

# Critical decisions

in emergency medicine

THE 2018 LLSA LITERATURE REVIEW



# The LLSA Literature Review

## Synopses of articles from ABEM's 2018 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 January 2018 through November 2018, each monthly issue of *Critical Decisions* has provided a summary of one of the articles from ABEM's 2018 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,

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*Critical Decisions in Emergency Medicine* is the official CME publication of the American College of Emergency Physicians. Additional volumes are available.

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Tseng HJ, Hanna TN, Shuaib W, et al. Imaging foreign bodies: ingested, aspirated, and inserted. *Ann Emerg Med*. 2015 Dec;66(6):570-582.

# Imaging Foreign Bodies

**Although the evaluation of a foreign body (FB) usually begins with plain radiographs, the accuracy of x-rays is affected by the object's size and density, the surrounding soft-tissue density, and the patient's body habitus.** Wood, plastic, metal, and rock will differ in appearance, but different objects of a given type can vary in their detectability. Ultrasound is an excellent initial modality for the evaluation of FBs in the superficial soft tissues and the genitourinary tract.

Esophageal FBs commonly get caught or obstruct at the level of the cricopharyngeus muscle. Most objects require endoscopic removal, with the exception of asymptomatic coin ingestions, which can be monitored for up to 24 hours before intervening. Emergent endoscopy is indicated for sharp esophageal FBs, button batteries in the esophagus, or any symptoms of severe obstruction. Button batteries are evidenced by a subtle halo sign on frontal projection or a step-off on lateral projection, findings that differentiate them from coins.

Batteries can cause liquefactive necrosis in the esophagus, leading to perforation, strictures, fistula, and hemorrhage. These ingestions can be fatal within hours. Once past the esophagus, small button batteries usually pass, but those larger than 2 cm should be removed if present for more than 48 hours. Urgent endoscopy is indicated for sharp objects in the stomach, blunt FBs in the esophagus, magnets, and large FBs. Long objects (>6 cm) can perforate the GI tract; those

retained in the stomach or duodenum should be removed.

Ingested FBs often pass through the GI tract without difficulty, but 10% to 20% of cases require endoscopic or surgical intervention. CT may be indicated to evaluate for complications such as a perforation or abscess. Oral contrast is generally not recommended. Thin fish or chicken bones, plastic, wood, and thin pieces of aluminum (eg, soft drink tabs) are notoriously difficult to visualize on x-ray; such objects frequently require diagnostic CT or endoscopy. Plastic bag clips, which are invisible on both x-rays and CT, are associated with high morbidity due to their sharp edges and irregular shape. Negative x-rays do not rule out a FB if clinical suspicion remains.

Cases that do not meet the criteria for endoscopic retrieval should be followed with serial imaging to confirm passage of the FB. Endoscopic removal is contraindicated for ingested drug packets due to the risk of rupture. These patients can be monitored, but surgical intervention is required if symptoms of obstruction or toxidrome develop.

Aspirated FBs are prevalent in children between the ages of 1 and 2 years. Unstable patients and those with severe symptoms should undergo immediate bronchoscopy or laryngoscopy. If the patient is stable, a two-view chest radiograph should be obtained; however, false negatives are common. Further workup can include fluoroscopy to evaluate for diaphragmatic asymmetry or bronchoscopy. Specialized views

(eg, expiratory or lateral decubitus radiographs) may be helpful.

Inserted rectal FBs often present as rectal or abdominal pain, bleeding, or incontinence, and can have a delayed presentation due to patient embarrassment. Two-view screening radiographs should be obtained prior to a digital rectal examination to protect providers from sharp injury. An upright chest x-ray can evaluate for perforation. CT imaging can be obtained if the FB is radiolucent or to evaluate for an abscess. A water-soluble contrast enema is helpful for detecting perforation or fistula. Rectal FBs can usually be removed transanally. Predictors of removal failure include objects that are larger than 10 cm, hard, sharp, located in the sigmoid colon, or retained for more than 2 days. Post-extraction x-rays should be used to evaluate for retained FBs or perforation.

## KEY POINTS

- Negative x-rays do not rule out FBs. Even objects made of the same material can differ in detectability, depending on the patient's habitus and the density, size, and location of the FB.
- Beware of ingested button batteries in the esophagus, bread bag clips, and magnets anywhere in the GI tract — all of which are associated with severe morbidity and mortality.
- Aspirated FBs are often radiolucent. If patients are unstable, proceed immediately to bronchoscopy or laryngoscopy.



# Can You Multitask?



## Evidence and Limitations of Task Switching and Multitasking in Emergency Medicine

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Skaugset LM, Farrell S, Carney M, et al. *Ann Emerg Med.* 2016;68:189-195.

**Emergency medicine physicians face frequent clinical interruptions and, therefore, must be proficient at task switching, a skill that enables one to shift between two discrete activities.** This skill is different than multitasking, which requires the simultaneous performance of two separate tasks. When an interruption leads to task switching, the primary task is less likely to be completed, which can increase the risk of errors. Consequently, it is important to be cognizant of these interruptions and the physician's response to them.

Memory consists of both working/short-term and long-term memory. While long-term memory is focused on unlimited, stored information, working memory is capable of processing only a finite amount of new information (depending upon the cognitive load inherent in completing a particular action). In particular, short-term memory is strained under the cognitive load of frequent or competing interruptions.

Multitasking requires the two tasks to be automated and solidified in our long-term memory (eg, walking and talking), where each is performed almost subconsciously. However, many activities performed in the emergency department, especially by more novice physicians, require deliberate attention — and therefore use working memory.

To accommodate interruptions during these tasks, physicians must utilize task switching. This leads to potential errors by increasing the time it takes to finish an action, decreasing quality, and preventing completion of the primary task.

To minimize the errors that result from interruptions, focus should turn to improving task switching at the level of the individual provider, and globally optimizing the emergency department environment. Physicians can prioritize tasks according to acuity, and establish methods to redirect or prevent interruptions during high-risk situations. Cognitive load can be mitigated through continued education and deliberate practice. By increasing proficiency in procedural skills and clinical knowledge, tasks ultimately will be stored in long-term memory, allowing physicians to multitask in situations where they otherwise would have had to task switch.

Environmental interventions should focus on minimizing distractions in the workspace and improving situational awareness. Interprofessional teams can work to create a consensus about the circumstances in which interruptions are acceptable, and provide feedback when unnecessary intrusions occur. Hospital policies or systems can further offload responsibilities to decrease interruptions. Electronic medical record

optimization, including common order sets, alert minimization, and standard documentation cues, also can decrease cognitive load. Finally, the physical space can be designed to clearly label quiet spaces in which staff can complete critical work with minimal distractions.

### KEY POINTS

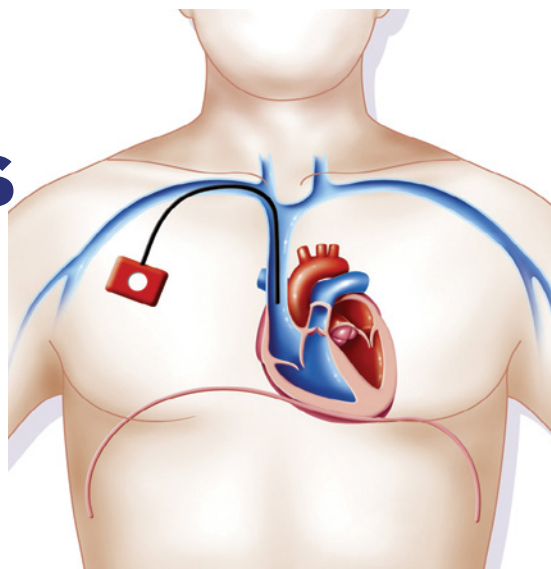
- Emergency physicians face numerous interruptions that necessitate frequent task switching. These distractions can increase the risk of errors, decrease the likelihood of task completion, and compromise the quality of work.
- Task switching is the shifting between two discrete tasks. This skill is in contrast to multitasking, which is the simultaneous performance of two separate tasks.
- To reduce the risks of task switching, a clinician can improve his or her skills through deliberate practice, which can decrease the cognitive load of certain tasks and move them into long-term memory.
- To minimize interruptions and the need to task switch, changes should be made to optimize the work environment and electronic medical records.

# Complications of Central Venous Catheterization

By Paul S. Jansson, MD, MS; and Susan R. Wilcox, MD

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Parietti J-J, Mongardon N, Mégarbane B, et al. Intravascular Complications of Central Venous Catheterization. *N Engl J Med*. Sep 2015;373(13):1220-1229.



**The placement of a central venous catheter (CVC) or “central line” is a core skill of emergency physicians and plays an important role in the resuscitation and ongoing care of the critically ill.**

Traditionally, three sites of CVC placement routinely have been used: the internal jugular vein, subclavian vein, and femoral vein, each of which carries its own risks, including mechanical issues such as inadvertent arterial cannulation or pneumothorax, central line-associated blood stream infections (CLABSI), and deep vein thrombosis (DVT).

The 3SITES Study attempted to evaluate CVC-related complications by insertion site in 10 intensive care units (ICUs) in France. Adult ICU patients who required catheterization were eligible for inclusion in the study. If more than one site of venipuncture was judged to be appropriate, the site was randomly assigned on a 1:1 (if two sites were appropriate) or 1:1:1 (if all three sites were appropriate) basis; patients for whom only one site was acceptable were excluded.

Insertion of the central line was conducted or supervised by physicians who had performed more than 50 previous placements, and followed a checklist and utilized maximal sterile barrier precautions. Chest x-rays were performed immediately after insertion

for internal jugular and subclavian vein cannulation to assess for line location and pneumothorax.

The primary outcomes were the incidence of major complications, defined as CLABSI or symptomatic DVT. CLABSI was diagnosed if the culture of both the catheter tip and peripheral blood shared the same microorganism. Symptomatic DVT was diagnosed using compression ultrasonography. The secondary outcome was the rate of major mechanical complications, including pneumothorax and asymptomatic DVT. Out of 7,559 possible catheter insertions, 3,471 insertions on 3,027 patients were included on an intention-to-treat comparison.

CLABSI or symptomatic DVT was rare overall, with 50 primary events occurring during the study period. The subclavian site had a statistically smaller complication rate (8 events) when compared to both the jugular and femoral sites (20 and 22 events, respectively,  $p = 0.02$ ).

Mechanical complications or asymptomatic DVT also were rare, with 36 major problems occurring during the study period. The femoral site had the fewest complications (6), followed by the jugular (12, 4 of which were pneumothorax) and the subclavian (18, 13 of which were pneumothorax;  $p = 0.047$ ). While the

femoral site resulted in significantly fewer complications than the subclavian ( $p = 0.03$ ), the other comparisons failed to reach statistical significance. However, outcome data for asymptomatic DVT was missing for 59% of the patients, limiting the analysis.

The risk of primary and secondary complications was nearly equal across all insertion sites. However, the authors advise clinicians to consider the expected duration of catheter placement when choosing a site; the risk of infectious and thrombotic events rises with prolonged catheterization, while the risks associated with line placement do not.

## KEY POINTS

- The subclavian site had the lowest rate of central line-associated blood stream infections or symptomatic DVT when compared to both the jugular and femoral sites.
- The subclavian site had the highest rate of major complications (typically pneumothorax) when compared to both the jugular and femoral sites.
- When selecting a site for CVC placement, clinicians should consider patient-specific factors and the anticipated duration of the central line, as the risks of CLABSI and DVT increase with time.



# Elder Abuse

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Lachs MS, Pillemer KA. Elder abuse. *N Engl J Med*. 2015;373(20):1947-1956.

**Although the emergency department diagnosis of elder abuse remains elusive, it has important implications for both health care professionals and patients.**

Previous national surveys estimate that elder abuse affects approximately 9% to 10% of the United States population; however, because these figures rely on self-reporting and exclude individuals who cannot reliably participate, they likely underestimate the magnitude of the problem. In addition to acute injuries, victims are at increased risk of death, hospitalization, and placement in a nursing home. In addition, the long-term effects of elder abuse include increased rates of depression and anxiety.

Although the definition of elder abuse has been much debated and continues to adapt, a consensus has arisen about the inclusion of five major types.

- **Physical abuse:** Acts carried out with the intention to cause physical pain or injury
- **Psychological or verbal abuse:** Acts carried out with the aim of causing emotional pain or injury
- **Sexual abuse:** Nonconsensual sexual contact of any kind
- **Financial exploitation:** Misappropriation of an older person's money or property
- **Neglect:** Failure of a designated caregiver to meet the needs of a dependent older person

As with any disease state, clinicians should consider a number of risk factors that may increase or decrease the likelihood of elder abuse, including:

- A "younger" older adult (increased likelihood of living with a spouse or adult children)
- Shared living environment
- Low income
- Lack of social support

Aside from dementia, no specific conditions or diseases have been identified as conferring a greater danger of abuse. Chronic disease and functional limitations, however, are risk factors, regardless of the specific cause. Unfortunately, many chronic conditions place patients at risk for a wide variety of associated problems such as falls, fractures, skin breakdown, and bruising, just to name a few.

Although it can be extremely challenging to identify victims of abuse, emergency physicians are in a unique position to recognize and intervene on behalf of this vulnerable population. There are strategies and services that can help providers assess and intervene if necessary. Potential victims should be interviewed alone; it's important to understand that the relative caregiver may be the abuser, and patients may be hesitant to reveal mistreatment. Both direct questions (eg, "Do you feel safe at home?") and indirect questions (eg, "Has someone not helped you when you needed

help?") can be used as screening tools. In every state but New York, even *suspected* cases of elder abuse must be reported to Adult Protective Services (APS).

There have been no large-scale randomized trials focused on interventions for elderly victims of abuse; therefore, recommendations are based on suggested best practices. The most promising response to this problem has been the development of multidisciplinary teams consisting of physicians, social workers, law-enforcement personnel, and community workers. Emergency department screening may be the first step in identifying these victims and enacting a multidisciplinary response, which can improve efficiency, coordination, and professional patient support.

## KEY POINTS

- The prevalence of elder abuse among emergency department patients may be higher than 10%.
- Older adults are susceptible to many types of maltreatment, including neglect, and physical, emotional, sexual, financial abuse.
- Physicians are mandated to report elder abuse to APS in every state, except New York.
- A multidisciplinary approach appears to be the best strategy for successful intervention.

# Spontaneous Intracerebral Hemorrhage

By Rachel Harper, MD; and Laura Welsh, MD  
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Hemphill JC, Greenberg SM, Anderson CS, et al. Guidelines for the management of spontaneous intracerebral hemorrhage. *Stroke*. 2015;46(7):2032-2060.



**In the past several years, considerable research advancements have been made in the management of patients with intracerebral hemorrhage (ICH).** Importantly, improvements in care can directly impact morbidity and mortality. The 2015 American Heart Association (AHA)/American Stroke Association (ASA) guidelines for the management of spontaneous ICH, an update to the 2010 recommendations, provide evidence-based guidance for treating these critically ill patients.

Upon presentation to an appropriate stroke center, a rapid noncontrast computed tomography (CT) scan should be obtained in any patient for whom ICH is considered (*level A recommendation*). Other imaging studies such as CT angiography and magnetic resonance imaging can be used to detect the patient's risk for hematoma expansion or evaluate for underlying vascular lesions. Because many patients experience neurological decompensation in the first few hours, a baseline severity score, calculated using diagnostic tools such as the National Institutes of Health Stroke Scale or ICH score also should be obtained early.

No predictive model is recommended for use in the emergency department to forecast an ICH patient's clinical prognosis or help families make care decisions. Instead, early aggressive

treatment always should be initiated, and any decisions about withdrawal of care should be put off until the second full day of hospitalization (*level B recommendations*).

The acute medical treatment of ICH focuses on the correction of hemostatic abnormalities and blood pressure control. In patients taking vitamin K antagonists, prothrombin complex concentrates (PCC) can reverse coagulopathy within minutes and may have fewer side effects than fresh frozen plasma (FFP), which requires higher transfusion volumes and has a longer time of action (*level B recommendation*). Intravenous vitamin K also should be administered; however, due to its slow peak of action, this supplement alone is insufficient for primary coagulopathy reversal.

While recombinant factor VIIa (rFVIIa) can rapidly normalize the international normalized ratio, it does not replace all necessary factors and is not recommended (*level B recommendation*). There is limited data on the reversal of newer anticoagulants, including dabigatran, rivaroxaban, and apixaban; however, PCC and rFVIIa can play roles in the reversal of these agents. Dabigatran alone may respond to dialysis (*level C recommendation*).

Elevated blood pressures are common in such cases and are associated with worse outcomes. For patients with an initial blood pressure between 150 mm Hg

and 220 mm Hg, a rapid reduction in blood pressure to a goal of 140 mm Hg is safe (*level A recommendation*) and can improve functional outcomes (*level B recommendation*). Starting blood pressures above 220 mm Hg should be lowered, but data regarding targets and safety are not available (*level C recommendation*).

## KEY POINTS

- Although a baseline severity score should be calculated for any patient with ICH, no predictive model is recommended for forecasting a clinical prognosis or helping families make care decisions in the emergency department.
- Patients taking vitamin K antagonists should receive intravenous vitamin K supplementation and replacement of vitamin K-dependent factors. PCCs can reverse anticoagulation quickly and with fewer side effects.
- Correcting hypertension to a systolic blood pressure goal of 140 mm Hg can help prevent recurrent ICH and is associated with improved functional outcomes.
- Surgical evacuation is recommended for patients with cerebellar hemorrhage, but its utility in supratentorial hemorrhage is not well established.



Intracranial pressure (ICP) monitoring is recommended for any patient with a low Glasgow coma scale (GCS) score (*level B recommendation*). In addition, anyone with a GCS below 8, signs of herniation, or a large ICH should be treated with a goal coronary perfusion pressure of 50 mm Hg to 70 mm Hg (*level C recommendation*). Although corticosteroids are not recommended for the treatment of elevated ICP, ventricular drainage may be indicated (*level B recommendation*).

There currently is insufficient evidence to support minimally invasive clot removal, aspiration, or the use of intraventricular thrombolytics (*level B recommendation*). For surgical evacuation, guidelines are driven by the location of the hemorrhage and the patient's condition. Those with cerebellar hemorrhage accompanied by clinical deterioration or evidence of hydrocephalus should undergo emergent surgical removal of the hemorrhage (*level C recommendation*). The benefits of surgical evacuation are not well established in cases of supratentorial ICH (*level A recommendation*).

After the initial resuscitation, care should focus on the prevention of secondary brain injury. As many as 16% of patients with ICH show signs of clinical seizure activity; this complication should be treated with antiseizure medication (*level A recommendation*). However, prophylactic antiseizure therapy has not demonstrated a benefit and may be associated with increased death and disability (*level B recommendation*). Fever should be treated, and both hyper- or hypoglycemia should be avoided (*level C recommendation*).

Additional treatments should focus on reducing the medical complications of ICH. Comprehensive stroke care should include a screening for myocardial ischemia with cardiac enzymes and an electrocardiogram (ECG); as many as 20% of these patients will have elevated cardiac enzymes within 24 hours of presentation. To reduce the risk of aspiration pneumonia, all patients should undergo a formal screening for dysphagia prior to any oral intake (*level B recommendations*). Finally, these patients necessitate admission to an inpatient unit with neuroscience acute care expertise.

**TABLE 1. Integral Components of the History, Physical Examination, and Workup of the Patient with ICH**

History	Comments
Time of symptom onset (or time the patient was last normal)	
Initial symptoms and progression of symptoms	
Vascular risk factors	History of stroke or ICH, hypertension, diabetes mellitus, and smoking
Medications	Anticoagulant drugs, antiplatelet agents, antihypertensive medications, stimulants (including diet pills), sympathomimetic drugs
Recent trauma or surgery	Carotid endarterectomy or carotid stenting (ICH may be related to hyperperfusion after such procedures.)
Dementia	Associated with amyloid angiopathy
Alcohol or illicit drug use	Cocaine and other sympathomimetic drugs are associated with ICH, stimulants
Seizures	
Liver disease	May be associated with coagulopathy
Cancer and hematological disorders	May be associated with coagulopathy
Physical Examination	
Vital signs	
A general physical examination focusing on the head, heart, lungs, abdomen, and extremities	
A focused neurological examination	A structured examination such as the National Institutes of Health Stroke Scale can be completed in minutes and provides a quantification that allows easy communication of the severity of the event to other caregivers. GCS score is similarly well known and easily computed.
Serum and Urine Tests	
Complete blood count, electrolytes, blood urea nitrogen and creatinine, and glucose	Higher serum glucose is associated with worse outcomes.
Prothrombin time (with international normalized ratio) and an activated partial thromboplastin time	Warfarin-related hemorrhages are associated with an increased hematoma volume, greater risk of expansion, and increased morbidity and mortality.
Cardiac-specific troponin	Elevated troponin levels are associated with worse outcomes.
Toxicology screen to detect cocaine and other sympathomimetic drugs of abuse	Cocaine and other sympathomimetic drugs are associated with ICH.
Urinalysis and urine culture, as well as a pregnancy test in women of childbearing age	
Other Routine Tests	
Neuroimaging	CT or MRI; consider contrast-enhanced or vascular imaging.
ECG	To assess for active coronary ischemia or prior cardiac injury; ECG abnormalities can mark concomitant myocardial injury.

Adapted from AHA/AHS Guidelines for the Management of Spontaneous Intracerebral Hemorrhage.



# Managing Suicidal Patients

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Betz ME, Boudreaux ED. Managing suicidal patients in the emergency department. *Ann Emerg Med*. 2016 Feb;67(2):276-282.

**As many as 8% of all emergency department patients report recent suicidal ideations.** Clinicians can use a suicide risk stratification tool to identify those who are most vulnerable. The intent to self-harm is not always readily admitted, however, so patients at risk should be appropriately screened. The evaluation should be conducted only in those who are sober and have a capacity for decision-making. Preliminary risk stratification contains questions about plan, intent, past attempts, mental health history, substance abuse, and issues with irritability or agitation. Example questions include:

- Have you been thinking about how you might kill yourself recently?
- Do you intend to kill yourself?
- Have you ever tried to kill yourself?
- Have you ever been treated for mental health problems?
- Has drinking or drug use been a problem for you?
- Have you been feeling anxious or agitated recently?

Patients who answer “no” to all of the above questions may not need further psychiatric assessment and can be discharged with a careful outpatient follow-up plan. A “yes” answer to any of the above questions warrants a comprehensive risk assessment with a mental health specialist (eg, psychiatrist, psychologist, or social

worker). From there, inpatient admission may be warranted.

In the absence of a specialist, an emergency provider can perform a more thorough assessment using a tool such as the Suicide Assessment Five-Step Evaluation and Triage (SAFE-T) protocol. This includes, but is not limited to, the identification of risk factors (psychiatric history, prior suicide attempts, substance use, family history, stressors), protective factors, suicide inquiry (ideation, plan, intent), determination of risk level (low risk can be addressed on an outpatient basis; high risk requires psychiatric assessment and likely admission), and documentation.

A number of quick, directed interventions can be quite impactful. These include patient education (instilling hope, reducing shame and stigma, providing clear follow-up and return instructions), safety planning (creating a structured plan with the patient, including coping strategies and people to contact), lethal means counseling (reducing access to guns, toxic medications, etc.), rapid referral (arranging for follow-up within 7 days), and identifying a social safety net (communicating with family and other providers regarding the visit).

Finally, it is crucial to establish a therapeutic alliance. This can be done by communicating directly, expressing empathy, explaining the anticipated

course of emergency department treatment, and providing basic comforts. Attempts at verbal de-escalation should be made before resorting to chemical or physical restraints. High-risk patients should be protected from self-harm; dangerous objects should be removed; and the patient should be observed closely and prevented from leaving without psychiatric clearance. As with any case, a focused medical evaluation should be performed to assess for problems that may be contributing to the patient's psychiatric complaints.

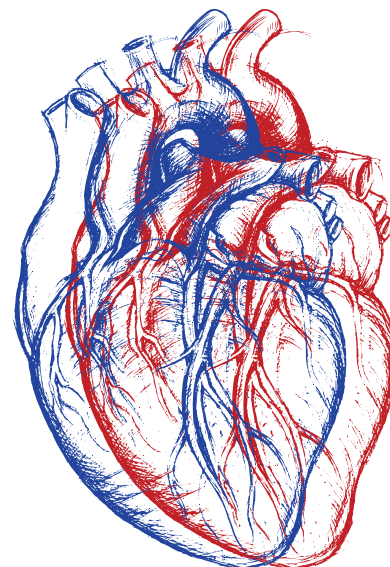
## KEY POINTS

- Not every patient with suicidal ideations requires a comprehensive psychiatric consultation in the emergency department. The proper use of validated screening and risk stratification tools, including the SAFE-T, can help identify the small subset of patients at high risk for suicide.
- Patients with suicidal thoughts represent an extremely vulnerable population that benefits from a therapeutic alliance, empathy, and open communication.
- High-risk signs include suicidal intention, having a plan, previous attempts, alcohol or drug use, psychiatric history, and recent anxiety, irritability, or aggression.

# Early Discharge for Acute Chest Pain

By Jason Fleenor, MD, LT; and Daphne Morrison Ponce, MD, LCDR  
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Mahler SA, Riley RF, Hiestand BC, et al. The HEART Pathway randomized trial: identifying emergency department patients with acute chest pain for early discharge. *Circ Cardiovasc Qual Outcomes*. 2015 Mar;8(2):195-203.



Physicians frequently use clinical guidelines to rule out acute coronary syndrome (ACS) in low-risk patients who present to the emergency department. This can contribute to excessive spending and unnecessary invasive testing. One such decision tool, the HEART Pathway, is designed to identify patients who may be safe to discharge early without undergoing additional cardiac tests (eg, stress testing, angiography, etc.). The pathway combines criteria from the HEART score with 0- and 3-hour troponin measurements.

A single-center randomized control trial analyzed if use of the HEART Pathway reduced cardiac testing, increased rates of early discharge, and shortened the index length of stay (LOS), while maintaining high sensitivity and negative predictive value (>99%) for major adverse cardiac events (MACE). The data was compared with usual care (per American College of Cardiology guidelines) and assessed at 30 days via phone interviews and/or record reviews.

Enrolled participants were at least 21 years old (mean age 53 years). Factors that negated participation included an ST-elevation greater than 1 mm, hypotension, a life expectancy of less than 1 year, a noncardiac condition that resulted in admission, or previous study enrollment. Eligible participants ( $n = 282$ ) were stratified by their known history of coronary artery disease and equally randomized into one of two treatment arms, either the HEART Pathway ( $n = 141$ ) or usual care ( $n = 141$ ).

	Objective Testing	Early Discharge	Median LOS	MACE
HEART Pathway	56.7%	39.7%	9.9 hours	5.7%
Usual care	68.8%	18.4%	21.9 hours	6.4%
P-value	0.048	<0.001	0.013	1

Patients with a HEART score of 0-3 and negative troponins (low-risk, 46.8%) were identified for early discharge and urged to follow up with their primary care physicians. Objective cardiac testing or a cardiology consultation was recommended for high-risk (53.2%) patients with a score of 4 or above. Admission was recommended for those with troponin levels above the 99th percentile. Ultimately, however, providers used their own discretion to determine the appropriate treatment for each patient. In some cases, nonadherence to the HEART Pathway was expected. Usual care consisted of serial troponin and objective cardiac testing on all patients with symptoms suggestive of ACS.

Differences in repeat cardiac-related emergency visits and nonindex hospitalizations were not significant ( $p = 0.75$  and  $>0.99$ , respectively). All MACE occurred at the index visit; no patients identified for early discharge or in the low-risk HEART Pathway experienced a major cardiac event within 30 days. The 10 patients who were lost to follow-up were assumed to be negative for MACE after a review of the Social Security Death Master File.

Nonadherence to the HEART Pathway occurred in 29% of low-risk

cases and 13% of high-risk cases. None of the low-risk patients in this group suffered MACE. Perfect adherence to the HEART Pathway would have resulted in a 46.8% early discharge rate compared to 39.7%. Overall, the study demonstrated a reduction in the use of the tool and a shorter length of stay, without an increase in the MACE rate. The combined use of serial troponin measurements and the HEART Pathway demonstrated a high sensitivity for the detection of MACE at 30 days in patients presenting with chest pain.

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## KEY POINTS

- The HEART Pathway is a clinical tool that can significantly reduce health care utilization and costs.
- Use of the HEART Pathway does not appear to increase the likelihood of a missed MACE.



# Venous Thrombosis in Pregnancy

By Eric Vaught, MD, MC, LT; and Daphne Morrison Ponce, MD, LCDR  
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Greer IA. Pregnancy complicated by venous thrombosis. *N Engl J Med*. 2015 Aug 6;373(6):540-547.

**Venous thromboembolism (VTE), which includes deep vein thrombosis (DVT) and pulmonary embolism (PE), is the leading cause of morbidity and mortality in pregnant women in the developed world.**

Although the absolute incidence of VTE in pregnancy is 1 to 2 per 1,000, this risk is 5 times higher than in nonpregnant patients. Most VTEs during pregnancy occur within the first 20 weeks of gestation, but the overall incidence is greatest during the first 6 weeks postpartum. DVTs in pregnant women are more likely to be in the left leg (85% in the left leg versus 55% in the right leg) and proximal in the iliofemoral region (72% proximal versus 9% distal). The strongest predictive risk factor is previous VTE in pregnancy. Other risk factors include venous stasis, immobilization, elevated BMI, and dehydration from emesis.

Suspected DVT is best assessed with serial compression duplex ultrasonography; one prospective study demonstrated a negative predictive value of 99.5%. If the initial ultrasound examination is negative but clinical suspicion remains high, it is safe to repeat the examination in 3 to 7 days with no interim anticoagulation

treatment. Iliocaval venous thrombosis is usually extensive and is often identified with compression ultrasonography; however, MRI or x-ray venography can be considered for evaluation if suspicion is high.

The majority of pregnant patients with PE also have DVT. A PE imaging workup can begin with the same compression ultrasound used for suspected DVT, as these two conditions often arise concurrently. If

a patient with PE symptoms has a DVT identified with ultrasound, no further imaging is needed and the diagnosis of PE can be made empirically. As in nonpregnant patients, clinical suspicion for PE should be heightened for those whose ECG shows sinus tachycardia or right heart strain.

Oxygen saturation is an unreliable diagnostic tool in pregnant or postpartum women. Similarly, D-dimer levels are not sensitive or

## KEY POINTS

- DVTs in pregnancy are more likely to be proximal and in the left leg. The diagnostic test of choice is serial compression duplex ultrasonography.
- If a DVT is identified in a patient with PE symptoms, no further imaging is needed, and empiric treatment should begin.
- VQ scans and CTPA have similar negative predictive values (100% and 99%, respectively). VQ scans emit a fetal radiation dose of 0.5 mGy, and CTPA emits a fetal radiation dose of 0.1 mGy. Both tests fall below the estimated level for teratogenesis and childhood cancer.
- CTPA can be used in patients with an abnormal chest x-ray or indeterminate VQ scan, or if there is concern for other etiologies.
- LMWH is the first-line treatment for VTE in pregnancy. There is no evidence to support an optimal dosing regimen for pregnant patients.
- Warfarin can be used in the postpartum period but should not be used in pregnant patients. Direct thrombin inhibitors and antifactor Xa inhibitors are contraindicated.
- Thrombolysis is indicated for the management of hemodynamically unstable PEs or for DVTs that threaten leg viability.



specific enough to aid in the diagnosis. There is limited clinical data to support the validity of the Modified Wells' Criteria for Pulmonary Embolism and LEfT clinical prediction tools (left leg >2-cm difference, edema, and first trimester) for diagnosing pregnant patients with VTE.

If further imaging is required to assess for PE, radiation exposure to the fetus must be minimized. It is estimated that 1 mGy of radiation exposure in utero increases the risk of fatal childhood cancer by 0.006%. Chest radiography emits more than 0.1 mGy of radiation; however, x-ray findings can have limited clinical utility in assessing for PE. Ventilation-perfusion (VQ) scans have a high negative predictive value and are commonly performed after a normal chest x-ray. Computed tomographic pulmonary angiography (CTPA) is useful if the VQ scan is indeterminate, or if other diagnoses are suspected.

Both tests minimize radiation to the fetus (CTPA = 0.1 mGy versus VQ scan = 0.5 mGy) and are well below the radiation threshold for teratogenesis. To further decrease radiation exposure, the ventilation portion of the VQ scan can be omitted without decreasing the negative predictive value. CTPA scans emit a maternal dose of 20 mGy to breast tissue, which is 20 to 100 times higher than VQ scan radiation; this risk can be mitigated with breast shields.

The treatment for VTE in pregnancy is low molecular-weight heparin (LMWH), which is more effective and has a better safety profile than unfractionated heparin in this patient population. Warfarin is contraindicated due to teratogenicity. The ideal dosing regimen for LMWH is unknown, and data is insufficient to support specific regimens in pregnant patients. Therefore, enoxaparin (either 1 mg/kg twice daily or 1.5 mg/kg once daily, based on either prepregnancy or current weight) is acceptable. Other appropriate dosing regimens include dalteparin (200 IU/kg once daily or 100 IU/kg twice daily) or tinzaparin (175 units/kg daily). There is no data to support

tracking antifactor Xa levels while a patient is taking LMWH.

LMWH should be stopped 24 hours before delivery or neuraxial anesthesia, and when labor starts or is suspected. Anticoagulation can be restarted 4 hours after delivery or after the epidural catheter has been removed. Anticoagulation is continued for at least 6 weeks postpartum (for a minimum total of 3 months). Warfarin may be used in the postpartum period. Oral direct thrombin inhibitors and antifactor Xa inhibitors should be avoided, as they cross the placenta and have adverse effects. Thrombolysis is reserved for life-threatening PEs with hemodynamic compromise or for DVTs

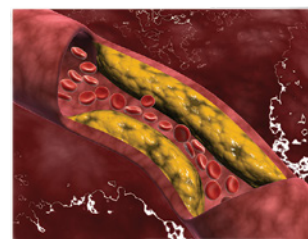
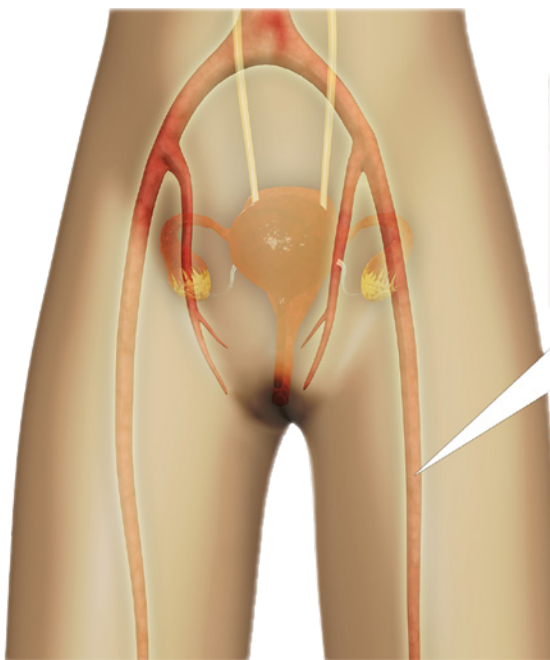
that are threatening leg viability. Caval filters can be used for recurrent PEs, despite adequate anticoagulation or if anticoagulation is contraindicated. Elastic compression stockings provide symptomatic relief only in patients with DVT.

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### Factors That Increase VTE Risk in Pregnant Patients



#### STASIS

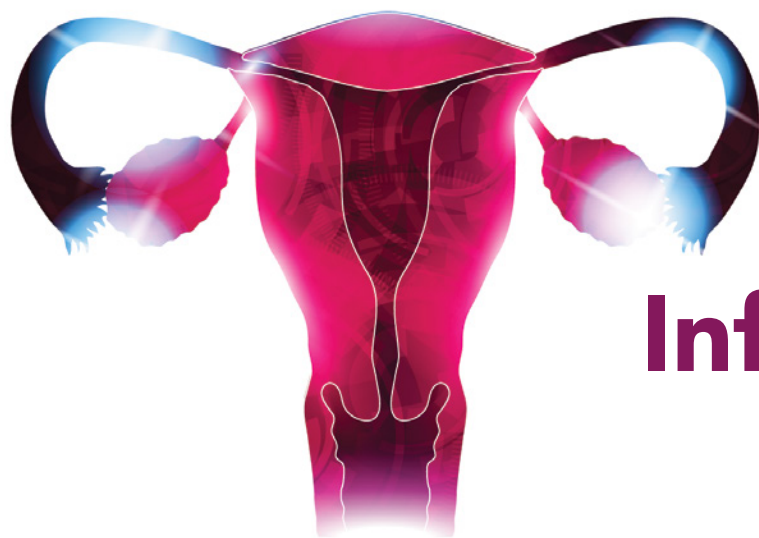
- Compression of iliac veins
- Right iliac artery over left iliac vein
- Gravid uterus
- Hormonally mediated vein dilation
- Immobilization

#### VASCULAR DAMAGE

- Vascular compression at delivery
- Assisted or operative delivery

#### HYPERCOAGULABLE BLOOD

- ↑ Procoagulant factors
  - ↑ Fibrogen, factor V, IX, X, and VIII concentrations
- ↓ Anticoagulant activity
  - ↓ Protein 5 concentration
  - ↑ Activated protein C resistance
- ↓ Fibrinolytic activity
  - ↑ PAI-1 and PAI-2 activity
  - ↓ tPA activity
- More thrombin generation
- Less clot dissolution



# Pelvic Inflammatory Disease

By Elizabeth Harmon, MD; and Laura Welsh, MD

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Brunham RC, Gottlieb SL, Paavonen J. Pelvic inflammatory disease. *N Engl J Med*. 2015 May 21;372(21):2039-2048.

**Pelvic inflammatory disease (PID) is an inflammatory disorder of the female upper-reproductive tract, including the endometrium, fallopian tubes, and ovaries.** The disease is caused by infection-induced inflammation that ascends from the vagina or cervix to the upper-genital tract.

Acute pelvic inflammatory disease (lasting  $\leq 30$  days) is most often caused by the sexually transmitted cervical pathogens *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, but *Mycoplasma genitalium* and bacterial vaginosis-associated pathogens are also common culprits. Approximately 15% of cases are caused by respiratory or enteric pathogens that colonize in the lower genital tract.

PID can be difficult to diagnose due to the wide variation in signs and symptoms, including lower abdominal pain, abnormal vaginal discharge, intermenstrual bleeding, and dyspareunia. The clinical diagnosis is based on findings of pelvic organ tenderness, including cervical motion tenderness, adnexal tenderness, or uterine tenderness, with associated signs of lower genital tract inflammation, such as cervical mucopurulent discharge or friability. Cervical or vaginal nucleic acid amplification tests for *N. gonorrhoeae* and *C. trachomatis* should be performed

on all patients with suspected PID. Ultrasonography can be helpful to identify an alternative diagnosis. However, while imaging might be specific in identifying thickened, fluid-filled fallopian tubes indicative of salpingitis, ultrasound lacks sufficient sensitivity.

The treatment of PID involves combination antibiotic regimens that empirically treat the likely pathogens; *N. gonorrhoeae* and *C. trachomatis* should always be covered. Outpatient regimens include a 2-week course of doxycycline and a one-time dose of a parenteral third-generation cephalosporin (eg, intramuscular ceftriaxone). Metronidazole can be added to this regimen to cover anaerobic pathogens. Indications for hospitalization include pregnancy, severe illness with the

inability to tolerate oral medications, or complications such as a tubo-ovarian abscess. Inpatient treatment involves doxycycline and a parenteral second-generation cephalosporin with anaerobic coverage (eg, cefoxitin or cefotetan), or a combination of clindamycin and gentamicin.

Long-term complications of PID include tubal infertility and an increased risk of ectopic pregnancy due to tubal epithelial inflammation, scarring, and adhesions. Short-term complications include tubo-ovarian abscesses and Fitz-Hugh-Curtis syndrome, a rare complication that causes liver capsule inflammation and adhesion formation. Early diagnosis and treatment is necessary to prevent both short-term and long-term complications of PID.

## KEY POINTS

- PID is caused by an ascending infection from the lower female genital tract to the endometrium, fallopian tubes, and pelvis.
- The most common causes of PID are *C. trachomatis* and *N. gonorrhoeae*; other culprits include bacterial vaginosis-associated anaerobes and respiratory or enteric pathogens.
- The clinical diagnosis is based on pelvic organ tenderness with cervical discharge or friability. Nucleic acid amplification tests for *N. gonorrhoeae* and *C. trachomatis* should be performed in all patients with suspected PID.
- Early treatment is essential to prevent both short- and long-term complications.



# Shared Decision Making

By Justin Boyle, AWS2; and Daphne Morrison Ponce, MD, LCDR  
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Hess EP, Grudzen CR, Thomson R, Raja AS, Carpenter CR. Shared decision-making in the emergency department: respecting patient autonomy when seconds count. *Acad Emerg Med*. 2015 Jul;22(7):856-864.

**Shared decision making (SDM) is the process by which collaborative health care choices are made by patients and their physicians.** Such decisions are based on both scientific evidence and each patient's individual values. Researcher Valerie Billingham famously summed up SDM at the 1998 Salzburg Global Seminar by coining the phrase "nothing about me without me." In other words, any decision made regarding the care of a patient must include input from the patient or his/her proxy.

Similarly, a survey conducted by the Picker Institute identified eight traits that can help reassure patients that they are in a safe, high-quality medical setting. SDM fulfills these specifically identified characteristics, including respect for patients' values, integration of care, communication and education, and involvement of friends or family. Although the approach has been embraced by emergency physicians, SDM can be challenging to implement in the fast-paced acute setting.

Shared decision making is typically described using the Charles et al conceptual framework, which describes three core components of SDM: *information exchange*, *deliberation*, and *choice*. The balance between these components

differentiates between three decision-making models (ie, paternalistic, shared, and informed), which must be tailored to each individual scenario.

Finally, Charles et al defines four criteria that must be present before SDM can be achieved:

1. At least two participants are involved.
2. Both participants share information.
3. Both participants work together to build a consensus.
4. An agreement on treatment is reached.

While other strategies might be appropriate in a given situation, they cannot satisfy the requirements of shared decision making without these key components.

In summary, shared decision making in the emergency department can help patients feel comfortable, informed, and involved in their own medical care. Emergency physicians should incorporate these important principles into their practice whenever possible.

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## KEY POINTS

- Shared decision making can be applied to both treatment and diagnostic decisions in the emergency department.
- Effective communication is key. Communication with patients, family, friends, and other physicians is crucial to creating a safe, effective, and smooth operation.
- SDM involves two parties who share information and work to build a consensus decision.
- SDM can occur with the patient or the patient's health care proxy.

# ACEP CLINICAL POLICY

## Well-Appearing Pediatric Patients With Fever

By Michelle Caskey, MD, LT; and Daphne Morrison Ponce MD, LCDR  
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American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Pediatric Fever, Mace SE, Gemme SR, et al. Clinical policy for well-appearing infants and children younger than 2 years of age presenting to the emergency department with fever. *Ann Emerg Med.* 2016 May;67(5):625-639.

- ✓ Fever is generally defined as a rectal temperature  $\geq 38^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ).
- ✓ Fevers include temperatures measured at home within the past 24 hours.
- ✓ Try to verify the accuracy of temperatures taken at home.
- ✓ Check the patient's immunization status. Children are not considered fully immune for 6 days after vaccination.
- ✓ Consider parent reliability and access to follow-up care for children considered medically safe for discharge.

**Fortunately, the majority of children who present to the emergency department with a fever will have a benign, self-limiting disease course.**

However, it is important to remember that clinically well-appearing pediatric patients can be masking serious bacterial infections (SBIs). Research indicates that nearly 50% of children with SBIs appear well, a presentation that gives weight to the term *occult* bacteremia.

The management of young children with fever historically has been guided by clinical decision aids. Current vaccination schedules, however, have altered the pretest probability of an SBI; as such, the approach to this population must be adjusted. The American College of Emergency Physicians (ACEP) Clinical Policy has outlined the approach to well-appearing, immunocompetent infants and young children (2 months–2 years old) with specific attention paid to four clinical questions.

**TABLE 1. Common Pathogens Causing Bacteremia, UTIs, or Meningitis**

Organism	Blood N (%)	Urine N (%)	CSF N (%)
<b>Gram Negative</b>	>100 bpm	>90 bpm	>90 bpm
<i>Escherichia coli</i>	78 (60)	719 (87)	7 (34)
<i>Klebsiella</i> sp.	3 (2)	34 (4)	1 (6)
<i>Salmonella</i> sp.	3 (2)	0 (0)	0 (0)
<i>Enterobacter</i> sp.	0 (0)	17 (2)	0 (0)
<b>Gram Positive</b>			
Group B <i>Streptococcus</i>	23 (18)	4 (0.5)	6 (27.5)
<i>Staphylococcus aureus</i>	8 (6)	0 (0)	0 (0)
<i>Enterococcus</i> sp.	3 (2)	17 (2)	0 (0)
<i>Streptococcus pneumoniae</i>	3 (2)	0 (0)	2 (12.5)

Greenhow TL, Hung YY, Herz AM, Losada E, Pantell RH. The changing epidemiology of serious bacterial infections in young infants. *Pediatr Infect Dis J.* 2014 Jun;33(6):595-599.





### **What clinical predictors can help identify patients at risk for urinary tract infections (UTIs)?**

The most common SBI in children younger than 24 months is a UTI. Of note, the presence of a viral illness does not preclude the presence of a bacterial UTI. Based on expert consensus, physicians should consider a urinalysis and urine cultures to identify infections in this population, especially in high-risk patients (eg, females <12 months old; uncircumcised males; non-black patients; and those with a fever >24 hours, a high fever (39°C [102°F]), negative viral respiratory testing, and no other obvious source of infection).



### **Which laboratory studies should be used to diagnose UTIs?**

The preliminary diagnosis of a UTI can be confirmed by one of the following laboratory tests: a leukocyte count, a Gram stain, the presence of leukocyte esterase, or the presence of nitrites. A urine culture should be used to make a definitive diagnosis. Leukocyte esterase has a higher sensitivity, while nitrites have a higher specificity. Leukocyte esterase also has a high specificity with specimens obtained via catheterization. Higher leukocyte counts correlate with higher positive predictive values.

Expert consensus emphasizes that a urine culture should be obtained when a UTI is suspected, even in the presence of a negative urinalysis. One retrospective review revealed that 30% of children with a positive culture had a negative urinalysis. In addition, a positive bag urinalysis can have a false-positive rate as high as 85%. Any positive urinalysis should prompt a urine culture via catheterization to ensure adequate antibiotic coverage.



### **What clinical predictors can help identify patients at risk for pneumonia, and when should a chest radiograph be obtained?**

The signs and symptoms of pneumonia include cough, hypoxia, rales, a high fever (39°C [102.2°F]), a history of fever for longer than 48 hours, and tachycardia or tachypnea out of proportion to the fever. When no obvious source of infection can be found, a chest radiograph should be obtained in any child presenting with one or more of these risk factors. A general rule of thumb is to allow an increase in heart rate of 10 beats per minute for every 1 degree Celsius of fever, but this guideline can vary widely when managing infants.

Chest x-rays are not recommended for infants who present with a fever and wheezing or have a high clinical likelihood of bronchiolitis. The presence of wheezing, stridor, or an abnormal ear/nose/throat examination reduces the likelihood of bacterial pneumonia.



### **What factors can put full-term infants (29-90 days old) at risk for meningitis, and when should cerebrospinal fluid be obtained?**

Although the data are unclear, experts agree that lumbar puncture (LP) should be considered. If a viral illness is diagnosed, it is reasonable to delay the LP; however, empiric antibiotics should be withheld unless another bacterial illness is diagnosed. The patient must be admitted, receive close clinical follow-up care, or return to the emergency department for a recheck.

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## **KEY POINTS**

- Infants with SBIs will be well-appearing almost 50% of the time. This ambiguity can cause significant provider anxiety regarding testing and disposition.
- The pretest probability of an SBI based on age and risk factors can safely guide appropriate testing.
- Regardless of age, children who are toxic or ill-appearing should always undergo emergent resuscitation and a comprehensive workup.
- Chest x-rays are not recommended for infants who present with a fever and wheezing or have a high clinical likelihood of bronchiolitis.