

# Emergency Neurologic Life Support (ENLS): Evolution of Management in the First Hour of a Neurological Emergency

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Published online: 5 October 2015  
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**Abstract** Emergency neurological life support (ENLS) is an educational program designed to provide users advisory instruction regarding management for the first few hours of a neurological emergency. The content of the course is divided into 14 modules, each addressing a distinct category of neurological injury. The course is appropriate for practitioners and providers from various backgrounds who work in environments of variable medical complexity. The focus of ENLS is centered on a standardized treatment algorithm, checklists to guide early patient care, and a structured format for communication of findings and concerns to other healthcare professionals. Certification and training in ENLS is hosted by the Neurocritical Care Society. This document introduces the concept of ENLS and describes the revisions that constitute this second version.

**Keywords** Emergency · Algorithm · Neurocritical care · Resuscitation · Critical care

## Background

Emergency neurologic life support (ENLS) was created upon the principle that efficient and appropriate management of the early stages of a neurological emergency has substantial impact on patient outcome. Despite an appreciation for this association, the medical community had not historically had standardized approaches to neurologic injuries similar to those developed for trauma and cardiac arrest. The inconsistencies in the methodologies of neurologic resuscitation have been further multiplied by the diversity of expertise of individuals who participate in the initial care of these patients. Few of these providers possess specific training in the neurosciences and, therefore, may struggle to deliver care focused on the neurologic needs of the patient.

ENLS was designed to focus on the fundamentals of acute management of patients suffering a range of neurologic emergencies. The treatment algorithms were devised to be simple, able to be administered across a spectrum of care environments, and clinically applicable for medical care givers of a variety of backgrounds. The basic structure of ENLS education was created by its inaugural chairs, Dr. Wade Smith and Dr. Scott Weingart. They observed a dualistic template for construction of the materials where each of the 13 topics was co-chaired by a practitioner from a critical care and emergency medicine background. The original ENLS algorithms and supporting manuscripts which embodied these tenants were published in *Neurocritical Care* in July 2012 and presented at the Neurocritical Care Society Annual Meeting the following fall [1]. Since that launch, the ENLS curriculum has been taken by hundreds of paramedics, nurses, advanced practice providers, pharmacists, resident and fellow trainees, and physicians of assorted training from around the world.

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These individuals have undergone ENLS training either through live courses given by accredited trainers or by on-line self-study on the ENLS training website (<http://www.neurocriticalcare.org/>).

Participants in the ENLS program undergo an educational experience that possesses a common set of objectives. Each module is built around a central treatment algorithm intended to effectively and efficiently guide the provider through the essential early steps of care. Check lists are provided to ensure consistent and timely completion of crucial tasks. Significant emphasis is placed on instructive and concise communication among team members, particularly during transition to a new care environment. While competency for ENLS materials is assessed by a post-course examination, the educational benefit of the course is intended to be longitudinal. Participants retain access to module manuscripts, algorithms, presentations, and instructional videos throughout the duration of their accreditation. Given the breadth and detail of the materials, users are encouraged to revisit the ENLS website to access reference resources. Due to the paucity of data available regarding best management of emergent neurologic conditions, much of the ENLS recommendations originate from expert opinion rather than established high level evidence. Accordingly, the materials are dynamic documents and users are encouraged to provide constructive feedback to improve the quality of the product. Additionally, it is a goal of the ENLS program to highlight areas where well-supported recommendations are lacking and stimulate academic pursuits to conduct research in these areas of need.

### Changes in ENLS Version 2.0

Observation and scrutiny of the original ENLS project have shaped the process and form of the current revision. The content change for the new manuscripts center around three chief priorities:

- (A) More comprehensive direction for pre-hospital management of neurological emergencies,
- (B) Inclusion of content unique to care of the pediatric patient,
- (C) Greater emphasis on the pharmacologic aspects of emergent neurologic care.

Where appropriate, each module contains dedicated pre-hospital and pediatric sections. Furthermore, a new module, *ENLS: Pharmacotherapy*, has been added to the series. All 14 of the module revisions were reviewed by an editor, critical care physician, emergency medicine physician,

pharmacists, a pediatric intensivist, neurologist or neurosurgeon, and a paramedic. The final manuscripts have undergone an external peer review process. Special attention was made to align the suggestions of the ENLS protocols with NCS, national, and international guidelines on the same topic. Since the initial launch, all certification questions have undergone numerous reviews to achieve consistency in format, level of difficulty, and relevance to care for the early hours of a neurological emergency. Users are now also able to review a succinct referenced commentary at the end of each module that addresses the correct and incorrect responses to their certification testing. Beginning in the fall of 2015, certified participants of ENLS will be eligible to renew their 2-year certification through an abbreviated on-line course.

### New Highlights in Care of the Emergency Neurological Patient

The release of a new version of ENLS is supported by the significant advancements seen in the field of emergency neurology in the past few years. Recent success of endovascular trials for treatment of acute ischemic stroke has impacted the time course and treatment options relevant to these patients and has created the necessity for improved communication and collaboration among treating facilities [2–4]. The recent release of the American Heart Association Guidelines for Spontaneous Hemorrhage addresses new treatment goals for blood pressure control and coagulation reversal [5]. New comparative studies of therapeutic temperature management after cardiac arrest raise questions regarding best temperature targets for neuroprotective therapy and the appropriateness of extrapolation of this strategy to children [6, 7]. These updates and many more have shaped the suggestions found in the following manuscripts.

For participants who wish to improve the convenience and accessibility of their ENLS resources, an ENLS iBook is now available which provides a comprehensive prose reference that is complimentary to the course manuscripts and algorithms [8]. Individual chapters are also available for purchase.

The ENLS project is indebted to the authors and reviewers who spent considerable time ensuring that the revised version met expectations for content, quality, and clinical guidance. The authors and reviewers are listed in Tables 1 and 2. Special gratitude is appropriate for Becca Stickney, who has provided extraordinary management and administrative support throughout this process.

**Table 1** List of ENLS protocols and their authors

Topic	Authors
Acute non-traumatic weakness	<b>Oliver Flower, MD</b> Royal North Shore Hospital, Sydney, Australia <b>Mark S. Wainwright MD, PhD</b> Northwestern University <b>Anna Finley Caulfield, MD</b> Stanford University
Airway and ventilation and sedation	<b>David Seder, MD</b> Maine Medical Center <b>Andy Jagoda, MD</b> Mt Sinai, NY <b>Becky Riggs, MD</b> Johns Hopkins University School of Medicine
Approach to the comatose patient	<b>Rhonda S Cadena, MD</b> University of North Carolina School of Medicine <b>Robert Stevens, MD</b> Johns Hopkins University School of Medicine <b>Jose A. Pineda</b> Washington University School of Medicine
Intracerebral hemorrhage	<b>Ed Jauch, MD, MS</b> Medical University of South Carolina <b>J. Claude Hemphill, MD</b> University of California, San Francisco <b>Jose A. Pineda, MD, MSCI</b> Washington University School of Medicine
Intracranial hypertension and herniation	<b>Robert D. Stevens, MD</b> Johns Hopkins University School of Medicine <b>Rhonda Cadena, MD</b> University of North Carolina School of Medicine <b>Michael Shoykhet, MD, PhD</b> Washington University School of Medicine
Ischemic stroke	<b>Harmut Gross, MD</b> Medical College of Georgia <b>Gene Sung, MD</b> University of Southern California <b>Kristin P. Guilliams, MD</b> Washington University in St. Louis, St. Louis Children's Hospital
Meningitis/encephalitis	<b>David Gaieski, MD</b> Sidney Kimmel Medical College at Thomas Jefferson University <b>Bart Nathan, MD</b> University of Virginia <b>Nicole F. O'Brien, MD</b> Nationwide Children's Hospital, Columbus, Ohio
Pharmacotherapy	<b>Gretchen M. Brophy, PharmD, BCPS</b> Virginia Commonwealth University <b>Theresa Human, PharmD, BCPS</b> Washington University in St. Louis <b>Lori Shutter, MD</b> University of Pittsburgh School of Medicine

**Table 1** continued

Topic	Authors
Resuscitation following cardiac arrest	<b>Jon Rittenberger, MD</b> University of Pittsburgh School of Medicine <b>Stuart Friess, MD</b> Washington University in St. Louis School of Medicine <b>Kees Polderman, MD</b> University of Pittsburgh School of Medicine
Spinal cord compression	<b>Brad Bunney, MD</b> University of Illinois at Chicago <b>Kristine O'Phelan</b> University of Miami <b>John W. Kuluz, MD</b> Nicklaus Children's Hospital
Status epilepticus	<b>Jan Claassen, MD</b> Columbia University College of Physicians and Surgeons <b>James J. Riviello, Jr., MD</b> Columbia University College of Physicians and Surgeons <b>Robert Silbergleit, MD</b> University of Michigan
Subarachnoid hemorrhage	<b>Jon Edlow, MD</b> Harvard Medical School <b>Anthony Figaji, MD</b> University of Cape Town, Cape Town, South Africa <b>Owen Samuels, MD</b> Emory University School of Medicine
Traumatic brain injury	<b>Rachel Garvin, MD</b> University of Texas Science Health Science Center <b>Chitra Venkatasubramanian, MD, MSc.</b> Stanford University <b>Angela Lumba-Brown, MD</b> Washington University School of Medicine, St. Louis Children's Hospital <b>Chad M. Miller, MD</b> OhioHealth
Traumatic spine injury	<b>Deborah Stein, MD</b> University of Maryland School of Medicine <b>Vincent Roddy, MD</b> Broward Health Medical Center <b>William Knight, MD</b> University of Cincinnati <b>Jose A. Pineda, MD MSCT</b> Washington University School of Medicine

## Conclusion

The revised version of ENLS maintains its aim to provide guidance for management of patients with emergent neurologic conditions. This latest version has expanded upon

**Table 2** ENLS Version 2 manuscript reviewers

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the multi-disciplinary approach to algorithm creation and has integrated new science and lessons learned from the original version into the new protocols. ENLS is appropriate and relevant for all types of providers practicing in a diverse array of settings. The educational value of ENLS is intended to extend beyond the initial instructional encounter as the supporting materials can serve as a convenient reference.

**Acknowledgments** We wish to thank all of the co-chairs in Table 1 for their efforts, as well as Dr. Daryl Gress for providing peer review of the manuscripts. Becca Stickney from the Neurocritical Care Society has taken the administrative management of ENLS to a higher level. We wish to thank many contributors in Table 2 who provided extensive feedback on pharmaceutical aspects of each protocol and at the editorial level within their specialty. Lastly, to all those members of the Neurocritical Care Society who took time from their busy practices to provide feedback: these protocols are yours. Please use them to educate others outside of your craft so that all patients have access to the best care possible in those critical first hours.

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