

# Critical

---

# decisions

in emergency medicine

THE 2017 LLSA LITERATURE REVIEW



THE OFFICIAL CME PUBLICATION OF THE AMERICAN  
COLLEGE OF EMERGENCY PHYSICIANS

# The LLSA Literature Review

## Synopses of articles from ABEM's 2017 Lifelong Learning and Self-Assessment Reading List

### FROM THE EDITORS

Since April 2003, *Critical Decisions in Emergency Medicine* has included the bonus feature "The LLSA Literature Review." The impetus for this section was our desire to provide ACEP members with yet another tool to use when preparing for the continuous certification initiative of the American Board of Emergency Medicine (ABEM), specifically the Lifelong Learning and Self-Assessment (LLSA) tests. Each year, as part of this program, ABEM publishes a list of articles focused on selected portions of the emergency medicine core content. These articles become the LLSA reading list for that year, and the questions for the tests are drawn from these articles.

From December 2016 through November 2017, each monthly issue of *Critical Decisions* has provided a summary of one of the articles from ABEM's 2017 reading list, with bullets highlighting the elements relevant to emergency medicine practice. This online supplemental issue includes a full collection of those summaries, which are intended to highlight the important concepts of each article. We are pleased to offer this benefit free to ACEP members, and hope you find it useful. ACEP members also can download full versions of the articles by logging in at [acep.org/llsa](http://acep.org/llsa).

If you would like to see what else *Critical Decisions* has to offer (clinical lessons, ECG and imaging reviews, drug reviews, and more), we invite you to explore a sample issue online at [www.acep.org/criticaldecisions](http://www.acep.org/criticaldecisions).

Best wishes,

**Andrew J. Eyre, MD**, Section Editor  
Harvard Affiliated Emergency Medicine Residency  
Brigham and Women's Hospital

**Michael S. Beeson, MD, MBA, FACEP**  
Northeastern Ohio Universities

## IN THIS ISSUE

Diagnosing and Treating Delirium Tremens. . . . .	4
ACEP Clinical Policy: Nontraumatic Thoracic Aortic Dissection. . . . .	5
Toxic Industrial Chemicals and Chemical Weapons . . . . .	6
Diagnosing Nephrolithiasis . . . . .	7
Pediatric Human Trafficking . . . . .	8
Evaluation and Management of Angioedema. . . . .	9
Diagnosing Lyme Disease . . . . .	10
Calcium Channel Blocker Overdose. . . . .	11
Treatment of Venous Thromboembolism . . . . .	12
Strategies for Infection Control. . . . .	13
Trauma Airway Management . . . . .	14
Integration of Palliative Care into EM. . . . .	15

# Critical decisions

in emergency medicine

*Critical Decisions in Emergency Medicine* is the official CME publication of the American College of Emergency Physicians. Additional volumes are available to keep emergency medicine professionals up to date on relevant clinical issues.

---

### EDITOR-IN-CHIEF

**Michael S. Beeson, MD, MBA, FACEP**  
Northeastern Ohio Universities,  
Rootstown, OH

---

### SECTION EDITORS

**Andrew J. Eyre, MD**  
Brigham & Women's Hospital/Harvard Medical School,  
Boston, MA

**Joshua S. Broder, MD, FACEP**  
Duke University, Durham, NC

**Frank LoVecchio, DO, MPH, FACEP**  
Maricopa Medical Center/Banner Phoenix Poison  
and Drug Information Center, Phoenix, AZ

**Amal Mattu, MD, FACEP**  
University of Maryland, Baltimore, MD

**Lynn P. Roppolo, MD, FACEP**  
University of Texas Southwestern Medical Center,  
Dallas, TX

**Christian A. Tomaszewski, MD, MS, MBA, FACEP**  
University of California Health Sciences,  
San Diego, CA

**Steven J. Warrington, MD, MEd**  
Kaweah Delta Medical Center, Visalia, CA

---

### ASSOCIATE EDITORS

**Walter L. Green, MD, FACEP**  
University of Texas Southwestern Medical Center,  
Dallas, TX

**John C. Greenwood, MD**  
University of Pennsylvania, Philadelphia, PA

**Sharon E. Mace, MD, FACEP**  
Cleveland Clinic Lerner College of Medicine/Case  
Western Reserve University, Cleveland, OH

**Jennifer L. Martindale, MD, MSc**  
Mount Sinai St. Luke's/Mount Sinai West  
New York, NY

**George Sternbach, MD, FACEP**  
Stanford University Medical Center, Stanford, CA

---

### RESIDENT EDITOR

**Nathaniel Mann, MD**  
Massachusetts General Hospital, Boston, MA

---

### EDITORIAL STAFF

**Rachel Donihoo**, Managing Editor  
rdonihoo@acep.org

**Jessica Hamilton**, Educational Products Assistant

**Lexi Schwartz**, Subscriptions Coordinator

**Marta Foster**, Director, Educational Products

ISSN2325-0186(Print)

ISSN2325-8365(Online)



# Diagnosing and Treating Delirium Tremens

By Katrina Destree MD, LT(MC) and Daphne Morrison-Ponce, MD, LCDR, Naval Medical Center, Portsmouth, Virginia

Schuckit MA. Recognition and management of withdrawal delirium (delirium tremens). *N Engl J Med.* 2014;371(22):2109-2113.

**Alcohol is classified as a central nervous system depressant that increases the release of gamma-aminobutyric acid in the brain and inhibits post-synaptic glutamate activity.** Once the body has developed a significant tolerance to alcohol, a subsequent drop in the blood alcohol level can trigger withdrawal symptoms such as anxiety, insomnia, hyperthermia, hypertension, tachycardia, tachypnea, and tremors. These symptoms can be seen within 8 hours after the initial decrease in a patient's blood alcohol level, peak at 72 hours, and can linger for 5 to 7 days after the last drink.

The Clinical Institute Withdrawal Assessment of Alcohol Scale (CIWA) is a widely used tool for gauging the severity of withdrawal symptoms and guiding medication management. In brief, scores lower than 8 indicate mild withdrawal symptoms that typically do not require medications; scores between 8 and 15 indicate moderate symptoms that usually respond to benzodiazepines; and scores greater than 15 may herald seizures and delirium requiring close monitoring and treatment with benzodiazepines.

Withdrawal delirium, also known as delirium tremens, is evidenced by fluctuating disturbances in attention and cognition with or without hallucinations. The typical onset of this complication is 3 days after the start of withdrawal symptoms; the typical course runs from 1 to 8

days. The mortality rate (1% to 4%) is secondary to cardiac arrhythmias, hyperthermia, and complications caused by seizures or other comorbidities. Withdrawal delirium can be predicted by:

- A CIWA score greater than 15
- A recent seizure or prior history of seizure or delirium
- Advanced age
- Additional misuse of depressants
- Comorbidities (eg, electrolyte abnormalities, cardiac disease)

The management of withdrawal delirium relies on the clinician's ability to identify and control symptoms in a safe environment such as ICU or a locked inpatient ward. Supportive treatment includes patient reorientation; the development of an appropriate sleep-wake cycle; adequate hydration; and the administration of glucose and thiamine (to avoid Wernicke encephalopathy and thiamine-related cardiomyopathies) and benzodiazepines (to reduce agitation and the risk of seizures).

A variety of benzodiazepine regimens of have been used successfully, including long-acting diazepam and short-acting lorazepam; doses vary widely from patient to patient. Alternative depressants such as phenobarbital, midazolam, clomethiazole, carbamazepine, and oxycarbazepine can be considered; however, there is no supportive data indicating that these agents provide any benefit in patients suffering from alcohol withdrawal. Adjunct medications, including propofol, dexmedetomidine

and haldol, may be used for patients with a minimal response to high-dose benzodiazepines. These alternative agents do, however, carry specific contraindications for certain populations.

\*\*\*

*The views expressed in this article are those of the author(s) and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense or the United States Government.*

\*\*\*

*I am (a military service member) (an employee of the U.S. Government). This work was prepared as part of my official duties. Title 17 U.S.C. 105 provides that 'Copyright protection under this title is not available for any work of the United States Government.' Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.*

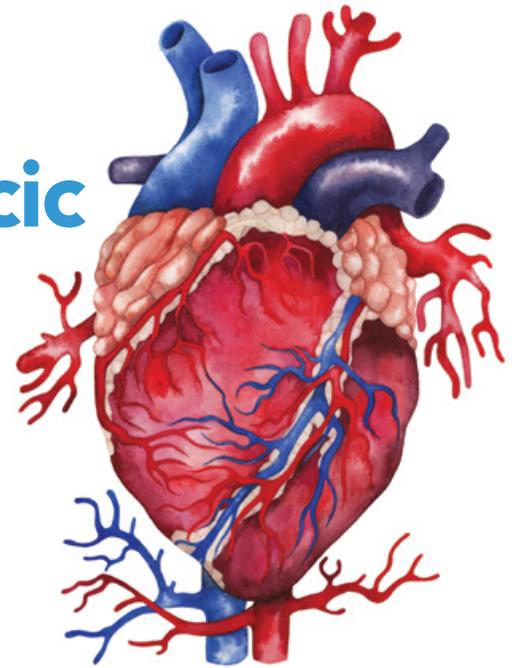
## KEY POINTS

- Alcohol withdrawal symptoms can be seen within 8 hours of a patient's last drink, and as long as 7 days after.
- Signs of withdrawal range from agitation, tachycardia, nausea/vomiting, hypertension, and hyperthermia to seizures and delirium.
- The management of withdrawal delirium relies on the clinician's ability to identify and control symptoms in a safe environment.
- Supportive treatment should include the administration of IV fluids, glucose, thiamine, and benzodiazepines.
- Adjunct medications such as propofol, haldol, and dexmedetomidine may be required for symptoms refractory to benzodiazepines.

# ACEP Clinical Policy: Nontraumatic Thoracic Aortic Dissection

By Emily S. Bartlett, MD, and Laura A. Welsh, MD  
University of Washington Medical School, Division of Emergency Medicine, Seattle

American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Thoracic Aortic Dissection, Diercks DB, Promes SB, et al. Clinical policy: critical issues in the evaluation and management of adult patients with suspected acute nontraumatic thoracic aortic dissection. *Ann Emerg Med.* 2015;65(1):32-42.



**Thoracic aortic dissection is a critical but difficult diagnosis to make due to its low incidence and variable clinical presentation.** Written by the American College of Emergency Medicine (ACEP), this clinical policy addresses evidence regarding the emergency department diagnosis and initial management of suspected nontraumatic thoracic aortic dissection in nonpregnant, adult patients. It aims to answer five key clinical questions.

**1. Are there clinical decision rules that can safely identify patients at low risk for thoracic aortic dissection?**

The low prevalence of this disease presents a challenge in the development of prospective decision rules. Existing clinical protocols should not be used alone to identify very low-risk patients (*level C recommendation*). The decision to pursue further diagnostic tests should be made at the discretion of the treating provider.

**2. Is a negative D-dimer sufficient to identify patients at very low risk for thoracic aortic dissection?**

D-dimer has been studied as a potential means of excluding aortic dissection and decreasing the need for additional diagnostic testing. However, the test is insufficient and should not be used alone to

exclude this deadly diagnosis (*level C recommendation*). False-negative values can occur in certain populations; elevations are not specific for thoracic aortic dissection.

**3. Is the diagnostic accuracy of CTA at least equivalent to TEE or MRA to exclude thoracic dissection?**

In the studies reviewed, computed tomography angiography (CTA) showed a diagnostic accuracy similar to that of transesophageal echocardiography (TEE) and magnetic resonance angiography (MRA) and may be used to exclude thoracic aneurysm (*level B recommendation*). Additionally, CTA has the potential ability to identify alternative etiologies for the patient's symptoms.

**4. Can an abnormal bedside TTE confirm an aortic dissection diagnosis?**

Although bedside transthoracic echocardiography (TTE) is an appealing diagnostic tool, particularly in hemodynamically unstable patients, current evidence does not support the reliability of a negative test to definitively diagnose thoracic aortic dissection (*level B recommendation*). However, a TTE finding suggestive of aortic dissection warrants surgical consultation or transfer to a higher level of care. (*level C recommendation*).

**5. Does reducing the targeted heart rate and blood pressure help mitigate morbidity and mortality?**

The leading cause of death in these patients is a progressive dissection resulting in rupture. Animal studies suggest that this devastated complication is associated with shear force. Therefore, major specialty guidelines list the following therapeutic targets: heart rate (60 beats/min), and systolic blood pressure (<120 mm Hg). While any elevations should be corrected, no specific targets have demonstrated a reduction in morbidity and mortality (*level C recommendation*).

## KEY POINTS

- No existing clinical decision rules can safely identify patients at very low risk for thoracic aortic dissection. Additionally, a negative D-dimer is not sufficient to exclude the diagnosis in this population.
- The accuracy of CTA is similar that of TEE and MRA for excluding thoracic aortic dissection.
- Bedside TTE is insufficient for diagnosing thoracic aortic dissection.
- No specific blood pressure and heart rate targets have demonstrated reduced morbidity or mortality.



# Toxic Industrial Chemicals and Chemical Weapons

By Arvin R. Akhavan, MD and Laura Welsh, MD  
University of Washington Medical School, Division  
of Emergency Medicine, Seattle

Tomassoni AJ, French RN, Walter FG. Toxic industrial chemicals and chemical weapons: exposure, identification, and management by syndrome. *Emerg Med Clin North Am.* Feb 2015;33(1):13-36.

**Despite efforts to prevent such events, chemical exposures by human industry, terrorism, or environmental disasters continue to put large populations at risk.**

The effects of toxicity can be subtle, and even a brief exposure can have dramatic clinical consequences. Emergency providers must be vigilant and prepared to identify and manage these scenarios appropriately.

Timely recognition and protection of health care workers from secondary exposure are of utmost importance. Physicians must receive training in the appropriate use of personal protective equipment and decontamination protocols. The clinical response should focus on the triage of illness severity and exposure risk, decontamination, chemical agent identification, and rapid initiation of treatment. The systems response includes initiation of surge and mass casualty protocols as well as notification of appropriate public health officials.

Occupational history can help identify the chemical(s) of interest. Providers should be familiar with common agents used in their local industries. Material safety data sheets also can be of assistance; however, this information is not always available. Physicians must be familiar with

chemical toxidromes to facilitate rapid diagnosis and effective treatment.

Mass casualty events involving multiple exposures and a delayed information exchange initially can confound the diagnosis. Certain exposures may mimic medical conditions. Additionally, multiple simultaneous chemical exposures can lead to additive, potentiating, synergistic, or antagonistic effects. Therefore, it is important for clinicians to identify and utilize appropriate toxicological resources, including poison control centers. In case of infrastructure failure, these protocols should be readily available in print form.

The level of a patient's risk is related to the toxicity of the agent and duration of exposure. Although the term "LD50" is used to identify a dose that is lethal to 50% of the population, it is difficult to apply this principle to any single patient. Different individuals may react uniquely to the same exposure. The route of exposure also can play an important role in a patient's prognosis. Whether an agent is inhaled, injected, ingested, or contacted dermally can significantly affect symptoms and outcomes.

The management of most patients is limited to decontamination and supportive care; however, antidotes

are available for certain chemicals. Although such treatments generally are effective, timely identification of the toxin is crucial. Procurement of antidotes, via discussion with local agencies and poison control, is of utmost importance.

In addition to acute illness, chronic medical disease also can result from toxic industrial exposure. Discharged patients should receive follow-up care from a toxicologist or occupational health specialist. Pregnant patients may benefit from outpatient referral to a geneticist.

## KEY POINTS

- The scope of chemicals used, wide range of potential exposures, and great variability with which toxicity presents makes it difficult to identify and manage such cases.
- Emergency providers are responsible for detecting toxic exposures, decontaminating victims, treating symptoms, and coordinating public health efforts to protect others who may be at risk.
- The provision of appropriate care is dependent upon a basic understanding of potential toxidromes, antidotal therapy, and local resource utilization.

# Diagnosing Nephrolithiasis



By Brittany Wootten, MD LT (MC) USN and Daphne Morrison Ponce, MD, LCDR (MC) USN Naval Medical Center, Portsmouth, Virginia

Smith-Bindman R, Aubin C, Balitz, et al. Ultrasonography versus computed tomography for suspected nephrolithiasis. *N Engl J Med.* Sep 2014;371(12):1100-1110.

**Given its high sensitivity, computed tomography (CT) has been long considered the standard diagnostic test for the initial evaluation of nephrolithiasis; however, this imaging modality is not without risks.** CT increases the lifetime cancer risk secondary to ionized radiation exposure, is associated with a significant number of incidental findings, and contributes to the growing cost of care for acute nephrolithiasis in the US.

This multicenter study compared CT, emergency point-of-care ultrasound, and radiologist-conducted ultrasonography in regard to the 30-day incidence of a high-risk diagnosis. Nearly 2,800 adult patients with flank or abdominal pain were randomized into one of the three imaging groups. Researchers excluded renal transplant recipients; patients who were obese, undergoing dialysis, or reliant on a single kidney; and those in whom an alternative diagnosis was likely. Trained emergency physicians provided point-of-care ultrasound.

Patients were contacted 3, 7, 30, 90, and 180 days after their initial evaluation to assess study outcomes. High-risk diagnoses with complications included abdominal aortic aneurysm with rupture, pneumonia with sepsis, appendicitis with rupture, diverticulitis with abscess or sepsis, bowel ischemia or perforation, renal infarction, renal stone with abscess, pyelonephritis with urosepsis or bacteremia, ovarian torsion with necrosis, and aortic dissection with ischemia. Cumulative radiation

exposure was defined as the sum of the effective doses from all imaging that was performed within 6 months after randomization.

Data was evaluated according to intention-to-treat analysis. Notably, 41.6% of patients had a history of kidney stones, 63.3% had hematuria, and 52.5% reported costovertebral-angle tenderness. The incidence of high-risk diagnoses with complications was universally low at 0.4% and did not differ substantially between groups ( $p = 0.3$ ). Radiation exposure was expectedly lower in both ultrasound cohorts ( $p < 0.001$ ).

Serious adverse events occurred in 12.4% of the point-of-care ultrasound cohort, 10.8% of the radiology ultrasound group, and 11.2% of those assigned to CT ( $p = 0.5$ ). There was no statistically significant difference in adverse outcomes, return visits, hospitalizations, or diagnostic accuracy between the three groups. Of the patients who were evaluated with only one imaging modality, those who received point-of-care ultrasound had markedly shorter lengths of stay in the emergency department. While the ultrasound groups were more likely to undergo additional diagnostic testing, their visits proved to be slightly less expensive.

The higher sensitivity of CT for evaluating nephrolithiasis did not translate to better outcomes or prevent significant missed diagnoses. The research does, however, support ultrasound as the first-line test in the

right patient population. Importantly, further imaging studies, which may be indicated on the basis of clinical judgment, ultimately might lead to lower cumulative radiation exposures without increasing the danger of adverse outcomes.

\*\*\*

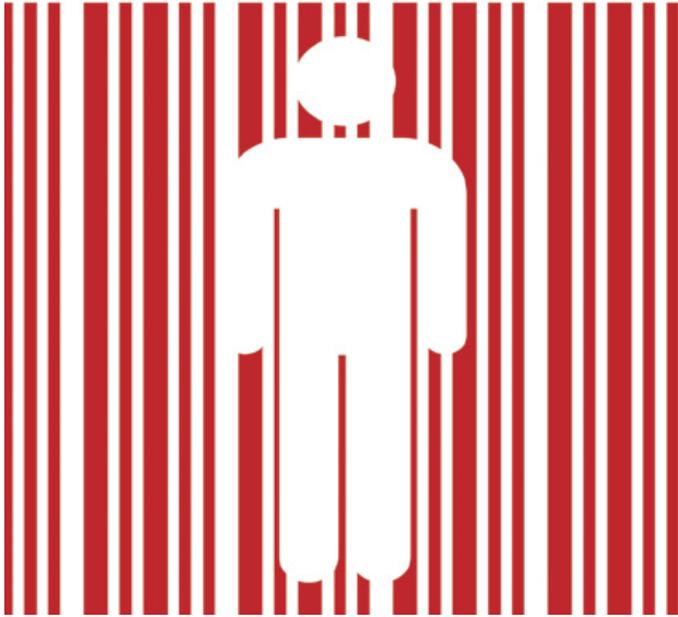
*The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Dept. of the Navy, Dept. of Defense or the United States Government.*

\*\*\*

*We are military service members. This work was prepared as part of our official duties. Title 17 U.S.C. 105 provides that 'Copyright protection under this title is not available for any work of the United States Government.' Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.*

## KEY POINTS

- There is no statistically significant difference between bedside ultrasound performed by qualified emergency physicians and comprehensive ultrasound performed by radiologists when evaluating for renal colic.
- Initial ultrasound imaging for the evaluation of nephrolithiasis may decrease overall radiation exposure to patients without increasing the risk of adverse outcomes.
- When comparing bedside point-of-care ultrasound, radiologist-performed ultrasound, and CT, there are no significant disparities in high-risk diagnoses with complications, return visits, hospitalizations, or diagnostic accuracy.



# Pediatric Human Trafficking

By Juwarat A. Kadiri MD, MPH and Hanni M. Stoklosa MD, MPH  
Brigham and Women's Hospital/Massachusetts General Hospital, Boston

Becker HJ, Bechtel K. Recognizing victims of human trafficking in the pediatric emergency department. *Pediatr Emerg Care*. Feb 2015;31(2):144-147.

Often termed *modern-day slavery*, human trafficking is defined by the United Nations as the recruitment, transfer, harboring, or receipt of [vulnerable] persons for the purpose of exploitation. According to US Federal Law, any child under the age of 18 involved in commercial sex is considered a victim regardless of the use of force, fraud, or coercion. Although sex trafficking is the most commonly recognized form of human trade, the practice also includes forced labor and involuntary servitude.

An estimated 30% of trafficking victims are seen by health care providers, an interface that provides a unique opportunity for intervention. Victims are unlikely to identify themselves for reasons such as shame, fear of repercussions or further abuse, and language barriers. Emergency physicians should receive in-depth training in victim identification and be prepared to recognize red flags that suggest trafficking.

The victim may be accompanied by the trafficker who identifies as family/friend and is reluctant to allow the patient to be alone with a clinician. The trafficker also may answer questions that are directed toward the patient. The patient may

offer a vague or inconsistent history, and may become defensive or anxious when law enforcement is mentioned. It is not uncommon for victims to show signs of mental illness or substance abuse.

When trafficking is suspected, it is important to separate the patient from any chaperone. Reassure the patient of privacy and confidentiality, obtain a thorough history using an interpreter if needed, and use nonjudgmental questioning. A thorough head-to-toe examination should be performed to assess for signs of trauma, including lacerations, abrasions, and ligature marks. Assess for the presence of unusual tattoos on locations such as the back of the neck, underarm, lower

back, or inner thigh, which can be forms of branding.

The management of these patients should involve a social worker early in the visit. The National Human Trafficking Resource Center operates a 24-hour hotline (1-888-373-7888), which is available to providers and victims in multiple languages. The center provides guidance on assessment questions and trafficker identification, and also assists in safety planning for victims. It is important to follow mandated reporting requirements. Victims who are non-US citizens are eligible for a special visa that offers protections and allows them to stay in the country legally.

## KEY POINTS

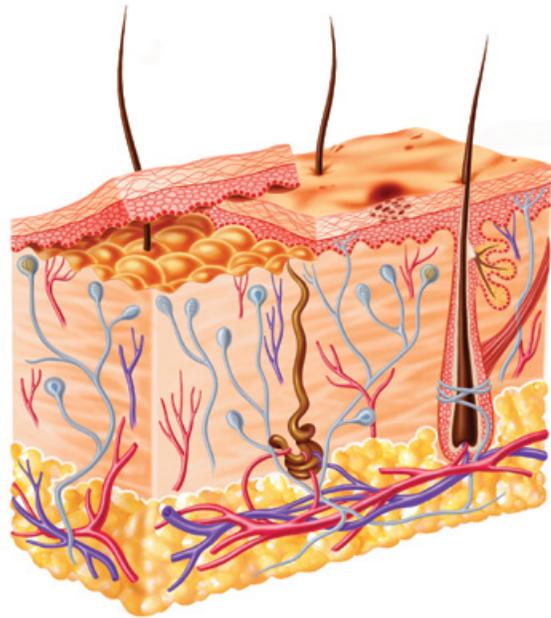
- An estimated 30% of trafficking victims interact with health care providers.
- Red flags of trafficking include being accompanied by a "family/friend" who is reluctant to allow the patient to be alone with a health care worker, a vague or inconsistent history, fear of law enforcement, and substance abuse.
- Physical signs include lacerations, abrasions, ligature marks, and unusual tattoos.
- When trafficking is suspected, involve social work early and follow mandated reporting requirements.
- The National Human Trafficking Resource Center operates a 24-hour hotline (1-888-373-7888).

# Evaluation and Management of Angioedema

By Zheng Ben Ma, MD, and Andrew Eyre, MD

The Brigham and Women's/Massachusetts General Hospital Harvard Affiliated Emergency Medicine Residency, Boston

Moellman JJ, Bernstein, JA Lindsell, C, et al. A consensus parameter for the evaluation and management of angioedema in the emergency department. *Acad Emerg Med.* 2014;21(4):469-484.



**Angioedema is defined as swelling of subcutaneous or submucosal tissues secondary to enhanced vascular permeability, a process that allows movement of fluid from the vascular space into the interstitial space.** The differing pathophysiology between the two broad types of angioedema, *bradykinin-mediated* and *histamine-mediated*, will help guide treatment.

Histamine-mediated angioedema can manifest with or without the associated features of anaphylaxis, including urticaria or respiratory, circulatory, or gastrointestinal symptoms. The mainstay of treatment for this class of angioedema includes epinephrine, histamine blockers, and corticosteroids.

Nonhistaminergic angioedema is caused by bradykinin accumulation. This may result from decreased metabolism in the case of ACE inhibitor (ACEI) use, low functional C1-inhibitor protein levels in hereditary angioedema (HAE) type 1, abnormal C1-inhibitor function in HAE type 2, or acquired C1-inhibitor (C1-INH) deficiency due to consumption from an underlying lymphoproliferative disorder or antibody production.

If a clear etiology is unknown, treatment with epinephrine followed by H1/H2 antagonists and corticosteroids is appropriate. While these agents are not effective for bradykinin-

mediated angioedema, they are not contraindicated and are potentially lifesaving. The only acute treatment readily available for ACEI angioedema is fresh frozen plasma (FFP), which contains variable amounts of C1-INH. However, FFP infusions may worsen symptoms in hereditary cases.

Several novel therapies have been FDA-approved for the management of HAE attacks. These include icatibant (a bradykinin 2-receptor antagonist that blocks the vascular effects of bradykinin), ecallantide (a kallikrein inhibitor, which limits bradykinin formation), and C1-INH concentrate. These theoretically are effective for the treatment of HAE attacks and ACE inhibitor-induced angioedema. However, data is limited for non-HAE patients.

The first step in treating angioedema is to manage the airway and address any respiratory or circulatory abnormalities, without initially focusing on the underlying cause or classification of the disease. The physical evaluation should be focused on assessing the vital signs, airway, skin, and abdomen. Edema of the lips, tongue, soft palate, or posterior pharynx should warrant closer attention. Stridor or a hoarse voice warrants direct visualization of the base of the tongue and larynx by nasopharyngoscopy or video laryngoscopy. An examination of

the airway structures should help determine if intubation is indicated.

While no laboratory test is immediately available to help guide initial treatment, C4 and tryptase levels drawn during an angioedema attack are useful in distinguishing bradykinin or histamine-mediated etiologies during follow up. Complement C4 levels are persistently low in HAE cases, while tryptase may be elevated in anaphylaxis or other mast cell-mediated disorders manifesting as angioedema.

## KEY POINTS

- Angioedema is a physical sign triggered by differing pathophysiological mechanisms.
- When a clear cause is unknown, try intramuscular epinephrine, antihistamines, and corticosteroids.
- Regardless of the etiology, initial management should be focused on correcting airway, breathing, and circulatory abnormalities.
- Although novel therapies for bradykinin-mediated hereditary angioedema are emerging, data on efficacy is limited.
- Ancillary testing, including C4 and tryptase levels drawn during the angioedema attack, are helpful only during follow up to help clarify triggering mechanisms.



# Diagnosing Lyme Disease

By Francisco Sanchez, MD, and Andrew J. Eyre, MD  
Massachusetts General Hospital, Brigham and Women's Hospital,  
Harvard Affiliated Emergency Medicine Residency, Boston

Shapiro ED. Clinical practice. Lyme disease. *N Engl J Med*. May 2014;370(18):1724-1731.

**Lyme disease is a tick-borne illness caused by *Borrelia burgdorferi*, a spirochete found in certain ixodes ticks (most commonly *Ixodes scapularis* or deer ticks).** The number of cases is growing in the United States, where the overwhelming majority of cases have been reported in New England and the mid-Atlantic states. The incidence is highest in children (5-14 years old) and middle-aged adults during the spring and summer months.

The most common presenting symptom is erythema migrans (EM), an erythematous annular macule with central clearing. Typically presenting between 1 and 2 weeks after a tick bite, the sign usually develops at the site of the bite (most often on the back, axilla, groin, legs, or head) and may be asymptomatic, pruritic, or even painful. Although commonly described as a “bull’s eye” rash, nearly two-thirds of patients will present with a confluent lesion without central clearing. Patients also may present with nonspecific symptoms such as fatigue, headache, and arthralgias, but high fever is rare.

While most cases of EM manifest as a single macular lesion, patients with disseminated Lyme disease may present with multiple skin lesions or extracutaneous symptoms. These may include cranial nerve palsy (most commonly involving the facial nerve), aseptic meningitis, and carditis, which most commonly presents as heart block. Ixodes ticks can transmit a number of diseases, and patients

with Lyme disease may be coinfecting with additional organisms, including *Babesia*, *Anaplasma*, and *Ehrlichia*. Therefore, coinfections should be considered in patients with symptoms such as high fever, anemia, leukopenia, or thrombocytopenia.

In the early phase of Lyme disease, the diagnosis should be made based on history, presence of EM, and history of possible tick exposure in areas where the disease is active. Due to poor sensitivity in the early phase of infection, serological testing is not routinely indicated. If testing for *B. burgdorferi* is required, a two-tier process is recommended, typically an ELISA followed by a Western blot if the ELISA is positive or equivocal. In the absence of disseminated disease, only 25% to 40% of patients have positive results.

A 2-week course of doxycycline, amoxicillin, or cefuroxime is the recommended treatment for Lyme disease. For tick bite prophylaxis, a single 200-mg dose of doxycycline does reduce the risk of developing the disease. However, bear in mind that the risk of transmission is low and typically occurs after 36 to 48 hours of tick attachment. Treatment with doxycycline is contraindicated in children and pregnant women. In patients with disseminated disease (eg, meningitis, heart block) hospital admission and treatment with ceftriaxone is recommended.

Nearly 15% of patients show a

Jarisch–Herxheimer-like reaction (eg, increased temperature, myalgia, and arthralgia) within 24 hours of treatment. Nonsteroidal anti-inflammatory drugs are recommended for symptom management.

Although there has been much public debate, there is no evidence to suggest that patients with persistent, nonspecific symptoms (fatigue, arthralgias, etc.) have ongoing or “chronic” Lyme infections. Such cases do not necessarily warrant continued antibiotic treatment.

## KEY POINTS

- Lyme disease, a tick-borne illness caused by *B. burgdorferi*, most commonly affects children and middle-aged adults in the northeastern US.
- Erythema migrans is classically described as a “bull’s eye” rash, but it often presents as a macule without central clearing.
- In the early phase of infection, serological testing is not routinely indicated due to low sensitivity.
- Treatment options for early Lyme disease include a 2-week course of doxycycline, amoxicillin, or cefuroxime.
- Although not routinely recommended due to low transmission rates, a single prophylactic dose of doxycycline can reduce transmission (contraindicated in pregnant women and children <8 years).

# Calcium Channel Blocker Overdose



By Daniel Hegg, MD, and Andrew J. Eyre, MD  
Massachusetts General Hospital, Brigham and Women's Hospital,  
Harvard Affiliated Emergency Medicine Residency, Boston

St-Onge M, Dubé PA, Gosselin S, Guimont C, et al. Treatment for calcium channel blocker poisoning: a systematic review. *Clin Toxicol (Phila)*. Nov 2014;52(9):926-944.

## Calcium channel blocker (CCB) overdose is a common and potentially life-threatening toxicological emergency. CCB

poisoning can manifest as hypotension, conduction abnormalities, arrhythmias, and bradycardia (or reflex tachycardia with dihydropyridine overdose), which may lead to shock with end-organ hypoperfusion. Other symptoms include hyperglycemia, nausea, vomiting, and noncardiogenic pulmonary edema.

Evidence regarding the treatment of CCB toxicity is based upon relatively weak and biased literature; few high-quality studies exist. Research comparing the effectiveness of each intervention is limited and clinical applicability relies on practical experience, case reports, and assessments of biological plausibility.

**GI decontamination.** After ensuring a secure airway, gastrointestinal (GI) decontamination (ie, activated charcoal, gastric lavage, and whole-bowel irrigation) may be considered for large, potentially life-threatening ingestions that occurred within the last 1 to 2 hours.

**Calcium.** The administration of calcium appears to reduce mortality and hemodynamic stability. Adverse effects are rare. A typical single dose is 1-5 grams of intravenous (IV) calcium chloride (or the equivalent of calcium gluconate), which can be followed by an infusion.

**High-dose insulin.** High-dose

insulin (IV bolus of 1 unit/kg followed by infusion of 0.5-2.0 units/kg/hr) initiated before or shortly after the administration of vasopressors may improve hemodynamics and survival. Hypoglycemia and hypokalemia are potential adverse effects of the treatment.

**Vasopressors.** Although the evidence is inconsistent, epinephrine, norepinephrine, and dopamine might improve hemodynamics and reduce mortality in patients with CCB toxicity.

**Glucagon.** Although a sound theoretical base exists for using glucagon in patients with impending or actual shock from a beta-blocker overdose, strong support for the drug's role in the treatment of CCB is lacking. Optimal dosing and efficacy is unclear. Commonly observed side effects include hyperglycemia and vomiting.

**Lipid emulsion therapies.** Limited studies suggest that lipid emulsion therapy may improve survival in patients with verapamil poisoning.

Hyponatremia, extreme lipemia, and an inability to obtain a reliable complete blood count or arterial blood gas and electrolyte measurements were noted in one case report. Hypertriglyceridemia and hypoxemia have been observed with exceptionally high doses (2 liters).

**Extracorporeal life support.** The use of extracorporeal life support is associated with a survival benefit in patients with severe shock or cardiac arrest secondary to cardiotoxic poisonings, including CCB toxicity. Such resources should be considered and mobilized early in severe cases.

**Pacemaker.** The evidence for transcutaneous or transvenous pacing is mixed; however, when successful capture is achieved, pacemakers appear to improve hemodynamics.

**Other agents.** A variety of other agents, including 4-aminopyridine, levosimendan, and atropine have been studied; however, there is no high-quality evidence to support their routine use.

## KEY POINTS

- GI decontamination should be considered for large, life-threatening ingestions that occurred within the last 1 to 2 hours.
- IV calcium is a reasonable first-line therapy that appears to reduce mortality and improve hemodynamics; side effects are rare.
- The dosing requirements and efficacy of glucagon in the treatment of CCB toxicity are unclear, and the associated risk of vomiting and aspiration warrants caution.
- When initiated before or shortly after vasopressors, high-dose insulin (IV bolus of 1 unit/kg followed by an infusion of 0.5-2.0 units/kg/hr) may improve odds of survival.
- Where available, extracorporeal life support should be considered early in patients with severe shock or cardiac arrest.



# Treatment of Venous Thromboembolism

By Ellen Vollmers, MD, PhD, and Andrew J. Eyre, MD

Massachusetts General Hospital, Brigham and Women's Hospital, Harvard Affiliated Emergency Medicine Residency, Boston

Wells P, Forgie M, Rodger M. Treatment of venous thromboembolism. *JAMA*. 2014;311(7):717-728.

**Venous thromboembolism (VTE) encompasses deep vein thrombosis (DVT) and pulmonary embolism (PE), two common and potentially fatal conditions for which the approaches to treatment (most often anticoagulation and thrombolysis) are not without significant risks.** The referenced article, which aims to provide the best evidence-based approach to the treatment of VTE, is a compilation of data from Cochrane reviews, meta-analyses, and clinical and randomized controlled trials.

Patient management is divided into three phases: acute (initial 5 to 10 days), long-term (end of acute phase to 3 to 6 months), and extended (beyond the 3- to 6-month long-term phase). Available anticoagulants include unfractionated heparin; low-molecular weight heparin (LMWH); indirect factor Xa inhibitors (eg, fondaparinux); vitamin K antagonists (VKAs), especially warfarin; and newer oral anticoagulants (OACs), including direct factor Xa inhibitors and factor IIa inhibitors.

While these agents demonstrate similar safety and efficacy for long-term treatment (with a preference for LMWH, specifically in malignancy-related cases), each has its own limitations. Heparin requires daily subcutaneous injections, and VKAs require frequent clinic visits for international normalized ratio monitoring. Reversal agents are available

for heparin and VKA anticoagulation; however, warfarin does not appear to improve outcomes in patients with post-reversal bleeding complications.

Acute monotherapy options include unfractionated heparin, LMWH (unfractionated heparin in renal impairment), fondaparinux, and rivaroxaban. VKAs require a heparin bridge to therapeutic levels. Thrombolysis should be saved for the treatment of DVT at immediate risk for gangrene or limb loss and patients with PE with hemodynamic compromise. These approaches provide no mortality benefit and increase the risk of bleeding complications significantly. Inferior vena cava filters are associated with an increased risk of recurrent DVT and should be saved for patients in whom anticoagulation is contraindicated.

Studies support long-term treatment for a minimum of 3 months, which is sufficient in the setting of provoked VTE. Unprovoked and malignancy-related VTE carry a significantly higher risk of recurrence. Extended or indefinite therapy may be considered; however, further research is needed to clarify which patients are most appropriate for such a course.

Although most cases of DVT can be treated on an outpatient basis, admission should be considered for patients with severe symptoms, renal impairment, high bleeding risk, or difficult social circumstances. Clinical decision rules also can be used to identify PE cases that are appropriate for outpatient care — an approach that can reduce costs and hospital admission rates substantially.

## KEY POINTS

- In addition to heparin, rivaroxaban and fondaparinux are approved for acute monotherapy.
- Recommendations regarding the ideal duration of VTE treatment remain unclear. Clinicians should carefully consider the potential risks and benefits of extended therapy.
- While associated with improved vein patency, thrombolysis does NOT reduce mortality and increases the risk of bleeding; it should be reserved for the most severe VTE cases.
- Uncomplicated DVT often can be treated at home. Refer to clinical prediction rules to identify PE patients who may be appropriate candidates for outpatient therapy.

# Strategies for Infection Control



By Anna Condino, MD, MPH, and Laura Welsh, MD, University of Washington School of Medicine, Emergency Medicine Residency, Seattle

Liang SY, Theodoro DL, Schuur JD, et al. Infection prevention in the emergency department. *Ann Emerg Med.* Sep 2014;64(3):299-313.

**Infection prevention in the emergency department remains a complex challenge with important implications for both health care professionals and patients.** One in 20 patients will develop a health care-associated infection during their hospital stay. Prevention efforts must address infections transmitted from patients to other patients and staff, as well as those caused by common medical interventions.

Infection control begins with hand hygiene. Hand washing should be performed before and after entering any patient care area. Alcohol-based gels or foams are superior to hand washing, unless there is a concern for *C. difficile* or visible soiling of the hands. Standard barrier precautions, including gloves, mask, eye protection, and gowns, are indicated if there is a risk of exposure to body fluids, respiratory secretions, or contaminated surfaces.

Rigorous identification processes, including standard triage questions, can identify potentially infectious patients. Patients and providers should wear regular surgical masks to reduce droplet transmission. Any patient with suspected airborne disease should be isolated in a negative-pressure room, and providers should wear properly fitted N95 masks or air-purifying respirators.

Contact precautions should be

used in cases of suspected multidrug-resistant (MDR) organisms or enteric pathogens. Electronic medical records can identify such patients, and empiric precautions may be instituted in high-risk cases. Equipment should be disinfected between patients; ultrasound probes, in particular, can have high rates of MRSA colonization. Common surfaces, including computers, stethoscopes, and phones, also should be cleaned regularly.

Central venous catheter (CVC) infections are associated with an increased mortality. A multisystem approach to infection prevention, including maximum barrier precautions, preprocedural time outs and proper skin antisepsis, is essential. Communication with inpatient teams regarding emergent CVCs placed under suboptimal sterility can facilitate prompt replacement.

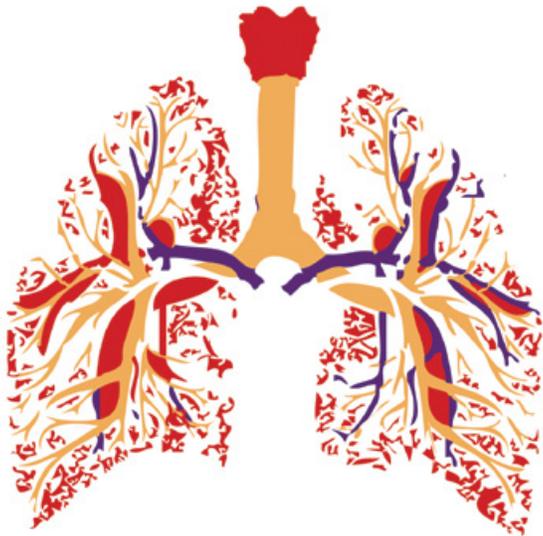
Urinary catheters should follow standardized, sterile insertion protocols. Efforts to decrease infection rates may reduce the inappropriate use of catheters, particularly in elderly patients. Emergently intubated patients may be at higher risk for ventilator-associated pneumonia (VAP). Ventilator care bundles that include raising the head of the bed and performing oral care reduce rates of VAP.

A combination of individual and systems-based solutions is needed to

produce sustainable improvements in infection prevention. Individual education alone is not effective. Common approaches that have been shown to improve infection control include consistent, easy access to supplies; designated clinical champions; formal monitoring programs; thoughtful design and maintenance of the built environment; electronic medical record support; and standardized workflows and checklists.

## KEY POINTS

- Infection prevention in the emergency department must be tailored to each unique situation, with consideration of space, time, and clinical constraints.
- Hand hygiene and standard barrier precautions remain the cornerstones of preventing person-to-person transmission of disease.
- Sterile technique should be followed for all urinary and central venous catheter insertions, with careful consideration of proper indications before insertion.
- Sustainable improvement efforts must target both individual behavior and systems-based solutions.



# Trauma Airway Management

By Grace Landers MD, LT (MC), and Daphne Morrison-Ponce MD, LCDR(MC), Naval Medical Center, Portsmouth, Virginia

Horton CL, Brown CA, and Raja AS. Trauma airway management. *J Emerg Med.* 2014, 46(6):814-820.

**The successful airway management of a trauma victim hinges on rapid, decisive action.** Clinicians must identify patients who require emergent intubation by answering three critical questions.

- **Is there a failure to maintain or protect the airway?** A trauma airway can be assessed by calculating the Glasgow Coma Scale Score (scores <12 indicate significant brain injury requiring intubation). Testing the gag reflex is not recommended as it can induce vomiting. Better clinical indicators of airway protection include the patient's ability to phonate, swallow, and handle secretions.
- **Is there a failure of oxygenation or ventilation?** This can be gauged by evaluating respiratory effort, exhalation of carbon dioxide, and oxygen saturation. Such failures can indicate impending respiratory collapse.
- **Is there a need for intubation based on the anticipated clinical course?** The opportunity to intubate early and in a controlled setting should be seized in patients with comorbid conditions.

If any of these questions can be answered in the affirmative, the clinician must proceed to the best intubation method based on the patient's stability and the availability of equipment.

The LEMON mnemonic (look externally, evaluate 3-3-2 rule, Mallampati score, obesity/obstruction and neck mobility) will help predict patients in whom direct laryngoscopy will be difficult. The MOANS mnemonic (mask seal, obesity/obstruction, age >55, no teeth and

stiff lungs) helps predict difficult mask ventilation. Rapid sequence intubation (RSI) is believed to be the safest and most successful approach in patients who lack difficult airway characteristics.

It is paramount to use an algorithmic approach and plan for adjunct methods any time a difficult airway is predicted. However, when the need for immediate intubation forces the clinician to act, a single "best attempt" (best device and most experienced operator) RSI followed by a surgical airway is recommended.

According to the LEMON algorithm, cervical spine immobilization automatically predicts a possible difficult airway; in such cases, manual immobilization outside the collar is required. While direct laryngoscopy and RSI have not been shown to significantly affect clinical outcomes regarding c-spine stabilization, the use of video-enhanced devices may be beneficial.

Patients with suspected head injuries may benefit from pretreatment with lidocaine (1.5 mg/kg) and fentanyl (2-3 mg/kg) to mitigate the rise in intracranial pressure associated with laryngeal manipulation. Etomidate (0.3 mg/kg) can be used for induction; dosing should be based on lean body

weight (a lower dose is required in cases of shock). Ketamine (1.5 mg/kg) is an alternative to etomidate, especially to facilitate awake intubations. The paralytic of choice remains succinylcholine (1-1.5 mg/kg) due to its short duration and rapid onset. Rocuronium (1.0 mg/kg) is a viable alternative when succinylcholine is contraindicated.

Although trachea-bronchea injuries are relatively rare, they should be considered in any trauma patient with dyspnea, respiratory distress, hoarseness, or dysphonia accompanied by pain, neck ecchymosis, swelling, or soft-tissue crepitus. Such cases should be managed with awake intubation techniques, tracheostomy, or cricothyrotomy. Otherwise, unguided placement of a large-bore endotracheal tube or positive-pressure ventilation can quickly complete a partial tracheal transection.

\*\*\*\*\*

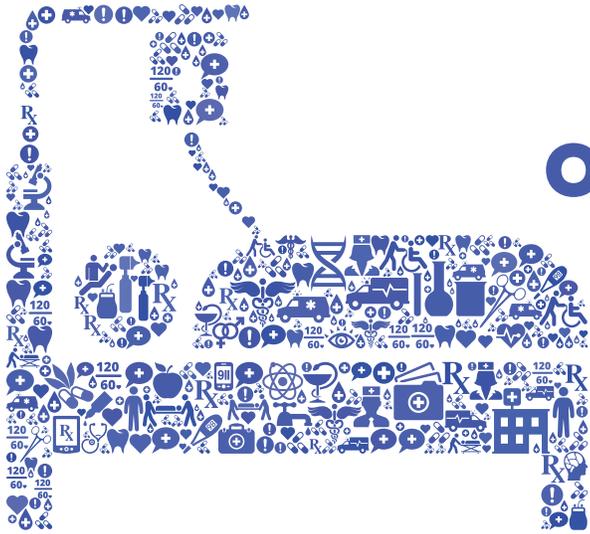
*The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Dept. of the Navy, Dept. of Defense or the United States Government.*

*We are military service members. This work was prepared as part of our official duties. Title 17 U.S.C. 105 provides that 'Copyright protection under this title is not available for any work of the United States Government.' Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.*

## KEY POINTS

- Delays in securing an advanced airway can compromise patient management.
- Airway deterioration can be prevented by performing a rapid clinical assessment and utilizing an airway algorithm to guide trauma management.
- Clinicians should maintain a high level of suspicion for tracheobronchial injury and plan for difficult airway management.
- Appropriate use of advanced airway tools, surgical airways, and consultation with specialists is important for the successful management of any trauma patient.

# Integration of Palliative Care into EM



By Liam Delahanty, MD, LT(MC) and Daphne Morrison-Ponce, MD, LT(MC),  
Naval Medical Center, Portsmouth, Virginia

Lamba S, DeSandre PL, Todd KH, et al. Improving Palliative Care in Emergency  
Medicine Board (IPAL-EM) Collaboration. *J Emerg Med.* 2014;46(2):264-270.

**With increasing frequency, emergency medicine clinicians are called to care for patients with chronic underlying diseases who are in the final stages of their lives.** The number of these terminally ill patients in “crisis” is expected to rise as the incidence of sudden death declines, and the treatment plan set forth in the emergency department often defines the trajectory of an individual’s care.

Palliative care is focused on the relief of suffering (physical, spiritual, or psychological). It is based on the patient’s personal goals and is appropriate for all phases of treatment; it is not just for the actively dying. Palliative care can run parallel to traditional care; however, it is best integrated early, as opposed to waiting until “nothing more can be done.” The timely implementation of a simultaneous care model may improve quality of life, or even prolong it.

Four models exist for the clinical integration of palliative medicine into the emergency department. The first, the *traditional consultation* model, requires clinicians to request an expert palliative care consultation. The *basic integration* model dictates that emergency and palliative medicine teams work collectively toward the same goals. Finally, the *advanced integration* and *ED-focused advanced integration* models stress established protocols and a collaboration between emergency clinicians (perhaps under the direction of a dual EM-palliative care

board-certified physician), a member of the nursing staff, and the palliative care team.

Potential screening criteria for a palliative care consultation include the presence of a life-threatening/life-limiting condition, as well as one or more global indicators of an unmet palliative care need (eg, frequent hospitalizations, functional decline, failure to thrive, complex care requirements).

Starting a palliative care initiative requires substantial effort; however, these four steps can help set the plan in motion:

1. **Identify a palliative care “champion”** within the emergency department. This can be any clinician interested in improving end-of-life care.
2. **Explore the existing literature.** The Improving Palliative Care in Emergency Medicine (IPAL-EM) project and the Education in Palliative and End-of-Life Care for Emergency Medicine (EPEC-EM) curriculum are among the web-based educational resources available.
3. **Pinpoint local palliative care and hospice resources,** either within your institution or the broader community. It is important to develop clear screening criteria for the activation of these resources.
4. **Perform a needs assessment** to identify areas that require improvement.

It should be noted that there is a lack of evidence regarding the clinical outcomes or strain on hospital staff/processes following implementation of an integrated palliative care program. As the specialty grows so, too, will research in end-of-life and palliative care issues.

\*\*\*

*The views expressed in this article are those of the author(s) and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense or the United States Government.*

\*\*\*

*I am (a military service member) (an employee of the U.S. Government). This work was prepared as part of my official duties. Title 17 U.S.C. 105 provides that ‘Copyright protection under this title is not available for any work of the United States Government.’ Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person’s official duties.*

## KEY POINTS

- Broadly defined, palliative care is patient care that is focused on relieving suffering (physical, spiritual, or psychological), based on patients’ goals.
- Palliative care can supplement and function parallel to conventional medical programs.
- Emergency clinicians can lead the integration of palliative care programs into emergency departments by performing a needs assessment, identifying a champion, conducting a literature review, and identifying community resources.