assessed—are the parameters that should determine the apportionment and utilization of system resources, including the level and geographic distribution of trauma centers within the system. When this rule is forgotten, the optimal function of systems suffers, and problems of either inadequate access or overutilization may develop.

The model of the inclusive trauma system has been well developed. There is substantial evidence to show the efficacy of these systems in improving outcomes after injury, but inclusive systems are undeniably difficult to develop, finance, maintain, and operate.

The system has a scale and function that places it in the realm of essential public services, yet it operates within the largely market-driven world of healthcare delivery. In most areas, the public health dimensions of the trauma system are not well recognized and not well funded by states or regions. Lacking a federal mandate or federal funding, the responsibility to develop trauma systems has fallen to state and local governments, and progress highly depends on the interest and engagement of public leadership at that level. As a result, some states have well-organized and well-funded systems whereas others have made little success beyond a level of coordination that has developed through individual interactions between front-line providers. Though there is general agreement about the necessary elements and the structure of a trauma system, as well as significant evidence to demonstrate that coordination of these individual elements into a comprehensive system of trauma care leads to improved outcomes after injury, this data has not led to a broad implementation of trauma systems across the country.

From an international perspective, trauma system implementation varies to an even higher degree due to the broad range of social structures and economic development in countries across the globe. Further, many of the cultural and economic forces that have driven trauma systems development in the United States are unique, especially those related to high rates of interpersonal violence and the various ways of financing health care. As a result, approaches to trauma system development are very different.

In many higher-income nations, especially those where health care is already an integral part of the social support network, the benefits of focusing trauma care expertise within trauma centers have been more easily recognized. Moreover, there are fewer economic barriers to the direction of patient flow based on injury severity. Combined with the relatively smaller size of many European nations and the resultant shorter transport times to a specialty center, these benefits have facilitated the functional development of trauma systems following an exclusive model.

By contrast, most low- and middle-income countries have severely limited infrastructure for patient transportation and definitive care. These nations face severe challenges in providing adequate care for the injured, and in providing health care across the board. These challenges are clearly demonstrated by the disproportionately high rates of death related to injury seen in such countries. In these settings, ATLS has had perhaps its greatest impact on systems development, bringing knowledge and basic pathways of trauma care to directly to the providers, independent of the healthcare infrastructure. In addition, ATLS at its core brings forward many of the primary elements of

a systematized approach to care, including the concept of transferring patients to more capable facilities as dictated by injury severity, and the importance of communication between providers at various levels of care. In many low- and middle-income countries, ATLS provides both the impetus to improve trauma care and the basic tools to begin to construct a system.

The broad success of ATLS, and the building of a large population of providers who understand the principles and approach to injury care, both in the United States and internationally, continues to be instrumental in furthering the implementation of trauma systems. The wide dissemination of knowledge regarding injury care and the importance of making the correct early decisions has established a common set of principles and a common language that serve to initiate changes in trauma care and act as a cohesive force bringing the various components of a system together. This group of providers committed to the care of the trauma patient, the far-flung ATLS family, is ultimately the source of the overall vision and cohesion necessary to drive improvements in systems of trauma care. They bind the many separate elements of an inclusive system into a functioning whole.

COURSE DEVELOPMENT AND DISSEMINATION

The ATLS course was conducted nationally for the first time under the auspices of the American College of Surgeons in January 1980. International promulgation of the course began in 1980.

The program has grown each year in the number of courses and participants. To date, the course has trained more than 1.5 million participants in more than 75,000 courses around the world. Currently, an average of 50,000 clinicians are trained each year in over 3,000 courses. The greatest growth in recent years has been in the international community, and this group currently represents more than half of all ATLS activity.

The text for the course is revised approximately every 4 years to incorporate new methods of evaluation and treatment that have become accepted parts of the community of doctors who treat trauma patients. Course revisions incorporate suggestions from members of the Subcommittee on ATLS; members of the ACS COT; members of the international ATLS family; representatives to the ATLS Subcommittee from the American College of Emergency Physicians and the American College of Anesthesiologists; and course instructors, coordinators, educators, and participants. Changes to the program reflect accepted, verified practice patterns, not unproven technology

or experimental methods. The international nature of the program mandates that the course be adaptable to a variety of geographic, economic, social, and medical practice situations. To retain current status in the ATLS Program, an individual must reverify training with the latest edition of the materials.

In parallel with the ATLS course is the Prehospital Trauma Life Support (PHTLS) course, sponsored by the National Association of Emergency Medical Technicians (NAEMT). The PHTLS course, developed in cooperation with the ACS COT, is based on the concepts of the ACS ATLS Program and is conducted for emergency medical technicians, paramedics, and nurses who are providers of prehospital trauma care.

Other courses have been developed with similar concepts and philosophies. For example, the Society of Trauma Nurses offers the Advanced Trauma Care for Nurses (ATCN), which is also developed in cooperation with the ACS COT. The ATCN and ATLS courses are conducted parallel to each other; the nurses audit the ATLS lectures and then participate in skill stations separate from the ATLS skill stations conducted for doctors. The benefits of having both prehospital and in-hospital trauma personnel speaking the same “language” are apparent.

INTERNATIONAL DISSEMINATION

As a pilot project, the ATLS Program was exported outside of North America in 1986 to the Republic of Trinidad and Tobago. The ACS Board of Regents gave permission in 1987 for promulgation of the ATLS Program in other countries. The ATLS Program may be requested by a recognized surgical organization or ACS Chapter in another country by corresponding with the ATLS Subcommittee Chairperson, care of the ACS ATLS Program Office, Chicago, Illinois. At the time of publication, the following 78 countries were actively providing the ATLS course to their trauma providers:

1. Argentina (Asociación Argentina de Cirugía)
2. Australia (Royal Australasian College of Surgeons)
3. Bahrain (Kingdom of Saudi Arabia ACS Chapter and Committee on Trauma)
4. Belize (College of Physicians and Surgeons of Costa Rica)
5. Bolivia (AMDA Bolivia)
6. Brazil (The Brazilian Committee on Trauma)
7. Canada (ACS Chapters and Provincial Committees on Trauma)

8. Chile (ACS Chapter and Committee on Trauma)
9. Colombia (ACS Chapter and Committee on Trauma)
10. Costa Rica (College of Physicians and Surgeons of Costa Rica)
11. Cuba (Brazilian Committee on Trauma)
12. Curaçao (ACS Chapter and Committee on Trauma)
13. Cyprus (Cyprus Surgical Society)
14. Czech Republic (Czech Trauma Society)
15. Denmark (ATLS Denmark Fond)
16. Ecuador (ACS Chapter and Committee on Trauma)
17. Egypt (Egyptian Society of Plastic and Reconstructive Surgeons)
18. Estonia (Estonia Surgical Association)
19. Fiji and the nations of the Southwest Pacific (Royal Australasian College of Surgeons)
20. France (Société Française de Chirurgie d'Urgence)
21. Georgia (Georgian Association of Surgeons)
22. Germany (German Society for Trauma Surgery and Task Force for Early Trauma Care)
23. Ghana (Ghana College of Physicians and Surgeons)
24. Greece (ACS Chapter and Committee on Trauma)
25. Grenada (Society of Surgeons of Trinidad and Tobago)
26. Haiti (Partnership with Region 14)
27. Honduras (Asociacion Quirurgica de Honduras)
28. Hong Kong (ACS Chapter and Committee on Trauma)
29. Hungary (Hungarian Trauma Society)
30. India (Association for Trauma Care of India)
31. Indonesia (Indonesian Surgeons Association)
32. Iran (Persian Orthopedic and Trauma Association)
33. Ireland (Royal College of Surgeons in Ireland)
34. Israel (Israel Surgical Society)
35. Italy (ACS Chapter and Committee on Trauma)
36. Jamaica (ACS Chapter and Committee on Trauma)
37. Jordan (Royal Medical Services/NEMSGC)
38. Kenya (Surgical Society of Kenya)
39. Kingdom of Saudi Arabia (ACS Chapter and Committee on Trauma)
40. Kuwait (Kingdom of Saudi Arabia ACS Chapter and Committee on Trauma)
41. Lebanon (Lebanese Chapter of the American College of Surgeons)
42. Lithuania (Lithuanian Society of Traumatology and Orthopaedics)
43. Malaysia (College of Surgeons, Malaysia)
44. Mexico (ACS Chapter and Committee on Trauma)
45. Moldova (Association of Traumatologists and Orthopedics of Republic of Moldova - ATORM)
46. Mongolia (Mongolian Orthopedic Association and National Trauma and Orthopedic Referral Center of Mongolia)
47. Myanmar (Australasian College of Emergency Medicine, International Federation for Emergency Medicine and Royal Australasian College Of Surgeons. The local stakeholders included the Myanmar Department of Health and Department of Medical Science).
48. Netherlands, The (Dutch Trauma Society)
49. New Zealand (Royal Australasian College of Surgeons)
50. Nigeria (Nigerian Orthopaedic Association)
51. Norway (Norwegian Surgical Society)
52. Oman (Oman Surgical Society)
53. Pakistan (College of Physicians and Surgeons Pakistan)
54. Panama (ACS Chapter and Committee on Trauma)
55. Papua New Guinea (Royal Australasian College of Surgeons)
56. Paraguay (Sociedad Paraguaya de Cirugía)
57. Peru (ACS Chapter and Committee on Trauma)
58. Philippines (Philippine College of Surgeons)
59. Portugal (Portuguese Society of Surgeons)
60. Qatar (Kingdom of Saudi Arabia ACS Chapter and Committee on Trauma)
61. Republic of China, Taiwan (Surgical Association of the Republic of China, Taiwan)
62. Republic of Singapore (Chapter of Surgeons, Academy of Medicine)
63. Slovenia (Slovenian Society of Trauma Surgeons)
64. Republic of South Africa (South African Trauma Society)
65. Somoa (Royal Australasian College of Surgeons)
66. Spain (Spanish Society of Surgeons)
67. Sri Lanka (College of Surgeons, Sri Lanka)
68. Sweden (Swedish Society of Surgeons)

69. Switzerland (Swiss Society of Surgeons)
70. Syria (Center for Continuing Medical and Health Education)
71. Taiwan (Taiwan Surgical Association)
72. Thailand (Royal College of Surgeons of Thailand)
73. Trinidad and Tobago (Society of Surgeons of Trinidad and Tobago)
74. United Arab Emirates (Surgical Advisory Committee)
75. United Kingdom (Royal College of Surgeons of England)
76. United States, U.S. territories (ACS Chapters and State Committees on Trauma)
77. Uruguay (Uruguay Society of Surgery)
78. Venezuela (ACS Chapter and Committee on Trauma)

THE CONCEPT

The concept behind the ATLS course has remained simple. Historically, the approach to treating injured patients, as taught in medical schools, was the same as that for patients with a previously undiagnosed medical condition: an extensive history including past medical history, a physical examination starting at the top of the head and progressing down the body, the development of a differential diagnosis, and a list of adjuncts to confirm the diagnosis. Although this approach was adequate for a patient with diabetes mellitus and many acute surgical illnesses, it did not satisfy the needs of patients suffering life-threatening injuries. The approach required change.

Three underlying concepts of the ATLS Program were initially difficult to accept:

1. Treat the greatest threat to life first.
2. Never allow the lack of definitive diagnosis to impede the application of an indicated treatment.
3. A detailed history is not essential to begin the evaluation of a patient with acute injuries.

The result was the development of the ABCDE approach to evaluating and treating injured patients. These concepts also align with the observation that the care of injured patients in many circumstances is a team effort that allows medical personnel with special skills and expertise to provide care simultaneously with surgical leadership of the process.

The ATLS course emphasizes that injury kills in certain reproducible time frames. For example, the loss of an airway kills more quickly than does loss of the ability to breathe. The latter kills more quickly than loss of circulating blood volume. The presence of an expanding intracranial mass lesion is the next most lethal problem. Thus, the mnemonic ABCDE defines the specific, ordered evaluations and interventions that should be followed in all injured patients:

Airway with restriction of cervical spine motion

Breathing

Circulation, stop the bleeding

Disability or neurologic status

Exposure (undress) and **E**nvironment (temperature control)

THE COURSE

The ATLS course emphasizes the rapid initial assessment and primary treatment of injured patients, starting at the time of injury and continuing through initial assessment, lifesaving intervention, reevaluation, stabilization, and, when needed, transfer to a trauma center. The course consists of precourse and postcourse tests, core content, interactive discussions, scenario-driven skill stations, lectures, interactive case presentations, discussions, development of lifesaving skills, practical laboratory experiences, and a final performance proficiency evaluation. Upon completing the course, participants should feel confident in implementing the skills taught in the ATLS course.

THE IMPACT

ATLS training in a developing country has resulted in a decrease in injury mortality. Lower per capita rates of deaths from injuries are observed in areas where providers have ATLS training. In one study, a small trauma team led by a doctor with ATLS experience had equivalent patient survival when compared with a larger team with more doctors in an urban setting. In addition, there were more unexpected survivors than fatalities.

There is abundant evidence that ATLS training improves the knowledge base, the psychomotor skills and their use in resuscitation, and the confidence and performance of doctors who have taken part in the program. The organization and procedural skills taught in the course are retained by course participants for at

least 6 years, which may be the most significant impact of all.

ACKNOWLEDGMENTS

The COT of the ACS and the ATLS Subcommittee gratefully acknowledge the following organizations for their time and efforts in developing and field-testing the Advanced Trauma Life Support concept: The Lincoln Medical Education Foundation, Southeast Nebraska Emergency Medical Services, the University of Nebraska College of Medicine, and the Nebraska State Committee on Trauma of the ACS. The committee also is indebted to the Nebraska doctors who supported the development of this course and to the Lincoln Area Mobile Heart Team Nurses who shared their time and ideas to help build it. Appreciation is extended to the organizations identified previously in this overview for their support of the worldwide promulgation of the course. Special recognition is given to the spouses, significant others, children, and practice partners of the ATLS instructors and students. The time that providers spend away from their homes and practices and the effort afforded to this voluntary program are essential components of ATLS Program existence and success.

SUMMARY

The ATLS course provides an easily remembered approach to evaluating and treating injured patients for any doctor, irrespective of practice specialty, even under the stress, anxiety, and intensity that accompanies the resuscitation process. In addition, the program provides a common language for all providers who care for injured patients. The ATLS course offers a foundation for evaluation, treatment, education, and quality assurance—in short, a system of trauma care that is measurable, reproducible, and comprehensive.

The ATLS Program has had a positive impact on the care of injured patients worldwide. This effect is a result of the improved skills and knowledge of the doctors and other healthcare providers who have been course participants. The ATLS course establishes an organized, systematic approach for evaluation and treatment of patients, promotes minimum standards of care, and recognizes injury as a world healthcare issue. Morbidity and mortality have been reduced, but the need to eradicate injury remains. The ATLS Program has changed and will continue to change as advances occur in medicine and the needs and expectations of our societies change.

BIBLIOGRAPHY

1. American College of Emergency Physicians. Clinical and Practice Management Resources. Trauma in the Obstetric Patient: A Bedside Tool. <http://www.acepnow.com/article/trauma-obstetric-patient-bedside-tool/>. Accessed April 18, 2017.
2. American College of Radiology. ACR–SPR Practice parameter for imaging pregnant or potentially pregnant adolescents and women with ionizing radiation. <http://www.acr.org/~media/9e2ed5531fc4b4fa53ef3b6d3b25df8.pdf>. Accessed April 18, 2017.
3. American College of Surgeons Committee on Trauma, American College of Emergency Physicians, American Academy of Pediatrics, et al. Policy statement—equipment for ambulances. *Pediatrics* 2009; 124(1): e166–e171.
4. American College of Surgeons, Committee on Trauma, National Trauma Data Bank (NTDB). <http://www.facs.org/trauma/ntdb>. Accessed May 12, 2016.
5. American College of Surgeons Committee on Trauma, American College of Emergency Physicians, Pediatric Emergency Medicine Committee, et al. Withholding termination of resuscitation in pediatric out-of-hospital traumatic cardiopulmonary arrest. *Pediatrics* 2014;133:e1104–e1116.
6. Badjatia N, Carney N, Crocco TJ. Guidelines for prehospital management of traumatic brain injury 2nd edition. *Prehospital Emergency Care* January/March 2004;12(Suppl 1).
7. Ball CG, Jafri SM, Kirkpatrick AW, et al. Traumatic urethral injuries: does the digital rectal examination really help us? *Injury* 2009 Sep;40(9):984–986.
8. Barquist E, Pizzutiello M, Tian L, et al. Effect of trauma system maturation on mortality rates in patients with blunt injuries in the Finger Lakes Region of New York State. *J Trauma* 2000;49:63–69; discussion 9-70.
9. Baumann Kreuziger LM, Keenan JC, Morton CT, et al. Management of the bleeding patient receiving new oral anticoagulants: a role for prothrombin complex concentrates. *Biomed Res Int* 2014;2014:583–794.
10. Baxter CR. Volume and electrolyte changes in the early post-burn period. *Clin Plast Surg* 1974;4:693–709.
11. Bazzoli GJ, Madura KJ, Cooper GF, et al. Progress in the development of trauma systems in the

- United States. Results of a national survey. *JAMA* 1995;273:395-401.
12. Berg MD, Schexnayder SM, Chameides L, et al. Part 13: pediatric basic life support: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2010 Nov 2;122(18 Suppl 3):S862-875.
 13. Biffi WL, Moore EE, Elliott JP, et al. Blunt cerebrovascular injuries. *Curr Probl Surg* 1999;36:505-599.
 14. Borst GM, Davies SW, Waibel BH et al. When birds can't fly: an analysis of interfacility ground transport using advanced life support when helicopter emergency medical service is unavailable. *J Trauma* 77(2):331-336.
 15. Boulanger BR, Milzman D, Mitchell K, et al. Body habitus as a predictor of injury pattern after blunt trauma. *J Trauma* 1992;33:228-232.
 16. Boyd DR, Dunea MM, Flashner BA. The Illinois plan for a statewide system of trauma centers. *J Trauma* 1973;13:24-31.
 17. Boyle A, Santarius L, Maimaris C. Evaluation of the impact of the Canadian CT head rule on British practice. *Emerg Med J* 2004;21(4):426-428.
 18. Braver ER, Trempel RE. Are older drivers actually at higher risk of involvement in collisions resulting in deaths or nonfatal injuries among their passengers and other road users? *Inj Prev* 2004;10:27-29.
 19. Bromberg WJ, Collier BC, Diebel LN, et al. Blunt cerebrovascular injury practice management guidelines: the Eastern Association for the Surgery of Trauma. *J Trauma* 2010;68:471-477.
 20. Brown JB, Stassen NA, Bankey PE et al. Helicopters improve survival in seriously injured patients requiring interfacility transfer for definitive care. *J Trauma* 70(2):310-314.
 21. Bruen KJ, Ballard JR, Morris SE, et al. Reduction of the incidence of amputation in frostbite injury with thrombolytic therapy. *Arch Surg* 2007 Jun;142(6):546-551; discussion 551-553.
 22. Bulger EM, Arenson MA, Mock CN, et al. Rib fractures in the elderly. *J Trauma* 2000;48:1040-1046.
 23. Bulger EM, Snyder D, Schoelles C, et al. An evidence-based prehospital guideline for external hemorrhage control: American College of Surgeons Committee on Trauma. *Prehospital Emerg Care* 2014;18:163-173.
 24. Cales RH. Trauma mortality in Orange County: the effect of implementation of a regional trauma system. *Ann Emerg Med* 1984;13:1-10.
 25. Cancio L. Airway management and smoke inhalation injury in the burn patient. *Clin Plast Surg* 2009 Oct;36(4):555-567.
 26. Cancio LC. Initial assessment and fluid resuscitation of burn patients. *Surg Clin North Am* 2014 Aug;94(4):741-754.
 27. Cancio LC, Lundy JB, Sheridan RL. Evolving changes in the management of burns and environmental injuries. *Surg Clin North Am* 2012 Aug;92(4):959-986, ix.
 28. Capizzani AR, Drogonowski R, Ehrlich PF. Assessment of termination of trauma resuscitation guidelines: are children small adults? *J Pediatr Surg* 2010;45:903-907.
 29. Carcillo JA. Intravenous fluid choices in critically ill children. *Curr Opin Crit Care* 2014;20:396-401.
 30. Carney N, Ghajar J, Jagoda A, et al. Concussion guidelines step 1: systematic review of prevalent indicators. *Neurosurg* 2014 Sep;75(Suppl 1):S3-S15.
 31. Carney N, Totten AM, O'Reilly C, et al. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition. *Neurosurg* 2017;80(1):6-15.
 32. Carta T, Gawaziuk J, Liu S, et al. Use of mineral oil Fleet enema for the removal of a large tar burn: a case report, *J Burns* 2015 Mar;41(2):e11-14.
 33. Celso B, Tepas J, Langland-Orban B, et al. A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. *J Trauma* 2006;60:371-78; discussion 8.
 34. Chames MC, Perlman MD. Trauma during pregnancy: outcomes and clinical management. *Clin Obstet Gynecol* 2008;51:398.
 35. Chidester SJ, Williams N, Wang W, et al. A pediatric massive transfusion protocol. *J Trauma* 2012;73(5):1273-1277.
 36. Clancy K, Velopulos C, Bilaniuk JW, et al. Screening for blunt cardiac injury: an Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma* 2012 Nov;73(5 Suppl 4):S301-306.
 37. Cohen DB, Rinker C, Wilberger JE. Traumatic brain injury in anticoagulated patients. *J Trauma* 2006;60(3):553-557.
 38. Como JJ, Bokhari F, Chiu WC, et al. Practice management guidelines for selective nonoperative management of penetrating abdominal trauma. *J Trauma* 2010 Mar;68(3):721-733.
 39. Compton J, Copeland K, Flanders S, et al. Implementing SBAR across a large multihospital health system. *Joint Commission J Quality and Patient Safety* 2012;38:261-268.
 40. Cothren CC, Osborn PM, Moore EE, et al. Preperitoneal pelvic packing for hemodynamically

- unstable pelvic fracture: a paradigm shift. *J Trauma* 2007;2(4):834–842.
41. CRASH-2 collaborators. The importance of early treatment with tranexamic acid in bleeding trauma patients: an exploratory analysis of the CRASH-2 randomized controlled trial. *Lancet* 2011;377(9771):1096–1101.
 42. Davidson G, Rivara F, Mack C, et al. Validation of prehospital trauma triage criteria for motor vehicle collisions. *J Trauma* 2014; 76:755–766.6.
 43. Dehmer JJ, Adamson WT. Massive transfusion and blood product use in the pediatric trauma patient. *Semin Pediatr Surg* 2010;19(4):286–291.
 44. Demetriades D, Kimbrell B, Salim A, et al. Trauma deaths in a mature urban trauma system: is trimodal distribution a valid concept? *JACS* 2005;201(3):343–48.
 45. Diaz JJ, Cullinane DC, Altman DT, et al. Practice Management Guidelines for the screening of thoracolumbar spine fracture. *J Trauma* 2007; 63(3):709–718.
 46. Ditillo M, Pandit V, Rhee P, et al. Morbid obesity predisposes trauma patients to worse outcomes: a National Trauma Data Bank analysis. *J Trauma* 2014 Jan;76(1):176–179.
 47. Doucet J, Bulger E, Sanddal N, et al.; endorsed by the National Association of EMS Physicians (NAEMSP). Appropriate use of helicopter emergency medical services for transport of trauma patients: guidelines from the Emergency Medical System Subcommittee, Committee on Trauma, American College of Surgeons. *J Trauma* 2013 Oct;75(4):734–741.
 48. Dressler AM, Finck CM, Carroll CL, et al. Use of a massive transfusion protocol with hemostatic resuscitation for severe intraoperative bleeding in a child. *J Pediatr Surg* 2010;45(7):1530–1533.
 49. Eastman AB. Wherever the dart lands: toward the ideal trauma system. *JACS* 2010 Aug;211(2):153–68.
 50. Eastridge BJ, Wade CE, Spott MA, et al. Utilizing a trauma systems approach to benchmark and improve combat casualty care. *J Trauma* 2010;69 Suppl 1:S5–S9.
 51. Edwards C, Woodard, E. SBAR for maternal transports: going the extra mile. *Nursing for Women's Health* 2009;12:516–520.
 52. Esposito TJ, Ingraham A, Luchette FA, et al. Reasons to omit digital rectal exam in trauma patients: no fingers, no rectum, no useful additional information. *J Trauma* 2005 Dec;59(6):1314–1319.
 53. Esposito TJ, Sanddal TL, Reynolds SA, et al. Effect of a voluntary trauma system on preventable death and inappropriate care in a rural state. *J Trauma* 2003;54:663–69; discussion 9-70.
 54. Estroff JM, Foglia RP, Fuchs JR. A comparison of accidental and nonaccidental trauma: it is worse than you think. *J Emerg Med* 2015;48:274–279.
 55. Faul M, Xu L, Wald MM, et al. *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths*. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2010.
 56. Felder S, Margel D, Murrell Z, et al. Usefulness of bowel sound auscultation: a prospective evaluation. *J Surg Educ* 2014;71(5):768–773.
 57. German Trauma Society. Prehospital (section 1). Emergency room, extremities (subsection 2.10). In: *S3—Guideline on Treatment of Patients with Severe and Multiple Injuries*. (English version AWMF-Registry No. 012/019). Berlin: German Trauma Society (DGU).
 58. Global Burden of Diseases Pediatric Collaboration. Global and national burden of diseases and injuries among children and adolescents between 1990 and 2013: findings from the Global Burden of Disease 2013 Study. *JAMA Peds* 2016;170(3): 267–287.
 59. Gonzaga T, Jenabzadeh K, Anderson CP, et al. Use of intra-arterial thrombolytic therapy for acute treatment of frostbite in 62 patients with review of thrombolytic therapy in frostbite. *J Burn Care Res* 2016 Jul–Aug;37(4):e323–324.
 60. Guidelines for field triage of injured patients: recommendations of the National Expert Panel on Field Triage, 2011. *MMWR Morb Mortal Wkly Rep* 2012;61:1–21.
 61. Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries. *Neurosurgery* 2013; 72(Suppl 2):1–259.
 62. Gunst M, Ghaemmaghami V, Gruszecki A, et al. Changing epidemiology of trauma deaths leads to bimodal distribution. *Proc (Bayl Univ Med Cent)* 2010;23(4):349–54.
 63. Hadley MN, Walters BC, Aarabi B, et al. Clinical assessment following acute cervical spinal cord injury. *Neurosurg* 2013;72(Suppl 2):40–53.
 64. Harrington DT, Connolly M, Biffi WL, et al. Transfer times to definitive care facilities are too long: a consequence of an immature trauma system. *Ann Surg* 241(6):961–968.
 65. Harvey A, Towner E, Peden M, et al. Injury prevention and the attainment of child and adolescent health. *Bull World Health Organ* 2009;87(5):390–394.
 66. Hendrickson JE, Shaz BH, Pereira G, et al. Coagulopathy is prevalent and associated with adverse outcomes in transfused pediatric trauma patients. *J Pediatr* 2012;160(2):204–209.

67. Hendrickson JE, Shaz BH, Pereira G, et al. Implementation of a pediatric trauma massive transfusion protocol: one institution's experience. *Transfusion* 2012;52(6):1228–1236.
68. Hoffman M, Monroe DM. Reversing targeted oral anticoagulants. *ASH Education Book* 2014;1:518–523.
69. Holcomb JB, del Junco DJ, Fox EE, et al. The prospective, observational, multicenter, major trauma transfusion (PROMMTT) study: comparative effectiveness of a time-varying treatment with competing risks. *JAMA Surg* 2013;148(2):127–136.
70. HRSA (Health Resources and Services Administration.) Model trauma care system plan. In: *Administration*. Rockville, MD: U.S Department of Health and Human Services; 1992.
71. HRSA. *Model trauma systems planning and evaluation*. Rockville, MD: U.S. Department of Health and Human Services; 2006.
72. Hurlbert J, Hadley MN, Walters BC, et al. Pharmacological therapy for acute spinal cord injury. *Neurosurg* 2013;72(Suppl 2):93–105.
73. Inaba K, Lustenberger T, Recinos G, et al. Does size matter? A prospective analysis of 28–32 versus 36–40 French chest tube size in trauma. *J Trauma* 2012;72(2):422–427.
74. Inaba K, Nosanov L, Menaker J, et al. Prospective derivation of a clinical decision rule for thoracolumbar spine evaluation after blunt trauma: An American Association for the Surgery of Trauma Multi-Institutional Trials Group Study. *J Trauma* 2015;78(3):459–465.
75. Inaba K, Siboni S, Resnick S, et al. Tourniquet use for civilian extremity trauma. *J Trauma* 2015;79(2):232–237.
76. Intimate Partner Violence Facts. www.who.int/violence_injury_prevention/violence/world_report/factsheets/en/ipvfacts.pdf. Accessed April 18, 2017.
77. Jain V, Chari R, Maslovitz S, et al. Guidelines for the management of a pregnant trauma patient. *J Obstet Gynaecol Can* 2015;37(6):553–571.
78. Johnson MH, Chang A, Brandes SB. The value of digital rectal examination in assessing for pelvic fracture-associated urethral injury: what defines a high-riding or non-palpable prostate? *J Trauma* 2013 Nov;75(5):913–915.
79. Kappel DA, Rossi DC, Polack EP, et al. Does the rural Trauma Team development course shorten the interval from trauma patient arrival to decision to transfer? *J Trauma* 2011;70:315–319.
80. Kassam-Adams N, Marsac ML, Hildenbrand A, et al. Posttraumatic stress following pediatric injury: update on diagnosis, risk factors, and intervention. *JAMA Peds* 2013;167:1158–1165.
81. Kharbanda AB, Flood A, Blumberg K, et al. Analysis of radiation exposure among pediatric patients at national trauma centers. *J Trauma* 2013;74:907–911.
82. Kirshblum S, Waring W 3rd. Updates for the International Standards for Neurological Classification of Spinal Cord Injury. *Phys Med Rehabil Clin N Am* 2014;25(3):505–517.
83. Knekt CD, Meylaerts SA, Leenen LP. Applicability of the trimodal distribution of trauma deaths in a Level I trauma centre in the Netherlands with a population of mainly blunt trauma Injury, *Int. J. Care Injured* 2008;39:993–1000.
84. Kobbe P, Micansky F, Lichte P, et al. Increased morbidity and mortality after bilateral femoral shaft fractures: myth or reality in the era of damage control? *Injury* 2013 Feb;44(2):221–225.
85. Kochanek PM, Carney N, Adelson PD, et al. Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents—second edition. *Pediatr Crit Med* 2012;13(Suppl 1):S1–82.
86. Konda SR, Davidovich RI, Egol KA. Computed tomography scan to detect traumatic arthrotomies and identify periarticular wounds not requiring surgical intervention: an improvement over the saline load test. *J Trauma* 2013;27(9):498–504.
87. Lai A, Davidson N, Galloway SW, et al. Perioperative management of patients on new oral anticoagulants. *Br J Surg* 2014 Jun;101(7):742–749.
88. Lansink KW, Leenen LP. Do designated trauma systems improve outcome? *Curr Opin Crit Care* 2007;13:686–90.
89. Latenser BA. Critical care of the burn patient: the first 48 hours. *Crit Care Med* 2009 Oct;37(10):2819–2826.
90. Lee C, Bernard A, Fryman L, et al. Imaging may delay transfer of rural trauma victims: a survey of referring physicians. *J Trauma* 2009;65:1359–1363.
91. Lee TH, Ouellet JF, Cook M, et al. Pericardiocentesis in trauma: a systematic review. *J Trauma* 2013;75(4):543–549.
92. Lee PM, Lee C, Rattner P, et al. Intraosseous versus central venous catheter utilization and performance during inpatient medical emergencies. *Crit Care Med* 2015 Jun;43(6):1233–1238.
93. Leeper WR, Leeper TJ, Yogt K, et al. The role of trauma team leaders in missed injuries: does specialty matter? *J Trauma* 2013;75(3):387–390.
94. Lewis P, Wright C. Saving the critically injured trauma patient: a retrospective analysis of

- 1000 uses of intraosseous access. *Emerg Med J* 2015 Jun;32(6):463-467.
95. Ley E, Clond M, Srour M, et al. Emergency department crystalloid resuscitation of 1.5 L or more is associated with increased mortality in elderly and nonelderly trauma patients. *J Trauma* 2011;70(2):398-400.
 96. Li C, Friedman B, Conwell Y, et al. Validity of the Patient Health Questionnaire-2 (PHQ-2) in identifying major depression in older people. *J Am Geriatr Soc* 2007 April;55(4):596-602.
 97. Liu T, Chen JJ, Bai XJ, et al. The effect of obesity on outcomes in trauma patients: a meta-analysis. *Injury* 2013 Sep;44(9):1145-1152.
 98. MacKenzie EJ, Rivara FP, Jurkovich GJ, et al. A national evaluation of the effect of trauma-center care on mortality. *New Engl J Med* 2006;354:366-78.
 99. MacKenzie EJ, Weir S, Rivara FP, et al. The value of trauma center care. *J Trauma* 2010;69:1-10.
 100. Mathen R, Inaba K, Munera F, et al. Prospective evaluation of multislice computed tomography versus plain radiographic cervical spine clearance in trauma patients. *J Trauma* 2007 Jun;62(6):1427.
 101. McCrum ML, McKee J, Lai M, et al. ATLS adherence in the transfer of rural trauma patients to a level I facility. *Injury* 44(9):1241-1245.
 102. McKee JL, Roberts DJ, van Wijngaarden-Stephens MH, et al. The right treatment at the right time in the right place: a population-based, before-and-after study of outcomes associated with implementation of an all-inclusive trauma system in a large Canadian province. *Ann Surg* 2015;261:558-564.
 103. Medina O, Arom GA, Yeraniosian MG, et al. Vascular and nerve injury after knee dislocation: a systematic review. *Clin Orthop Relat Res* 2014 Oct;472(1):2984-2990.
 104. Mills WJ, Barei DP, McNair P. The value of the ankle-brachial index for diagnosing arterial injury after knee dislocation: a prospective study. *J Trauma* 2004;56:1261-1265.
 105. Milzman DP, Rothenhaus TC. Resuscitation of the geriatric patient. *Emerg Med Clin NA* 1996;14:233-244.
 106. Min L, Burruss S, Morley E, et al. A simple clinical risk nomogram to predict mortality-associated geriatric complications in severely injured geriatric patients. *J Trauma* 74(4):1125-1132.
 107. Morrissey BE, Delaney RA, Johnstone AJ, et al. Do trauma systems work? A comparison of major trauma outcomes between Aberdeen Royal Infirmary and Massachusetts General Hospital. *Injury* 2015;46:150-155.
 108. Morshed S, Knops S, Jurkovich GJ, et al. The impact of trauma-center care on mortality and function following pelvic ring and acetabular injuries. *J Bone Joint Surg Am* 2015;97:265-272.
 109. Murphy JT, Jaiswal K, Sabella J, et al. Prehospital cardiopulmonary resuscitation in the pediatric trauma patient. *J Pediatr Surg* 2010 Jul;45(7):1413-1419.
 110. Mutschler Amy, Nienaber U, Brockkampa T, et al. A critical reappraisal of the ATLS classification of hypovolaemic shock: does it really reflect clinical reality? *Resuscitation* 2013;84:309-313.
 111. Nathens AB, Jurkovich GJ, Rivara FP, et al. Effectiveness of state trauma systems in reducing injury-related mortality: a national evaluation. *J Trauma* 2000;48:25-30; discussion 30-31.
 112. National Academy of Sciences. *Accidental Death and Disability: The Neglected Disease of Modern Society*. Washington, DC: National Academies Press; 1966.
 113. Natsuhara KM, Yeraniosian MG, Cohen JR, et al. What is the frequency of vascular injury after knee dislocation? *Clin Orthop Relat Res* 2014 Sep;472(9):2615-2620.
 114. Neff NP, Cannon JW, Morrison JJ, et al. Clearly defining pediatric mass transfusion: cutting through the fog and friction using combat data. *J Trauma* 2015 Jan;78(1):22-28.
 115. O'Brien CL, Menon M, Jomha NM. Controversies in the management of open fractures. *Open Orthop J* 2014;8:178-184.
 116. O'Malley E, Boyle E, O'Callaghan A, et al. Role of laparoscopy in penetrating abdominal trauma: a systematic review *World J Surg* 2013 Jan;37(1):113-122.
 117. O'Toole RV, Lindbloom BJ, Hui E, et al. Are bilateral femoral fractures no longer a marker for death? *J Orthoped Trauma* 2014 Feb;28(2):77-81.
 118. Onzuka J, Worster A, McCreddie B. Is computerized tomography of trauma patients associated with a transfer delay to a regional trauma centre? *CJEM*:10(3):205-208.
 119. Osborn PM, Smith WR, Moore EE, et al. Direct retroperitoneal pelvic packing versus pelvic angiography: a comparison of two management protocols for haemodynamically unstable pelvic fractures. *Injury* 2009 Jan;40(1):54-60.
 120. Osborne Z, Rowitz B, Moore H, et al. Obesity in trauma: outcomes and disposition trends. *Am J Surg* 2014;207(3):387-392; discussion 391-392.
 121. Oyetunji TA, Chang DC, et al. Redefining hypotension in the elderly: normotension is not reassuring. *Arch Surg* 2011 Jul;146(7):865-869.

122. Palusci VJ, Covington TM. Child maltreatment deaths in the U.S. National Child Death Review Case Reporting System. *Child Abuse and Neglect* 2014;28:25–36.
123. Pang JM, Civil I Ng A, Adams D, et al. Is the trimodal pattern of death after trauma a dated concept in the 21st century? Trauma deaths in Auckland 2004. *Injury* 2008;39:102–106.
124. Patregnani JT, Borgman MA, Maegele M, et al. Coagulopathy and shock on admission is associated with mortality for children with traumatic injuries at combat support hospitals. *Pediatr Crit Care Med* 2012;13(3):1–5.
125. Petrone P, Talving P, Browder T, et al. Abdominal injuries in pregnancy: a 155-month study at two level 1 trauma centers. *Injury* 2011;42(1):47–49.
126. Pham TN, Gibran NS. Thermal and electrical injuries. *Surg Clin North Am* 2007 Feb;87(1):185–206, vii–viii. Review.
127. Post AF, Boro T, Eckland JM. Injury to the brain. In: Mattox KL, Feliciano DV, Moore EE, eds. *Trauma*. 7th ed. New York, NY: McGraw-Hill; 2013:356–376.
128. Pruitt BA. Fluid and electrolyte replacement in the burned patient. *Surg Clin North Am* 1978;58(6):1313–1322.
129. Puntnam-Hornstein E. Report of maltreatment as a risk factor for injury death: a prospective birth cohort. *Child Maltreatment* 2011;16:163–174.
130. Quick JA, Bartels AN, Coughenour JP, et al. Trauma transfers and definitive imaging: patient benefit but at what cost? *Am Surg* 79(3):301–304.
131. Richardson JD. Trauma centers and trauma surgeons: have we become too specialized? *J Trauma* 2000;48:1–7.
132. Roberts D, Leigh-Smith S, Faris P, et al. Clinical presentation of patients with tension pneumothorax: a systematic review. *Ann Surg* 2015;261(6):1068–1078.
133. Romanowski KS, Barsun A, Pamlieri TL, et al. Frailty score on admission predicts outcomes in elderly burn injury. *J Burn Care Res* 2015;36:1–6.
134. Scaife ER, Rollins MD, Barnhart D, et al. The role of focused abdominal sonography for trauma (FAST) in pediatric trauma evaluation. *J Ped Surg* 2013;48:1377–1383.
135. Schmitt SK, Sexton DJ, Baron EL. Treatment and Prevention of Osteomyelitis Following Trauma in Adults. UpToDate. <http://www.uptodate.com/contents/treatment-and-prevention-of-osteomyelitis-following-trauma-in-adults>. October 29, 2015.
136. Sheridan RL, Chang P. Acute burn procedures. *Surg Clin North Am* 2014 Aug;94(4):755–764.
137. Shlamovitz GZ, Mower WR, Bergman J, et al. How (un)useful is the pelvic ring stability examination in diagnosing mechanically unstable pelvic fractures in blunt trauma patients? *J Trauma* 2009;66(3):815–820.
138. Shrestha B, Holcomb JB, Camp EA, et al. Damage control resuscitation increases successful nonoperative management rates and survival after severe blunt liver injury. *J Trauma* 2015;78(2):336–341.
139. Snyder D, Tsou A, Schoelles K. *Efficacy of Prehospital Application of Tourniquets and Hemostatic Dressings to Control Traumatic External Hemorrhage*. Washington, DC: National Highway Traffic Safety Administration; 2014, 145.
140. Sosa JL, Baker M, Puente I, et al. Negative laparotomy in abdominal gunshot wounds: potential impact of laparoscopy. *J Trauma* 1995 Feb;38(2):194–197.
141. Steinhausen E, Lefering R, Tjardes T, et al. A risk-adapted approach is beneficial in the management of bilateral femoral shaft fractures in multiple trauma patients: an analysis based on the trauma registry of the German Trauma Society. *J Trauma* 2014;76(5):1288–1293.
142. Stevens JA. Fatalities and injuries from falls among older adults—United States 1993–2003 and 2001–2005. *MMWR Morb Mortal Wkly Rep* 2006;55:1221–1224.
143. Sussman M, DiRusso SM, Sullivan T, et al. Traumatic brain injury in the elderly: increased mortality and worse functional outcome at discharge despite lower injury severity. *J Trauma* 2002;53:219–224.
144. Thomson DP, Thomas SH. Guidelines for air medical dispatch. *Prehosp Emerg Care* 2003 Apr–Jun;7(2):265–271.
145. Tornetta P, Boes MT, Schepsis AA, et al. How effective is a saline arthrogram for wounds around the knee? *Clin Orthop Relat Res* 2008;466:432–435.
146. United Nations, Department of Economic and Social Affairs, Population Division (2015). *World Population Ageing*.
147. United States Bureau of the Census. Population projections of the United States by age, sex, race, and Hispanic origin: 1995 to 2050. <http://www.census.gov/prod/1/pop/p25-1130.pdf>. Accessed April 18, 2017.
148. Velmahos GC, Demetriades D, Cornwell EE 3rd. Transpelvic gunshot wounds: routine laparotomy or selective management? *World J Surg* 1998 Oct;22(10):1034–1038.
149. Vercruyse GA, Ingram WL, Feliciano DV. The demographics of modern burn care: should most

- burns be cared for by the non-burn surgeon? *Am J Surg* 2011;201:91–96.
150. Walls RM, Murphy MF, eds. *The Manual of Emergency Airway Management*. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2012.
151. Walter J, Doris PE, Shaffer MA. Clinical presentation of patients with acute cervical spine injury. *Ann Emerg Med* 1984;13(7):512–515.
152. Washington CW, Grubb RL Jr. Are routine repeat imaging and intensive care unit admission necessary in mild traumatic brain injury? *J Neurosurg* 2012;116(3):549–557.
153. Weiss M, Dullenkopf A, Fischer JE, et al., European Paediatric Endotracheal Intubation Study Group. Prospective randomized controlled multi-centre trial of cuffed or uncuffed endotracheal tubes in small children. *Br J Anaesth* 2009;103(6):867–873.
154. West JG, Trunkey DD, Lim RC. Systems of trauma care. A study of two counties. *Arch Surg* 1979;114:455–460.
155. Wijdicks EFM, Varelas PN, Gronseth GS, et al. Evidence-based guideline update: determining brain death in adults. Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology* 2010;74:1911–1918.
156. Willett K, Al-Khateeb H, Kotnis R, et al. Risk of mortality: the relationship with associated injuries and fracture. Treatment methods in patients with unilateral or bilateral femoral shaft fractures. *J Trauma* 2010 Aug;69(2):405–410.
157. Yelon JA. Geriatric trauma. In: Moore EE, Feliciano DV, Mattox K, eds. *Trauma*. 7th ed. New York, NY: McGraw Hill, 2012.

BRIEF CONTENTS

Foreword	v
Preface	vii
Acknowledgments	xv
Course Overview	xxix
CHAPTER 1 Initial Assessment and Management	2
CHAPTER 2 Airway and Ventilatory Management	22
CHAPTER 3 Shock	42
CHAPTER 4 Thoracic Trauma	62
CHAPTER 5 Abdominal and Pelvic Trauma	82
CHAPTER 6 Head Trauma	102
CHAPTER 7 Spine and Spinal Cord Trauma	128
CHAPTER 8 Musculoskeletal Trauma	148
CHAPTER 9 Thermal Injuries	168
CHAPTER 10 Pediatric Trauma	186
CHAPTER 11 Geriatric Trauma	214
CHAPTER 12 Trauma in Pregnancy and Intimate Partner Violence	226
CHAPTER 13 Transfer to Definitive Care	240
APPENDICES	255
APPENDIX A: Ocular Trauma	257
APPENDIX B: Hypothermia and Heat Injuries	265
APPENDIX C: Trauma Care during Mass-Casualty, Austere, and Operational Environments	275
APPENDIX D: Disaster Preparedness and Response	289
APPENDIX E: ATLS and Trauma Team Resource Management	303
APPENDIX F: Triage Scenarios	317
APPENDIX G: Skills	335
INDEX	376

DETAILED CONTENTS

Foreword	v	CHAPTER 2	
Preface	vii	AIRWAY AND VENTILATORY	
Acknowledgments	xv	MANAGEMENT	22
Course Overview	xxix		
CHAPTER 1			
INITIAL ASSESSMENT AND			
MANAGEMENT	2		
Objectives	3	Objectives	23
Introduction	4	Introduction	24
Preparation	4	Airway	24
Triage	6	Ventilation	26
Primary Survey with Simultaneous Resuscitation	7	Airway Management	27
Adjuncts to the Primary Survey with Resuscitation	10	Management of Oxygenation	36
Consider Need for Patient Transfer	12	Management of Ventilation	38
Special Populations	13	Teamwork	38
Secondary Survey	13	Chapter Summary	39
Adjuncts to the Secondary Survey	18	Bibliography	39
Reevaluation	19	CHAPTER 3	
Definitive Care	19	SHOCK	42
Records and Legal Considerations	19	Objectives	43
Teamwork	19	Introduction	44
Chapter Summary	20	Shock Pathophysiology	44
Bibliography	21	Initial Patient Assessment	45
		Hemorrhagic Shock	48
		Initial Management of Hemorrhagic Shock	51
		Blood Replacement	54
		Special Considerations	56
		Reassessing Patient Response and Avoiding Complications	58

Teamwork	58	Anatomy Review	104
Chapter Summary	58	Physiology Review	107
Additional Resources	59	Classifications of Head Injuries	109
Bibliography	59	Evidence-Based Treatment Guidelines	III
CHAPTER 4		Primary Survey and Resuscitation	117
THORACIC TRAUMA	62	Secondary Survey	120
Objectives	63	Diagnostic Procedures	120
Introduction	64	Medical Therapies for Brain Injury	120
Primary Survey: Life-Threatening Injuries	64	Surgical Management	122
Secondary Survey	72	Prognosis	124
Teamwork	78	Brain Death	124
Chapter Summary	78	Teamwork	124
Bibliography	79	Chapter Summary	124
		Bibliography	125
CHAPTER 5		CHAPTER 7	
ABDOMINAL AND PELVIC TRAUMA	82	SPINE AND SPINAL CORD TRAUMA	128
Objectives	83	Objectives	129
Introduction	84	Introduction	130
Anatomy of the Abdomen	84	Anatomy and Physiology	130
Mechanism of Injury	85	Documentation of Spinal Cord Injuries	135
Assessment and Management	86	Specific Types of Spinal Injuries	136
Teamwork	98	Radiographic Evaluation	139
Chapter Summary	98	General Management	141
Bibliography	99	Teamwork	144
		Chapter Summary	144
CHAPTER 6		Bibliography	145
HEAD TRAUMA	102		
Objectives	103		
Introduction	104		

CHAPTER 8			
MUSCULOSKELETAL TRAUMA	148		
Objectives	149	Cold Injury: Systemic Hypothermia	183
Introduction	150	Teamwork	183
Primary Survey and Resuscitation of Patients with Potentially Life- Threatening Extremity Injuries	150	Chapter Summary	183
Adjuncts to the Primary Survey	152	Bibliography	184
Secondary Survey	153		
Limb-Threatening Injuries	156	CHAPTER 10	
Other Extremity Injuries	161	PEDIATRIC TRAUMA	186
Principles of Immobilization	163	Objectives	187
Pain Control	163	Introduction	188
Associated Injuries	164	Types and Patterns of Injury	188
Occult Skeletal Injuries	165	Unique Characteristics of Pediatric Patients	188
Teamwork	165	Airway	190
Chapter Summary	165	Breathing	195
Bibliography	166	Circulation and Shock	195
		Cardiopulmonary Resuscitation	199
CHAPTER 9		Chest Trauma	199
THERMAL INJURIES	168	Abdominal Trauma	200
Objectives	169	Head Trauma	202
Introduction	170	Spinal Cord Injury	205
Primary Survey and Resuscitation of Patients with Burns	170	Musculoskeletal Trauma	206
Patient Assessment	174	Child Maltreatment	207
Secondary Survey and Related Adjuncts	176	Prevention	208
Unique Burn Injuries	178	Teamwork	208
Patient Transfer	180	Chapter Summary	209
Cold Injury: Local Tissue Effects	181	Bibliography	209
		CHAPTER 11	
		GERIATRIC TRAUMA	214
		Objectives	215

Introduction	216	CHAPTER 13	
Effects of Aging and Impact of Preexisting Conditions	216	TRANSFER TO DEFINITIVE CARE	240
Mechanism of Injury	217	Objectives	241
Primary Survey with Resuscitation	217	Introduction	242
Specific Injuries	220	Determining the Need for Patient Transfer	242
Special Circumstances	222	Treatment before Transfer	245
Teamwork	223	Transfer Responsibilities	246
Chapter Summary	223	Modes of Transportation	248
Bibliography	223	Transfer Protocols	249
		Transfer Data	251
		Teamwork	251
		Chapter Summary	251
		Bibliography	251
CHAPTER 12		APPENDICES	255
TRAUMA IN PREGNANCY AND INTIMATE PARTNER VIOLENCE	226	APPENDIX A: Ocular Trauma	257
Objectives	227	APPENDIX B: Hypothermia and Heat Injuries	265
Introduction	228	APPENDIX C: Trauma Care in Mass-Casualty, Austere, and Operational Environments (Optional Lecture)	275
Anatomical and Physiological Alterations of Pregnancy	228	APPENDIX D: Disaster Preparedness and Response (Optional Lecture)	289
Mechanisms of Injury	231	APPENDIX E: ATLS and Trauma Team Resource Management	303
Severity of Injury	232	APPENDIX F: Triage Scenarios	317
Assessment and Treatment	233	APPENDIX G: Skills	335
Perimortem Cesarean Section	235		
Intimate Partner Violence	235		
Teamwork	237		
Chapter Summary	238		
Additional Resources Concerning Intimate Partner Violence	238		
Bibliography	238		
		INDEX	377

ATLS[®]

Advanced Trauma Life Support[®]

Student Course Manual



1 INITIAL ASSESSMENT AND MANAGEMENT

Repeat the primary survey frequently to identify any deterioration in the patient's status that indicates the need for additional intervention.

CHAPTER I OUTLINE

OBJECTIVES

INTRODUCTION

PREPARATION

- Prehospital Phase
- Hospital Phase

TRIAGE

- Multiple Casualties
- Mass Casualties

PRIMARY SURVEY WITH SIMULTANEOUS RESUSCITATION

- Airway Maintenance with Restriction of Cervical Spine Motion
- Breathing and Ventilation
- Circulation with Hemorrhage Control
- Disability (Neurologic Evaluation)
- Exposure and Environmental Control

ADJUNCTS TO THE PRIMARY SURVEY WITH RESUSCITATION

- Electrocardiographic Monitoring
- Pulse Oximetry
- Ventilatory Rate, Capnography, and Arterial Blood Gases
- Urinary and Gastric Catheters
- X-ray Examinations and Diagnostic Studies

CONSIDER NEED FOR PATIENT TRANSFER

SPECIAL POPULATIONS

SECONDARY SURVEY

- History
- Physical Examination

ADJUNCTS TO THE SECONDARY SURVEY

REEVALUATION

DEFINITIVE CARE

RECORDS AND LEGAL CONSIDERATIONS

- Records
- Consent for Treatment
- Forensic Evidence

TEAMWORK

CHAPTER SUMMARY

BIBLIOGRAPHY

OBJECTIVES

After reading this chapter and comprehending the knowledge components of the ATLS provider course, you will be able to:

1. Explain the importance of prehospital and hospital preparation to facilitate rapid resuscitation of trauma patients.
2. Identify the correct sequence of priorities for the assessment of injured patients.
3. Explain the principles of the primary survey, as they apply to the assessment of an injured patient.
4. Explain how a patient's medical history and the mechanism of injury contribute to the identification of injuries.
5. Explain the need for immediate resuscitation during the primary survey.
6. Describe the initial assessment of a multiply injured patient, using the correct sequence of priorities.
7. Identify the pitfalls associated with the initial assessment and management of injured patients and describe ways to avoid them.
8. Explain the management techniques employed during the primary assessment and stabilization of a multiply injured patient.
9. Identify the adjuncts to the assessment and management of injured patients as part of the primary survey, and recognize the contraindications to their use.
10. Recognize patients who require transfer to another facility for definitive management.
11. Identify the components of a secondary survey, including adjuncts that may be appropriate during its performance.
12. Discuss the importance of reevaluating a patient who is not responding appropriately to resuscitation and management.
13. Explain the importance of teamwork in the initial assessment of trauma patients.