

## Part 13: First Aid

### 2010 American Heart Association and American Red Cross International Consensus on First Aid Science With Treatment Recommendations

David Markenson, Co-Chair\*; Jeffrey D. Ferguson, Co-Chair\*; Leon Chameides; Pascal Cassan; Kin-Lai Chung; Jonathan L. Epstein; Louis Gonzales; Mary Fran Hazinski; Rita Ann Herrington; Jeffrey L. Pellegrino; Norda Ratcliff; Adam J. Singer; on behalf of the First Aid Chapter Collaborators

**Note From the Writing Group:** Throughout this article, the reader will notice combinations of superscripted letters and numbers (eg, “Dilution with Milk or Water<sup>FA-202A</sup>”). These callouts are hyperlinked to evidence-based worksheets, which were used in the development of this article. An appendix of worksheets, applicable to this article, is located at the end of the text. The worksheets, co-copyrighted by the American Heart Association and American Red Cross, are available in PDF format and are open access.

The American Heart Association (AHA) and the American Red Cross cofounded the National First Aid Science Advisory Board in order to review and evaluate the scientific literature on first aid in preparation for the 2005 Consensus on Science and Treatment Recommendation document.<sup>1</sup> In preparation for the 2010 process, the National First Aid Science Advisory Board was broadened into an International First Aid Science Advisory Board with inclusion of representatives from a number of international first aid organizations (Table).

#### The Process

The International First Aid Science Advisory Board identified 38 questions in first aid practice that had not been subjected to an evidence review process or that needed to be updated since the 2005 process. Two or more members of the International First Aid Science Advisory Board volunteered to independently review the scientific literature and complete an evidence-based review worksheet summarizing the literature (see Part 2 of this supplement for additional information). After the evidence was presented to the full board, a draft consensus summary of the scientific evidence and a draft consensus treatment recommendation were developed and represented at a subsequent meeting. Thus, each question, evidence-based review, draft summary of science, and draft treatment recommendation was presented and discussed on 2 separate occasions, and a Consensus on Science

and Treatment Recommendation was reached by the Board. This document is a report of the group’s consensus.

As in 2005, the worksheets revealed the continuing paucity of scientific evidence to support specific first aid interventions. Very little research is being conducted in first aid, and most of the recommendations are extrapolations from research and experience in other medical venues, animal studies, and case series. It is hoped that this document will be a stimulus to future research in first aid.

#### First Aid for Medical Emergencies

##### Summary

The medical questions addressed include poisoning, anaphylaxis, oxygen administration, and aspirin administration for a suspected coronary event.

No changes were recommended for first aid management of acute poisoning.

In reviewing epinephrine administration for anaphylaxis, evidence was found that laypeople and some medical and prehospital professionals are unable to recognize the signs and symptoms of anaphylaxis and therefore cannot, without training, make an independent decision to administer epinephrine with an auto-injector or to administer a second dose if the first is not effective. This issue takes on added importance in view of legislation in some jurisdictions that permits these actions.

No evidence was found, except in decompression injuries, to support the routine administration of oxygen by first aid providers.

The administration of aspirin to a victim experiencing chest discomfort is problematic. The literature is clear on the benefit of early administration of aspirin in an acute coronary event, except when there is a clear contraindication, such as aspirin allergy or a bleeding disorder. Less clear, however, is whether first aid providers can recognize the signs and symptoms of an acute

The American Heart Association and the American Red Cross request that this document be cited as follows: Markenson D, Ferguson JD, Chameides L, Cassan P, Chung K-L, Epstein JL, Gonzales L, Hazinski MF, Herrington RA, Pellegrino JL, Ratcliff N, Singer AJ; on behalf of the First Aid Chapter Collaborators. Part 13: first aid: 2010 American Heart Association and American Red Cross International Consensus on First Aid Science. *Circulation*. 2010;122(suppl 2):S582–S605.

\*Co-chairs and equal first co-authors.

(*Circulation*. 2010;122[suppl ]:S582–S605.)

© 2010 American Heart Association, Inc., and American Red Cross.

*Circulation* is available at <http://circ.ahajournals.org>

DOI: 10.1161/CIRCULATIONAHA.110.971168

**Table. International First Aid Science Advisory Board Member Organizations**


---

American Academy of Pediatrics
American Burn Association
American College of Emergency Physicians
American College of Occupational and Environmental Medicine
American College of Surgeons
American Heart Association
American Pediatric Surgical Association
American Red Cross
American Red Cross Advisory Council on First Aid, Aquatics, Safety and Preparedness
American Safety and Health Institute
Austrian Red Cross
Canadian Red Cross
Divers Alert Network
Egyptian Red Crescent
European Reference Center for First Aid Education
French Red Cross
Grenada Red Cross
Hong Kong Red Cross
Hungarian Red Cross
International Federation of Red Cross and Red Crescent Societies
Medic First Aid
National Association of EMS Educators
National Association of EMS Physicians
National Athletic Trainers' Association
National Safety Council
Norwegian Red Cross
Occupational Safety and Health Administration
Red Cross Society of China
Resuscitation Council of Asia
St. John Ambulance, United Kingdom

---

coronary event or identify the contraindications to aspirin. Aspirin administration should never delay EMS activation.

## Poisoning

### *Dilution With Milk or Water*<sup>FA-202A</sup>

#### *Consensus on Science*

There are no human studies on the effect of treating oral caustic exposure with dilution therapy. One in vitro LOE 5 chemistry study<sup>2</sup> demonstrated no benefit from the addition of large volumes of diluent to either a strong base or a strong acid. Five LOE 5 animal studies<sup>3-7</sup> demonstrated histological benefit to the esophagus when a diluent was administered following exposure to an alkali or acid.

#### *Treatment Recommendation*

There is insufficient evidence for or against the administration of a diluent as a first aid measure for ingestion of a caustic substance.

#### *Knowledge Gaps*

Does the early administration of milk or water as compared to nothing by mouth improve outcome in patients with poisoning with caustic substances?

### *Syrup of Ipecac*<sup>FA-203B</sup>

#### *Consensus on Science*

Two LOE 2 studies<sup>8,9</sup> and 1 LOE 4 study<sup>10</sup> demonstrated no benefit to administering syrup of ipecac to a suspected poisoning victim. Two LOE 2 studies<sup>11,12</sup> demonstrated untoward effects, such as intractable emesis and delayed charcoal administration, when syrup of ipecac was given. One LOE 2 epidemiological study<sup>13</sup> showed that the administration of syrup of ipecac is not associated with decreased healthcare utilization.

#### *Treatment Recommendations*

Ipecac syrup should not be used by the lay public as a first aid treatment of acute poisoning.

#### *Knowledge Gaps*

What is the role of gastric emptying in poisoning treatment? How does the treatment outcome differ with and without stomach emptying?

### *Activated Charcoal*<sup>FA-201B</sup>

#### *Consensus on Science*

No evidence was found to suggest that activated charcoal is efficacious as a component of first aid for acute poisoning, although 2 small LOE 5 studies<sup>14,15</sup> suggest that it may be safe to administer. One LOE 3 study<sup>16</sup> demonstrated that the majority of children will not take the recommended dose of activated charcoal.

#### *Treatment Recommendation*

There is insufficient evidence to recommend for or against the administration of activated charcoal in a first aid setting.

#### *Knowledge Gaps*

Does the prehospital administration of charcoal by lay rescuers improve outcome? Does the administration of activated charcoal by a first aid provider cause harm?

## Anaphylaxis

### *Recognition of Anaphylaxis by First Aid Providers*<sup>FA-303B</sup>

#### *Consensus on Science*

Four LOE 4<sup>17-20</sup> and 3 LOE 5<sup>21-23</sup> studies documented the difficulty that first aid providers have in assessing and recognizing signs and symptoms of anaphylaxis. Evidence from 1 LOE 4 study<sup>24</sup> demonstrated that parents of children with multiple anaphylactic reactions can more accurately begin to recognize the signs and symptoms indicating the need for administration of an auto-injector, but with a lack of training and experience, they are unable to provide appropriate care.

#### *Treatment Recommendation*

First aid providers should not be expected to recognize the signs and symptoms of anaphylaxis without repeated episodes of training and encounters with victims of anaphylaxis.

#### *Knowledge Gaps*

How can a first aid provider determine that a witnessed allergic reaction needs epinephrine? Are there anaphylactic reactions that do not respond to epinephrine?

### *Second Dose of Epinephrine*<sup>FA-302A, FA-302B</sup>

#### *Consensus on Science*

One small, retrospective LOE 4 chart review,<sup>25</sup> 1 LOE 4 retrospective patient survey,<sup>26</sup> and 1 LOE 4 retrospective

chart review of children with food allergy<sup>27</sup> found that 12% to 36% of patients with anaphylactic reactions received a second dose of epinephrine because the first dose did not relieve symptoms. Two LOE 4<sup>28,29</sup> and 2 LOE 5 studies<sup>30,31</sup> documented adverse reactions, including fatalities, due to misdiagnosis of an anaphylactic reaction, inappropriate route of administration, or excessive doses of epinephrine. One LOE 3 retrospective study<sup>32</sup> demonstrated that 20% of anaphylactic reactions are biphasic, with a mean of 10 hours between 2 symptomatic episodes.

#### *Treatment Recommendation*

There is insufficient evidence for or against the routine first aid administration of a second dose of epinephrine.

#### *Knowledge Gaps*

How can a first aid provider determine that a victim needs additional epinephrine? What should the time interval be between doses of epinephrine? How often does someone with an anaphylactic reaction respond to a second dose of epinephrine if they did not respond to the first? Are anaphylactic reactions biphasic, and if so, how does that influence first aid measures?

### **Oxygen**<sup>FA-701A</sup>

#### *Consensus on Science*

There is no study that directly addresses the first aid use of oxygen for breathing difficulty or complaints of chest pain. In 1 large LOE 3 retrospective case study,<sup>33</sup> underwater divers experiencing decompression injury required fewer decompressions and had a greater likelihood of complete recovery if first aid included normobaric oxygen. One small LOE 4 case series<sup>34</sup> reported less ST-segment elevation in patients who received oxygen by face mask at 15 L/min and who were admitted to the CCU for acute transmural myocardial infarction than in those who did not receive oxygen. In 1 LOE 2 randomized controlled trial conducted before the introduction of reperfusion therapy<sup>35</sup> in 200 patients admitted to the hospital with a suspected acute myocardial infarction, there was no reduction in frequency of ventricular tachycardia or in mortality when oxygen was provided at 6 L/min for 24 hours. One LOE 2 systematic review<sup>36</sup> found no controlled trials (and only inpatient use) to support the routine use of oxygen for acute myocardial infarction patients. One LOE 2 systematic review<sup>37</sup> found no randomized controlled trials evaluating the benefit of oxygen therapy for acute exacerbation of chronic obstructive pulmonary disease (COPD) patients in the out-of-hospital setting.

#### *Treatment Recommendations*

There is no evidence for or against the routine use of oxygen as a first aid measure for victims experiencing shortness of breath or chest pain. Oxygen may be beneficial for first aid in divers with a decompression injury.

#### *Knowledge Gaps*

What is the risk to the victim of providing oxygen (ie, delay in EMS activation)? How does the outcome differ if oxygen is given by first aid providers to patients with chest pain, breathing difficulty, or other conditions?

### **Chest Discomfort – Aspirin Administration**<sup>FA-1204A, FA-1204B</sup>

#### *Consensus on Science*

Evidence from 2 large, randomized LOE 1 trials<sup>38,39</sup> clearly demonstrated that administration of aspirin within the first 24 hours of onset of chest discomfort in patients with acute coronary syndromes reduced mortality. Evidence from an LOE 3 retrospective registry<sup>40</sup> showed an association between early prehospital administration of aspirin and lower mortality in patients with acute myocardial infarction. There is evidence from an LOE 4 retrospective study<sup>41</sup> that prehospital administration of aspirin is safe. This study suggested that prehospital aspirin might facilitate early reperfusion and demonstrated the value of early aspirin administration during acute myocardial infarction.

#### *Treatment Recommendation*

Administration of aspirin is recommended for chest discomfort if the victim does not have an allergy, a recent episode of bleeding, or other contraindications to aspirin, but administration of aspirin should never delay activation of EMS.

#### *Knowledge Gaps*

Does administration of aspirin by first aid providers delay EMS involvement? Can first aid providers recognize contraindications to aspirin? What are the clinical results with treatment versus nontreatment with aspirin by first aid providers of patients with subsequently proven coronary events?

### **Positioning of Breathing but Unresponsive Victim**<sup>FA-2001A</sup>

#### *Consensus on Science*

There is no evidence that positioning an unresponsive, breathing victim in a recovery position (ie, lateral recumbent or **High Arm IN Endangered Spine [HAINES]** position) as compared to a supine position decreases complications. Most evidence comes from LOE 5 studies performed on responsive volunteers that compare the types of lateral positioning only. One LOE 5<sup>42</sup> and 1 LOE 4<sup>43</sup> study recommended the HAINES position for unresponsive persons with potential spinal cord trauma. Two LOE 5 studies<sup>44,45</sup> in healthy volunteers showed decreased dependent forearm perfusion and therefore a greater potential for nerve damage with the HAINES position. Four LOE 5 studies<sup>46–49</sup> supported the lateral recumbent recovery position because it was easier for the rescuer and more comfortable for the victim. One LOE 4<sup>50</sup> and 1 LOE 5<sup>51</sup> study compared the supine to a lateral position and concluded that there was no difference in heart rate variability or in risk for aspiration pneumonia.

#### *Treatment Recommendations*

There is no evidence that turning an unresponsive, spontaneously breathing victim into any side-lying versus a supine position is beneficial. If a person with a suspected cervical spine injury is turned to the side, the HAINES position appears to be safer than the lateral recumbent position.

#### *Knowledge Gaps*

What are the risks of any position for patients who are not responsive but breathing?

## Injury Emergencies

### Summary

Since the 2005 scientific review, new data have become available about the effect of tourniquets to control bleeding. This experience comes primarily from the battlefields of Iraq and Afghanistan. There is no question that tourniquets do control bleeding, but when tourniquets remain in place too long, reported complications include gangrene distal to the application, shock, and death. Protocols for the proper use of tourniquets to control bleeding exist, but there is no experience with civilian use or how to teach the proper application of tourniquets to first aid providers. Studies have shown that not all tourniquets are the same, and some manufactured tourniquets perform better than others and better than improvised ones. This issue will take on increasing importance in this age of terrorism and the possibility of mass casualties during disasters.

Because of its importance, the issue of spinal stabilization was once again reviewed. Unfortunately, very few new data are available, and it is still not clear whether and how often secondary spinal cord injury occurs and whether the methods that have been recommended for spinal stabilization or movement restriction are effective.

The literature on first aid for snake bites was once again reviewed. Previously, evidence supported pressure immobilization for neurotoxic snake bites, but it now appears that there is a benefit to application of pressure even for nonneurotoxic snake bites. The challenge is that the range of pressure used appears to be critical and may be difficult to estimate in the field.

A new section on jellyfish stings has been added, and new recommendations for treatment have been made.

### Optimal Position in Shock [FA-1601A, FA-1601C](#)

#### *Consensus on Science*

Evidence from 2 LOE 4<sup>52,53</sup> and 3 LOE 5<sup>54–56</sup> studies demonstrated that use of passive leg raising or the modified Trendelenburg position does not significantly increase mean arterial pressure or cardiac output over a period of 7 minutes.<sup>52</sup> Evidence from 2 LOE 4<sup>57,58</sup> and 2 LOE 5<sup>59,60</sup> studies demonstrated that passive leg raising can increase cardiac output and volume responsiveness. No studies demonstrated improved patient outcome, but 1 LOE 4 study<sup>53</sup> noted potential harm with the Trendelenburg position.

#### *Treatment Recommendation*

There is insufficient evidence for or against raising the legs as a first aid intervention for shock.

#### *Knowledge Gaps*

What are the relative benefits and risks of supine positioning with passive leg raising and modified Trendelenburg positioning in victims with shock? Is there potential harm of passive leg elevation in victims with pelvic, abdominal, chest, and head trauma?

### When to Suspect Cervical Spine Trauma [FA-502E](#)

#### *Consensus on Science*

The LOE 5 National X-Radiography Utilization Study (NEXUS) identified midline cervical neck tenderness, focal

neurological deficit, altered mental status, intoxication, and distracting injury as the 5 key clinical criteria predicting high risk for spine injury in adults,<sup>61</sup> children,<sup>62</sup> and the elderly<sup>63</sup> and demonstrated that elimination of any of these factors weakened the predictive value.<sup>64</sup> The LOE 5 Canadian C-Spine Rule (CCR) study<sup>65</sup> identified age  $\geq 65$  years, dangerous injury mechanism, and paresthesia as conditions that should create a high level of suspicion for cervical spine injury. A large LOE 5 study of children younger than 3 years of age<sup>66</sup> identified a Glasgow Coma Scale (GCS) score  $< 14$ , a GCS Eye Opening score of 1, motor vehicle crash, and age  $\geq 2$  years as signs that should create a high level of suspicion for cervical spine trauma in young children. One LOE 5 study<sup>67</sup> has validated these risk factors with the possible exception of injury mechanism, and 11 LOE 5 studies have shown that emergency medical technicians can identify the risk factors in most patients with possible cervical spinal injury<sup>68–70</sup> with excellent reliability<sup>71,72</sup> when applied in selective spinal immobilization protocols.<sup>73–78</sup>

#### *Treatment Recommendations*

Cervical spine injury should be suspected in traumatic injury if the victim:

- Is  $\geq 65$  years of age
- Is involved as driver, passenger, or pedestrian in a motor vehicle, motorized cycle, or bicycle crash
- Falls from a greater than standing height
- Has tingling in the extremities
- Complains of pain or tenderness in the neck or back
- Has sensory deficit or muscle weakness involving the torso or upper extremities
- Is not fully alert or is intoxicated
- Has other painful injuries, especially of the head and neck
- Is a child  $\geq 2$  years of age, has a GCS score  $< 14$ , or has a GCS Eye Opening score of 1

### Benefit of Spinal Immobilization [FA-501A, FA-501D](#)

#### *Consensus on Science*

There are no published studies that support or refute the benefit of spinal immobilization by first aid providers. One retrospective, nonrandomized, and probably underpowered LOE 5 study<sup>79</sup> of spinal immobilization by emergency medical technicians using immobilization devices failed to show any neurological benefit compared with no spinal immobilization. Two LOE 4 studies<sup>80,81</sup> examined data from before the era of routine spinal immobilization and compared them to the era after the introduction of routine spinal immobilization and determined that secondary spinal injury occurred in 3% to 25% of patients suffering a spinal injury. An LOE 5 review of the literature<sup>82</sup> estimated that 0.03% to 0.16% of patients may be helped by spinal restriction.

#### *Treatment Recommendation*

There is insufficient evidence for or against spinal immobilization. It is reasonable to recommend spinal motion restriction, in victims with risk factors for cervical spine injury.

**Method for Spinal Motion Restriction**<sup>FA-503A</sup>*Consensus on Science*

There are no studies that support or refute any 1 method of spinal motion restriction in victims of trauma. One LOE 5 study in healthy volunteers<sup>83</sup> concluded that professional rescuer application of bilateral sandbags held in place by 3-inch tape placed across the forehead was more effective than any other method, including extrication collars, in restricting spinal motion. Two LOE 5 studies, 1 in cadavers with spinal injury<sup>84</sup> and the other in traumatic cardiac arrest,<sup>85</sup> showed that manual stabilization was ineffective in protecting the spinal cord.

*Treatment Recommendation*

There is insufficient evidence for or against manual cervical spine restriction of motion. The only proven method of cervical spine immobilization is use of bilateral sandbags held together with tape over the forehead, thus restricting both lateral and anterior-posterior neck motion.

*Knowledge Gaps*

Is there a benefit to applying (as compared with not applying) spinal motion restriction to all victims of head and neck trauma? What is the risk?

**Thermal Cutaneous Burns**<sup>FA-101C</sup>*Consensus on Science*

Evidence from 5 LOE 3<sup>86–90</sup> and 4 LOE 4 retrospective<sup>91–94</sup> studies, as well as 28 LOE 5 animal experiments,<sup>95–122</sup> demonstrated that cooling of thermal burns with water at room temperature (15°C to 25°C) within 30 minutes of injury reduces pain, depth of injury, and the need for grafting. In 1 LOE 4 case series<sup>123</sup> and 5 LOE 5 animal studies,<sup>111,121,124,125</sup> cooling of burns with ice or ice water increased tissue damage.

*Treatment Recommendation*

Cooling of thermal burns with tap water is recommended as soon as possible but no later than 30 minutes after the injury. Large burns should not be cooled without the ability to monitor the victim's core temperature because that may cause hypothermia, especially in children. Cooling with ice or ice water is not recommended.

*Knowledge Gaps*

What is the role of cooling in large burns? When is a burn sufficiently large that cold application creates risk of hypothermia? Is there a benefit to use of water gel versus tap water in the cooling of a burn? How long should burns be cooled?

**Blisters**<sup>FA-103A</sup>*Consensus on Science*

Evidence from 1 LOE 2 human study,<sup>126</sup> 2 small LOE 4 clinical studies,<sup>127,128</sup> 1 LOE 5 human volunteer study,<sup>129</sup> and 4 LOE 5 animal studies<sup>118,130–132</sup> demonstrated that leaving burn blisters intact improves healing and reduces pain.

*Treatment Recommendation*

Burn blisters should be left intact.

*Knowledge Gaps*

Is there an outcome benefit of burn treatment with a modern occlusive dressing with and without prior blister debridement?

**Bleeding Control****Direct Pressure, Pressure Points, and Elevation**<sup>FA-401C</sup>*Consensus on Science*

There are no studies evaluating the effectiveness of direct pressure as a first aid for bleeding. One LOE 1 randomized, prospective, but not double-blind study,<sup>133</sup> 1 LOE 1 meta-analysis,<sup>134</sup> and 5 LOE 2 studies<sup>135–139</sup> showed that hemostasis can be achieved by manual direct pressure over an arteriotomy site after cardiac catheterization. Three LOE 5 animal studies<sup>140–142</sup> showed that increasing intra-abdominal pressure by insufflation of air can control intra-abdominal bleeding. Three LOE 4<sup>143–145</sup> and 1 LOE 5<sup>146</sup> studies showed that bleeding from even large wounds can be controlled and hemostatic pressure achieved by application of an adhesive elastic bandage over gauze. One LOE 4 study<sup>147</sup> in 10 volunteers showed no effect on distal pulses when pressure was applied over the proximal artery.

*Treatment Recommendation*

Control of bleeding is best achieved with direct manual pressure over the bleeding area. Pressure can be maintained by applying an elastic adhesive bandage over gauze pads. There is evidence against using pressure points (indirect pressure) but no evidence for or against elevation of the bleeding part as a method of hemorrhage control.

*Knowledge Gaps*

All our knowledge about direct pressure hemostasis is extrapolated from cardiac catheterization experience and the battlefield, and studies of bleeding control in civilian settings by first aid providers are needed. Do first aid providers apply sufficient pressure? Do first aid providers apply pressure for a sufficient amount of time to control bleeding? How often does properly applied pressure fail to control bleeding, and which alternative method works?

**Tourniquets – Routine Use**<sup>FA-402C, FA-402D</sup>*Consensus on Science*

There are no studies of the use of tourniquets to control hemorrhage in a civilian setting by first aid providers. Two LOE 5 retrospective studies<sup>148,149</sup> and 1 LOE 5 prospective study<sup>150</sup> supported the use of a tourniquet to control extremity hemorrhage on the battlefield. One LOE 4 retrospective case study<sup>145</sup> found that direct pressure was superior to a tourniquet in controlling hemorrhage. One LOE 1 prospective study in orthopedic patients undergoing surgery that used a tourniquet to achieve a bloodless field<sup>151</sup> showed that metabolic markers of muscular injury were directly related to the length of time the tourniquet was in place. One LOE 3 prospective, controlled study during orthopedic surgery<sup>152</sup> showed enhanced transendothelial neutrophil migration with potential for muscle injury while a tourniquet was in place. One LOE 4 case report documented paralysis after surgical use of a tourniquet,<sup>153</sup> 1 LOE 5 retrospective review documented limb paralysis following use of a tourniquet during surgery,<sup>154</sup> and 1 LOE 5 animal study on muscular contraction following tourniquet use and its relationship to inflating pressure<sup>155</sup> demonstrated potential neurological complications of pro-

longed tourniquet use. Two of these studies<sup>153,154</sup> showed that the neurological complication was potentially reversible.

#### *Treatment Recommendation*

Properly applied tourniquets do control hemorrhage under surgical and battlefield conditions, but because of potential complications, there are insufficient data for or against recommending their routine use in civilian first aid.

#### *Knowledge Gaps*

What is the maximum time that a tourniquet can be left in place before the benefit/risk ratio reverses? Can first aid providers be taught how tightly to apply a tourniquet? Are there any advantages/disadvantages to intermittent release of an applied tourniquet?

#### **Tourniquets – When Should They be Used?**<sup>FA-403A, FA-403C</sup>

##### *Consensus on Science*

There are no studies on the use of a tourniquet to control bleeding in the civilian setting by first aid providers. One LOE 4 retrospective study of 11 patients on the use of paramedic application of tourniquets in a community setting<sup>156</sup> showed that tourniquets are effective and can be used by trained professionals without complications. Two LOE 5 retrospective studies<sup>148,149</sup> and 2 LOE 5 prospective studies<sup>150,157</sup> documented the effectiveness of tourniquets in controlling extremity hemorrhage on the battlefield.

Two LOE 5 studies,<sup>158,159</sup> 1 LOE 5 study,<sup>160</sup> and 1 LOE 2 prospective randomized study<sup>161</sup> tested different tourniquets for ease of volunteer application and effectiveness and showed that commercially available devices are safer than improvised ones; in 1 study,<sup>150</sup> only 25% of improvised tourniquets were effective. Three commercially available tourniquets that have been found to be reliable in combat and experimental situations are the Combat Application Tourniquet (CAT<sup>®</sup>), the Special Operations Forces Tactical Tourniquet (SOFTT<sup>®</sup>), and the Emergency and Military Tourniquet (EMT<sup>®</sup>).<sup>150,161</sup>

One LOE 5 prospective but not randomized study<sup>162</sup> on prolonged tourniquet application during surgery and 2 LOE 5 animal studies<sup>163,164</sup> showed that local hypothermia of the extremity protected against adverse effects of ischemia.

##### *Treatment Recommendation*

In civilian settings, tourniquets should only be used for control of extremity hemorrhage if direct pressure is not adequate or possible (eg, multiple injuries, inaccessible wounds, multiple victims). Specifically designed tourniquets are superior to improvised ones but should only be used with proper training. There is insufficient evidence to determine how long a tourniquet can remain in place safely. Cooling of the distal limb should be considered if a tourniquet needs to remain in place for a prolonged period of time.

##### *Knowledge Gaps*

Which specifically designed tourniquet is best and easiest to use in a civilian setting?

Do improvised tourniquets stop bleeding in a civilian setting? Does cooling of an extremity after application of a tourniquet in humans prolong the safety margin of tourniquets? In delayed-help environments, can tourniquets be

loosened to reassess or stop bleeding with direct pressure when conditions warrant (eg, scene safety improves, access to wounds improves, or additional resources are available)?

#### **Hemostatic Agents**<sup>FA-404B, FA-404C, FA-404D</sup>

##### *Consensus on Science*

Evidence from 4 LOE 4 studies in adults<sup>165–168</sup> showed a significant improvement compared with standard treatment for out-of-hospital control of life-threatening bleeding when topical hemostatic agents were used by trained individuals. This beneficial outcome was supported by 21 LOE 5 animal studies.<sup>168–186</sup> Effectiveness varied substantially among the agents used. Adverse effects of some agents included tissue destruction with induction of a proembolic state and potential thermal injury.

##### *Treatment Recommendation*

The out-of-hospital application of a topical hemostatic agent to control life-threatening bleeding not controlled by standard techniques is reasonable, but the best agent and the conditions under which it should be applied are not known.

##### *Knowledge Gaps*

Which hemostatic agents are most effective as a first aid measure? Which hemostatic agents have the least side effects when used by first aid providers? How do hemostatic agents compare with direct pressure and tourniquets? When should they be used?

#### **Straightening an Angulated Fracture**<sup>FA-602A, FA-602B</sup>

##### *Consensus on Science*

One LOE 4 prehospital study<sup>187</sup> and 6 LOE 5 hospital studies and reviews<sup>188–193</sup> showed no evidence that straightening of an angulated suspected long bone fracture shortens healing time or reduces pain prior to permanent fixation. One LOE 4<sup>194</sup> study showed reduced pain with splinting without straightening. One LOE 5<sup>195</sup> study on cadavers suggested that straightening angulated fractures decreases compartment size and might increase compartment pressure. One LOE 5 study<sup>196</sup> showed no evidence that traction splints could have prevented any hemodynamic compromise in isolated long bone leg fractures in children.

##### *Treatment Recommendation*

In general, there should be no attempt to manipulate a suspected extremity fracture.

##### *Knowledge Gaps*

In the first aid setting, what are the benefits/risks of realigning long bones that are angulated and presumed to be fractured? Does travel time to a definitive healthcare facility make a difference? Does the application of traction reduce blood loss?

#### **Stabilizing Suspected Extremity Fracture**<sup>FA-605A</sup>

##### *Consensus on Science*

There are no published studies that evaluate the change in pain or functional recovery when a first aid provider stabilizes a suspected extremity fracture.

##### *Treatment Recommendation*

There is no evidence for or against manual stabilization or splinting for a suspected extremity fracture by first aid providers.

*Knowledge Gaps*

Is there any benefit in terms of pain reduction or healing if first aid providers stabilize a suspected fracture? Is there any harm in stabilizing a suspected fracture as a first aid maneuver? Does distance from a definitive healthcare facility make a difference in effectiveness of stabilization?

### **Musculoskeletal Injury and Heat Application** <sup>FA-604A, FA-604B</sup>

*Consensus on Science*

In 1 LOE 1 study involving only 30 subjects<sup>197</sup> with ankle sprains, cold was more effective than heat or alternating cold and heat for reducing ankle edema within 24 hours following a musculoskeletal injury.

*Treatment Recommendation*

There is insufficient evidence for or against the application of heat to an acute musculoskeletal injury. Cold application appears to be superior in the early reduction of edema.

### **Musculoskeletal Injury and Cold Application** <sup>FA-603C</sup>

*Consensus Science*

In 2 LOE 2 studies<sup>198,199</sup> and 1 LOE 5 study,<sup>200</sup> cold application reduced pain, swelling, edema, and the duration of disability after musculoskeletal injury. Evidence from 3 LOE 5 studies<sup>201–203</sup> showed that a mixture of ice and water is more effective in lowering tissue temperature in the injured area than ice alone. Three LOE 5 studies<sup>204–206</sup> showed that the duration of cryotherapy should not exceed 20 minutes. One LOE 1 study<sup>207</sup> demonstrated that intermittent 10-minute applications of ice and water (melting ice water) were as effective as standard ice application for 20 minutes.

*Treatment Recommendation*

Musculoskeletal, including joint, injuries should be treated with the application of ice (crushed or cubed) with water. Cooling time should be interrupted every 20 minutes. Intermittent 10-minute cooling is also acceptable if 20 minutes of cooling causes discomfort.

### **Topical Agents and Dressings** <sup>FA-801B</sup>

*Consensus on Science*

Evidence from 2 small, nonrandomized LOE 2 trials in volunteers<sup>208,209</sup> and supportive evidence from 1 LOE 2 human study of other wound types<sup>210</sup> and 3 LOE 5 well-designed animal studies<sup>211–213</sup> demonstrated significantly shorter healing time of abrasions treated with any occlusive dressing or topical antibiotic versus no dressing or topical antibiotic.

*Treatment Recommendation*

After cleaning, superficial traumatic abrasions should be covered with a clean occlusive dressing and/or a topical antibiotic that keeps the wound moist and prevents drying. There are insufficient data to recommend any particular dressing or topical antibiotic.

*Knowledge Gaps*

What are the best topical agent and dressing in the home setting? When should the first aid provider seek additional care for superficial wounds?

### **Irrigation of Superficial Wounds** <sup>FA-802B</sup>

*Consensus on Science*

Evidence from 6 LOE 1 clinical trials,<sup>214–219</sup> 1 LOE 2 clinical trial,<sup>220</sup> 1 LOE 1 meta-analysis<sup>221</sup> of simple traumatic lacerations in the emergency department, and 6 LOE 5 animal studies<sup>222–227</sup> demonstrated that irrigation is better than no irrigation, that higher irrigation pressures are more effective than lower pressures, that higher volumes are better than lower volumes (within a range of 100 to 1000 mL), and that tap water is as good as (or better than) any other irrigation solution in reducing infection rates. In 1 small LOE 1 clinical study,<sup>228</sup> body temperature saline was more comfortable than cold saline, and in 1 LOE 5 inanimate study,<sup>229</sup> soap and water were more effective than irrigation with saline alone.

*Treatment Recommendation*

Irrigation of acute superficial wounds with a large volume of warm or room temperature tap water from a reliable source (with or without soap) is recommended.

*Knowledge Gaps*

What are the effectiveness and best method of wound irrigation in the home? Is there a benefit to using soap in addition to water in cleaning superficial wounds?

### **Eye Injury – Irrigation** <sup>FA-1301B</sup>

*Consensus on Science*

There are no human studies comparing irrigation of eyes with tap water and irrigation with another substance following eye exposure to a toxin. Two LOE 5 studies<sup>230,231</sup> support tap water over saline solution for emergency rinsing of caustic burns of the eyes. Three LOE 5 studies<sup>230,232,233</sup> found phosphate buffer, borate buffer eye wash, and amphoteric solutions (Diphoterine<sup>®</sup>, Previn) to be more effective than water in lowering intraocular pH in caustic burns of the eyes. In a single LOE 5 study,<sup>234</sup> water performed no better than normal saline or isotonic magnesium chloride (MgCl<sub>2</sub>) solution when rinsing eyes exposed to hydrofluoric acid. One LOE 5 study<sup>233</sup> found a specialized rinsing solution for hydrofluoric acid eye burns (Hexafluorine<sup>®</sup>) to be more efficient than tap water. One LOE 5 study<sup>235</sup> showed little difference between a single lavage of water or an amphoteric solution in removing radioactivity but also found the amphoteric solution to be significantly more effective than water in 3 successive lavages and in an eyewash device.

*Treatment Recommendation*

Immediate irrigation of eyes exposed to a toxin with large amounts of tap water is beneficial.

*Knowledge Gaps*

What is the optimal rinsing method for eyes exposed to a toxin? Does irrigation of ocular hydrofluoric acid burns with water compared with other substances improve outcome? How does the effectiveness of water compare with the effectiveness of other emergency rinsing solutions for ocular burns?

## Human and Animal Bites<sup>FA-1801A</sup>

### Consensus on Science

Irrigation of bite wounds for the prevention of rabies is supported by 2 LOE 5 animal studies<sup>236,237</sup> and is supported for the prevention of bacterial infection by 1 LOE 3 retrospective human study.<sup>238</sup> Tap water, saline, and soap and water solutions were among the irrigating solutions that were beneficial, although they were not directly compared. Despite multiple recommendations in review literature and common clinical practice, no evidence was found that application of povidone-iodine is beneficial for the treatment of human or animal bites.

### Treatment Recommendation

Irrigation of human and animal bite wounds with a copious amount of fluid (water or saline) is recommended to minimize the risks of bacterial and rabies infections. There is no evidence for or against any specific irrigation fluid.

## Snake Bite

### Pressure Immobilization<sup>FA-1001A</sup>

#### Consensus on Science

One LOE 5 monkey study<sup>239</sup> showed that application of a pressure bandage to create  $\approx 55$  mm Hg of pressure and simultaneous immobilization of the bitten extremity with a splint are effective and safe in retarding snake venom uptake into the systemic circulation. One LOE 2 human study<sup>240</sup> and 1 LOE 5 animal study<sup>241</sup> demonstrated that lymphatic flow and “mock venom” uptake can be significantly or almost completely reduced by proper application of pressure and immobilization but that either pressure or immobilization alone was ineffective. No adverse effects were observed within certain prescribed pressure ranges (between 40 and 70 mm Hg for upper, and 55 to 70 mm Hg in lower limbs); a useful and practical field estimation for this pressure range is the application of a comfortably tight bandage that allows the insertion of a finger under it. Theoretically, if a venom produces more local tissue effects than systemic effects, damage may be increased if the venom is “trapped” in 1 place with use of pressure and immobilization. One LOE 5 animal study<sup>242</sup> demonstrated the effectiveness of pressure and immobilization on survival from the venom of non-neurotoxic North American snakes. Two LOE 5 studies<sup>243,244</sup> using volunteer first aid providers showed that retention of the ability to perform proper pressure/immobilization application is poor.

### Treatment Recommendation

Properly performed pressure immobilization of extremities should be considered in first aid following snake envenomation.

### Knowledge Gaps

Does first aid provider compressive wrapping of an extremity bitten by a venomous snake improve outcome? What is the best method to teach the optimal way to apply a compressive dressing? How often does this need to be refreshed for retention?

### Suction<sup>FA-1002A</sup>

#### Consensus on Science

In 1 LOE 4 case series descriptive report,<sup>245</sup> suction was effective in treating snake envenomation. In 1 LOE 5 controlled animal study,<sup>246</sup> suction provided no clinical benefit, and death

occurred earlier in the animals treated with suction than in the control animals. The author concluded that “suction may be conducive to a more rapid invasion of venom.” One LOE 4 retrospective case series<sup>247</sup> concluded that there was little support for the application of suction in the management of snake envenomation. One LOE 5 simulated-snakebite study in human volunteers<sup>248</sup> determined that only 0.04% of a venom load was recovered by a suction device. There was no benefit to application of a suction device for rattlesnake envenomation in an LOE 5 porcine study,<sup>249</sup> and the suction may have caused injury. An LOE 4 case report<sup>250</sup> of the application of suction to a snake envenomation victim demonstrated visual harm to tissue in the region of the application of the suction device.

### Treatment Recommendation

Suction should not be applied to treat snake envenomation; it is ineffective and may be harmful.

### Knowledge Gaps

No further studies on suctioning following snake bite are warranted.

## Jellyfish Stings

### Topical Applications to Prevent Nematocyst Discharge<sup>FA-1806-2B</sup>

#### Consensus on Science

In 2 LOE 5<sup>251,252</sup> animal studies of jellyfish stings, vinegar prevented further nematocyst discharge. One of these studies<sup>251</sup> supported vinegar use for *Olindias sambaquiensis*, and the second<sup>252</sup> for the Portuguese man-of-war (*Physalia physalis*). One LOE 5 animal study<sup>252</sup> supported the use of a baking soda slurry to decrease further nematocyst release. One LOE 1 study<sup>253</sup> and 1 LOE 2 study<sup>254</sup> concluded that pain cannot be diminished with use of a commercial aerosol spray, meat tenderizer, or freshwater wash and that papain, meat tenderizer, and vinegar are less effective than heat in relieving pain from acute jellyfish stings.

### Treatment Recommendation

Jellyfish stings should be liberally washed with vinegar (4% to 6% acetic acid solution) as soon as possible for at least 30 seconds to prevent further envenomation and/or to inactivate nematocysts. If vinegar is not available, baking soda slurry may be used instead. Topical application of aluminum sulfate or meat tenderizer is not recommended for the relief of pain.

### Heat or Cold Application<sup>FA-1806-1B</sup>

#### Consensus on Science

In 2 LOE 2<sup>254,255</sup> and 2 LOE 3 studies,<sup>256,257</sup> hot-water immersion was effective for first aid treatment of pain of jellyfish stings. One LOE 2 study<sup>258</sup> concluded that there is a statistically significant but possibly clinically unimportant reduction in pain with application of dry hot or cold packs in comparison with dry thermo-neutral packs for box jellyfish stings. The response was greatest with hot versus cold packs. In 1 LOE 4 study,<sup>259</sup> cold packs reduced pain, but in 2 LOE 2 studies,<sup>255,258</sup> the use of cold packs produced no significant relief of pain.

### Treatment Recommendation

After the nematocysts are removed or deactivated, the pain caused by jellyfish stings should be treated with hot-water immersion when possible. The victim should be instructed to



take a hot shower or immerse the affected part in hot water (temperature as hot as tolerated, or at 45°C if there is the capability to regulate temperature) as soon as possible. The immersion should continue for at least 20 minutes, or for as long as pain persists. If hot water is not available, dry hot packs or, as a second choice, dry cold packs may also be helpful in decreasing pain.

### **Pressure Immobilization Bandage**<sup>FA-1806-3B</sup>

#### *Consensus on Science*

Two LOE 5 animal studies<sup>260,261</sup> showed fair to good evidence that the application of pressure with an immobilization bandage causes further release of venom, even from already fired nematocysts.

#### *Treatment Recommendation*

Pressure immobilization bandages are not recommended for the treatment of jellyfish stings.

#### *Knowledge Gaps*

Almost all evidence-based research on the best first aid treatment for jellyfish stings involves species of jellyfish found in Indo-Pacific waters. More research is needed on species found in other waters (eg, Atlantic Ocean). More specific research on the best first aid treatment of jellyfish stings is needed.

## **Environmental Emergencies**

### **Summary**

The literature on the first aid treatment of frostbite was reviewed. There continues to be evidence against thawing of a frozen body part if there is any chance of refreezing. The evidence is not clear at this time regarding the benefit of nonsteroidal anti-inflammatory agents as a first aid treatment for frostbite. There is evidence against the use of chemical warmers since they have been demonstrated to be capable of reaching temperatures that could damage tissues.

Oral fluid replacement has been found to be as effective as intravenous fluid in exercise- or heat-induced hypohydration. The best fluid appears to be a carbohydrate-electrolyte mixture.

### **Cold Injury**

#### **Rewarming Frostbite**<sup>FA-901B</sup>

#### *Consensus on Science*

Seven LOE 5 animal studies<sup>262–268</sup> of frostbite injury demonstrated a beneficial effect of rapid rewarming in water baths between 37°C and 42°C for 20 to 30 minutes. Beneficial outcomes included the return of venous circulation, arterial circulation, and/or microcirculation, as well as decreased tissue loss (as measured by paw volume, level of tissue necrosis, or amputation). Three LOE 4 case series of frostbite victims<sup>269–271</sup> treated with rewarming protocols demonstrated a trend toward improved outcome (ie, reduced tissue loss) when rewarming was rapid versus gradual or at room temperature. Two LOE 4 case series<sup>269,270</sup> also described severe tissue loss when frostbitten tissue was thawed and then refrozen or was rewarmed with a dry heat source. One LOE 5 bench study<sup>272</sup> of commercially available disposable chemical hand and foot warmers found that temperatures created by these chemical warmers reached 69°C to 74°C. In 1 LOE 4 case series<sup>273</sup> and 1 LOE 4 cohort study<sup>274</sup> of severe frostbite without perfusion after rewarming treatment

with intravenous or intra-arterial tissue plasminogen activator (tPA), the amputation rate was decreased significantly when treatment was performed within 24 hours of injury.

#### *Treatment Recommendation*

When providing first aid to a victim of frostbite, rewarming of frozen body parts is only beneficial if there is no risk of refreezing. For severe frostbite, rewarming should be accomplished within 24 hours.

Rewarming is best achieved by immersing the affected part in water between 37°C and 40°C (ie, body temperature) for 20 to 30 minutes. Chemical warmers should not be placed directly on frostbitten tissue because they can reach temperatures that can cause burns. Following rewarming, efforts should be made to protect frostbitten parts from refreezing and to quickly evacuate the victim for further care.

#### *Knowledge Gaps*

At what interval from injury (eg, 24, 48, or 72 hours) is rewarming at the site of injury no longer beneficial? If a warm-water bath is not available, but chemical hand warmers are, how long should they be applied to frostbitten tissue?

#### **Anti-inflammatory Agents**<sup>FA-902B</sup>

#### *Consensus on Science*

Evidence from 1 LOE 2 cohort study<sup>275</sup> showed a significant reduction in morbidity, a reduction in tissue loss, and a decrease in hospital stay for victims of localized cold injury treated with ibuprofen 12 mg/kg per day and topical aloe vera (n=56) versus standard treatment (n=98). Groups were not matched for size or degree of injury. Evidence from 1 LOE 3 bench study<sup>276</sup> demonstrated elevated levels of inflammatory mediators in blister fluid of frostbite patients. In 6 LOE 5 animal studies,<sup>264,277–281</sup> frostbite treatment that included administration of a nonsteroidal anti-inflammatory drug (NSAID) either before or following injury was beneficial. Two LOE 4 case series<sup>273,282</sup> reported healing without major tissue loss when an NSAID was included in treatment protocols, while 2 LOE 4 studies<sup>271,283</sup> did not clearly describe outcomes. One LOE 4 case series<sup>273</sup> and 1 LOE 3 cohort study<sup>274</sup> found dramatic reductions in amputation rates (33/174 digits at risk<sup>273</sup> and 10% versus 41%,<sup>274</sup> respectively) following use of intravenous or intra-arterial tPA plus heparin within 24 hours of injury for severe frostbite with absent pulses following rewarming.

#### *Treatment Recommendations*

There is insufficient evidence for or against the use of ibuprofen or other NSAIDs as a first aid measure for victims of frostbite.

#### *Knowledge Gaps*

Good-quality research is needed to establish whether there is a true benefit from the use of NSAIDs for frostbite in humans, both in the prethaw and postthaw phases of injury. Does the early use of NSAIDs for frostbite lead to an increase in bleeding complications in patients treated with tPA for ongoing (warm) ischemia following thawing?

### **Heat Injury**

#### **Fluid Treatment of Hypohydration**<sup>FA-1705A, FA-1706A</sup>

#### *Consensus on Science*

The level of evidence regarding the treatment of hypohydration is extremely low because studies have been per-

formed in volunteers and are underpowered, and the target of hypohydration is generally less than 2% dehydrated. One LOE 2<sup>284</sup> and 1 LOE 5<sup>285</sup> study showed that oral rehydration is as effective as intravenous rehydration. In a model of exercise- and heat-induced mild hypohydration, 1 LOE 1 study<sup>286</sup> and 8 LOE 2 studies<sup>284,287–293</sup> demonstrated that oral carbohydrate/electrolyte solutions were more effective than water in restoring intravascular volume. One LOE 2 study<sup>293</sup> showed that the volume consumed must exceed the volume lost in sweat. In 1 LOE 2 study,<sup>287</sup> fluids containing a mixture of glucose and fructose led to a more rapid hydration than those containing only glucose, but 1 LOE 2 study<sup>288</sup> showed that carbohydrate concentration above 6% compromised fluid absorption. One LOE 2 study<sup>294</sup> showed that milk is more effective than water for fluid replacement for hypohydration.

#### *Treatment Recommendations*

Exercise-related hypohydration should be treated with an oral carbohydrate/electrolyte solution. Milk is an acceptable alternative. The volume consumed should exceed the volume lost in sweat.

#### *Knowledge Gaps*

What is the best fluid composition for oral rehydration? Are there benefits of cooling with water immersion versus water spray?

### **Education**

Because education in first aid continues to be undocumented in a scholarly way, many questions remain. What is the best way to teach first aid skills? Evidence shows a deterioration of skills almost from the moment that a course is completed. How does one ensure that the skills, once learned, are retained so they are available when needed? The progress in technology has unleashed an ever-growing number of attractive simulation techniques but no data that they improve knowledge or skill competencies. An evaluation of the literature only raises more questions but does not provide any definitive answers.

### **Evaluation of Progress and Performance**<sup>FA-2102A</sup>

#### *Consensus on Science*

There are no data regarding the optimal method to evaluate and monitor progress in first aid education. Four LOE 1 studies<sup>295–298</sup> and 1 LOE 2 study<sup>299</sup> with well-defined populations explored evaluation during resuscitation training, but no conclusions can be drawn because a variety of methods were used.

#### *Treatment Recommendation*

There are no data for or against any method of evaluating or monitoring a first aid provider trainee's educational progress.

#### *Knowledge Gaps*

Well-designed studies are needed to evaluate the optimal evaluation strategy (method, timing, duration) of first aid courses.

### **Simulation in First Aid Education**<sup>FA-2101A, FA-2101B</sup>

#### *Consensus on Science*

There are no studies evaluating the effect of simulation in first aid education. In other medical educational settings, simulations have been used successfully both in education and in

testing. Five LOE 1<sup>300–304</sup> and 10 LOE 2<sup>305–314</sup> studies showed the benefit of using simulations as an educational tool. One LOE 1 study<sup>315</sup> showed the benefit of using simulation as an evaluative tool.

One LOE 1 study,<sup>300</sup> 4 LOE 2 studies,<sup>308,311,313,314</sup> 2 LOE 3 studies,<sup>316,317</sup> and 1 LOE 5 study<sup>318</sup> showed that use of simulation in medical education improved learning outcomes.

Two LOE 2 studies<sup>300,319</sup> showed that ACLS training using simulation is an effective training method for initial patient management skills. In these studies, simulation tools and simulated patients produced identical or better educational outcomes than either traditional lecture-based or clinical-based learning for ACLS, advanced trauma life support, or the equivalent.

#### *Treatment Recommendation*

In first aid training, the use of simulation appears to improve participant learning if it is accompanied by other effective teaching methods.

#### *Knowledge Gaps*

Well-designed studies to compare training using simulation with didactic lectures and other pedagogic methods are needed. Well-designed studies on the efficiency of first aid providers trained using simulation versus other pedagogic methods are also needed.

### **Frequency of First Aid Retraining**<sup>FA-2103A</sup>

#### *Consensus on Science*

There are no data to support a recommendation for the frequency needed for first aid retraining. Four LOE 1 studies<sup>320–323</sup> and 1 LOE 2 study<sup>299</sup> demonstrated a loss of skills between 3 and 6 months following BLS training. Evidence from 1 study<sup>299</sup> suggested that video retraining in first aid at 1 week, 1 month, and 13 months after initial training produces better retention of skills than no retraining over this period.

#### *Treatment Recommendation*

There are insufficient data to recommend a specific frequency of retraining in first aid in order to retain skills and knowledge.

#### *Knowledge Gaps*

Well-designed studies are needed to help define the optimal retraining/update strategy (timing, duration, etc). Well-designed studies are needed to evaluate self-instruction versus a traditional first aid refresher course.

### **Acknowledgments**

We thank the following individuals (the First Aid Chapter Collaborators) for their collaborations on the worksheets contained in this section: Olav Aasland; Juan Acosta; Kristian L. Arnold; David Berry; Richard N. Bradley; Rick Caissie; Barbara Caracci; Arthur Cooper; Cara B. Doughty; Jonathan I. Groner; Jeffrey Guy; Christopher P. Holstege; Vincent Hubert; Keichi Ikegami; Lisa S. Jutte; Sue O. Kell; Blaine C. Long; Andrew MacPherson; Daniel Meyran; Neal Pollock; Jeanette Previdi; William Raynovich; Karyl Reid; Samantha Roberts; Paul Satterlee; Susanne Schunder-Tatzber; Hong Shen; Ralph Shenefelt; Eunice M. Singletary; William Smith; Jeff Woodin; Brad Yeargin; and Susan W. Yeargin.

## Disclosures

## CoSTR Part 13: Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
David Markenson	New York Medical College—Interim Chairman	None	None	None	None	None	None
Jeffrey D. Ferguson	Brody School of Medicine at East Carolina University—Assistant Professor	None	None	None	None	None	*Currently functioning as expert witness in two cases pending trial/resolution. Total fees to date are less than \$10 000 in the past twelve months
Leon Chameides	Emeritus Director Pediatric Cardiology Connecticut Children's Medical Center Clinical Professor University of Connecticut	None	None	None	None	None	None
Pascal Cassan	French Red Cross/International federation of RC/RC—Coordinator of the European Reference Centre for First Aid Education—National Medical Advisor of the French Red Cross	None	None	None	None	None	*Coordinator of the Scientific Committee of the National First Aid Commission for the Interior Ministry in France (No payed)
Kin-Lai Chung	Hong Kong Hospital Authority Hospital Chief Executive	None	None	None	None	None	*Chairman of Board of Quality Assurance—St. John Ambulance Association of Hong Kong
Jonathan L. Epstein	NorthEast Emergency Medical Services, Inc.: Regional EMS Council—EMS System Oversight and Training Center (CPR/AED/First Aid)—Executive Director; Isis Maternity: Pre-Natal and Post-Partum Retail and Educational Company—CPR and First Aid Instructor	None	None	None	None	*American Red Cross Advisory Council for First Aid, Aquatics, Safety and Preparedness—Vice-Chair	None
Louis Gonzales	City of Austin/Travis County EMS System: Office of the Medical Director—Performance Management & Research Coordinator *Consultant—Senior Science Editor for the American Heart Association	None	None	None	None	None	None
Mary Fran Hazinski	Vanderbilt University School of Nursing—Professor; AHA ECC Product Development—Senior Science Editor †The significant compensation that I receive is for my writing and editorial responsibilities for the 2010 CoSTR document and the 2010 AHA Guidelines for CPR and ECC	None	None	None	None	None	None
Rita Ann Herrington	CVS/Minute Clinic—Family Nurse Practitioner	None	None	None	None	None	None
Jeffrey L. Pellegrino	Kent State University—Assistant Director Faculty Professional Development Center	None	None	None	None	*Subject Matter Expert, wilderness first aid	†StayWell Publishing, author of Wilderness First Aid Instructor Manual
Norda Ratcliff	Bloomington Hospital Promptcare—Adult NP	None	None	None	None	None	None
Adam J. Singer	Stony Brook University—Physician	None	None	None	None	None	None

This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives \$10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns \$10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

\*Modest.

†Significant.

CoSTR Part 13: Worksheet Collaborator Disclosures

Worksheet Collaborator	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
Olav Aasland	Norwegian Red Cross NGO; First Aid Advisor	None	None	None	None	None	None
Juan Acosta	Yakima Regional Medical and Cardiac Center Attending Physician—Emergency Department	None	None	None	None	None	None
Kristian L. Arnold	Occupational and Emergency Medicine consulting Chief Medical Officer	None	None	None	None	None	None
David Berry	Weber State University College/University Assistant Professor	None	None	None	None	None	None
Richard N. Bradley	The University of Texas Health Science Center at Houston—Associate Professor of Emergency Medicine; Texas Air National Guard—Residency Trained Flight Surgeon	None	None	None	None	None	None
Rick Caissie	Canadian Red Cross—National Director, Injury Prevention Programs	None	None	None	None	None	*I served as an expert witness in a coroners inquest relating to CPR procedures in a drowning of a twelve year old boy. No compensation was given. I was also asked to provide an expert opinion in a law suit, in which a twenty year old male struck a light pole while skiing and became paralyzed. The law firm paid \$175.00 to cover administrative expenses long distance phone calls, photocopying etc.). No compensation was given
Barbara Caracci	National Safety Council—Director of Program Development and Training †I am a salaried employee of the National Safety Council. My salary comes from work I do with the emergency care product line. This includes making sure our student and instructor materials are technically accurate.	None	None	None	None	None	None
Arthur Cooper	Columbia University—Professor of Surgery	*Clinical Decision Rule to Identify Children with Abdominal Injuries, CDC (consultant, directly) Car Seats for Kids at Harlem Hospital, NYSDMV (principal investigator, none) EMSC Network Development Demonstration Project, HRSA (co-principal investigator, none) Pediatric Disaster Coalition, NYCDOHMH (consultant, directly) Neonatal Transport Ventilator, Friends of Harlem Hospital (principal investigator, none)	None	*Symposium Lecture, Carilion Clinic (directly) EMSC Stakeholder's Group, HRSA (directly) Commissioned Paper, Vulnerable Populations, Forum on Medical and Public Health Preparedness, IOM (directly) Pediatric Preparedness Consensus Conference, Children's Health Fund (directly)	None	None	None
Cara B. Doughty	Baylor College of Medicine; Assistant Professor	None	None	None	None	None	None

(Continued)

CoSTR Part 13: Worksheet Collaborator Disclosures, *Continued*

Worksheet Collaborator	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
Jonathan Groner	The Ohio State University College of Medicine, non-profit state university; Professor of Clinical Surgery; Nationwide Children's Hospital Non-profit pediatric hospital (501-3(c)) ;Trauma Medical Director	None	None	None	None	None	None
Jeffrey Guy	Vanderbilt University School of Medicine Director Burn Center; Associate Professor of Surgery	*AFIRM grant	None	None	None	None	*Multiple expert witness on both medical liability cases as well as medical malpractice defense cases
Christopher P. Holstege	University of Virginia—Associate Professor	None	None	None	None	None	None
Vincent Hubert	Physician, Necker Hospital, France	None	None	None	None	None	None
Keiichi Ikegami	Dokkyo Medical University Professor	None	None	None	None	None	None
Lisa S. Jutte	Ball State University Assistant Professor of Athletic Training	None	None	None	None	None	None
Sue O. Kell	University of Virginia Health System—Administrative Programs Coordinator	None	None	None	None	None	None
Blaine C. Long	Oklahoma State University Assistant Professor	None	None	None	None	None	None
Andrew MacPherson	Vancouver Island Health Authority Emergency Physician BC Ambulance Service Medical Director	None	None	None	None	None	None
Daniel Meyran	Physician	None	None	None	None	None	None
Jeanette Previdi	Bergen Regional Medical Center, 230 E. Ridgewood Ave., Paramus, NJ 07652—Health & Education Coordinator/Life Support Training Center Coordinator	None	None	None	None	None	Currently serve as volunteer on BLS & ACLS Regional Faculty and BLS National Faculty for the American Heart Association (AHA), and as volunteer member of AHA First Aid Subcommittee
Neal Pollock	Duke University Medical Center University Research Associate Divers Alert Network Diving safety and emergency support organization Research Director	None	None	None	None	None	None
William Raynovich	Creighton University University Associate Professor and Director	None	None	None	None	None	*Expert Witness: My compensation was under \$2500
Karyl Reid	Hackensack University Medical Center—APN-C Pediatric Emergency Dept.	None	None	None	None	None	None
Samantha Roberts	Government of Grenada Guidance Officer	None	None	None	None	None	None
Paul Satterlee	Allina Hospitals and Clinics—Associate Medical Director, medical transportation; Emergency Care Consultants: Private group of ED physicians—partner—EM physician	None	None	*Ridgewater Community College paramedic refresher course	†Enova Medical Technologies—medical manufacturing company emphasizing headlamps and splint/cast material. My wife and I are one of over 25 investors in the company that is located in our community. Our investment was \$25 000	†National Safety Council I have been the medical advisor for their Emergency Care products for 4 years	†Medical Director, Century College Paramedic Program. I am the medical director for the EMS education programs for this state college located in my community
Susanne Schunder-Tatzber	OMV Oilcompany Coporate Medical Advisor	None	None	None	None	None	None
Hong Shen	Chinese PLA-general hospital; public health hospital and institute; emergency physician, professor	None	None	None	None	None	None

(Continued)

CoSTR Part 13: Worksheet Collaborator Disclosures, *Continued*

Worksheet Collaborator	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
Ralph Shenefelt	Health and Safety Institute: educational services— executive	None	None	None	†Shareholder. Health and Safety Institute, Inc. Health & Safety Institute is an affiliate of ASHI Holding Company, HSI, Health & Safety Institute, MEDIC HEALTH & SAFETY, MEDIC FIRST AID, MEDIC FIRST AID logo, American Safety & Health Institute, and the ASHI logo are registered trademarks of Medic First Aid International, Inc. or ASHI Holding Company. Corporate Headquarters: Health & Safety Institute, 1450 Westec Drive, Eugene, OR 97402 USA	None	*Modest and occasional income earned donated entirely to All Children's Hospital 801 6th St. South St. Petersburg, FL 33701
Eunice M. Singletary	University of Virginia Health Sciences Foundation Also holds an academic appointment as Associate Clinical Professor for the Dept. of Emergency Medicine with the University of Virginia medical center. Attending Physician, Dept. of Emergency Medicine The Medical Clinic of Big Sky, Montana—Attending physician	None	None	None	None	None	None
William Smith	Emergency Medicine of Jackson Hole—Clinical ED Physician, Resident Rotation Supervisor; University of Washington School of Medicine—Clinical WWAMI Faculty; Stanford Wilderness Medicine Fellowship—Rotation Supervisor for Grand Teton National Park; Jackson Hole Fire/EMS—Medical Director; National Park Service and Grand Teton National Park—NPS EMS Advisory Committee, Medical Advisor for Grand Teton National Park; United States Army Reserve—Emergency Physician	None	None	*Conference Presentations for multiple EMS, Wilderness Medicine, and Hospital groups: Wilderness Medical Associates—WALS (Wilderness Advanced Life Support) Course Wilderness Medical Society, Snowmass, CO, Park City, UT Wilderness Medicine Conference—Mountain Destinations, Santa Fe, NM, Big Sky, MT Colorado Symposium on Emergency Care, Telluride, CO NAEMSP (National Association of EMS Physicians) plus other groups/organizations with less common presentations *Wilderness Medicine—Big Sky, MT Wilderness Medical Associates—WALS Colorado Symposium on Emergency Care	None	*Chinook Board of Advisors—volunteer National Park Service—EMS Advisory Council—volunteer	*Limited Consulting for Expert Witness for Emergency/Wilderness Medicine *Personal Consulting business (Wilderness and Emergency Medicine Consulting—WEMC, LLC) Jackson, WY. I'm President/Medical Director, and provide emergency and wilderness medicine consulting in many forms from providing clinical care to teaching to other business opportunities
Jeff Woodin	Tualatin Valley Fire & Rescue: Emergency Medical and Fire Service provider—Lieutenant/ Paramedic; Portland Community College: Educational institution—contract Instructor	None	None	None	None	None	None
Brad Yeargin	Indiana State University Athletic Trainer	None	None	None	None	None	None
Susan W. Yeargin	Indiana State University Assistant Professor	None	None	None	None	None	None

This table represents the relationships of worksheet collaborators that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all worksheet collaborators are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives \$10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns \$10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

\*Modest.  
†Significant.

## Appendix

## CoSTR Part 13: Worksheet Appendix

Task Force	WS ID	PICO Title	Short Title	Authors	URL
First Aid	FA-1001A	In victims of a venomous snakebite (P) does pressure immobilization (I) of an extremity, when compared to no therapy (C), improve outcome (O)?	Compression wrapping in snakebites	Christopher P. Holstege	<a href="http://circ.ahajournals.org/site/C2010/FA-1001A.pdf">http://circ.ahajournals.org/site/C2010/FA-1001A.pdf</a>
First Aid	FA-1002A	In victims of a venomous snakebite (P) does application of suction (I) to the envenomation site, when compared to no therapy (C), improve outcome (O)?	Suction for snake bite	Christopher P. Holstege	<a href="http://circ.ahajournals.org/site/C2010/FA-1002A.pdf">http://circ.ahajournals.org/site/C2010/FA-1002A.pdf</a>
First Aid	FA-101C	Does the use of cooling (I) improve healing and pain control (O) in patients after thermal injuries (P)?	Cooling of thermal burn	Adam J. Singer, Jeff Guy	<a href="http://circ.ahajournals.org/site/C2010/FA-101C.pdf">http://circ.ahajournals.org/site/C2010/FA-101C.pdf</a>
First Aid	FA-103A	In patients with burns (P), does leaving the burn blister intact (I), compared with removing the blister (C), improve healing and pain control (O)?	Burn blister treatment	Adam J. Singer	<a href="http://circ.ahajournals.org/site/C2010/FA-103A.pdf">http://circ.ahajournals.org/site/C2010/FA-103A.pdf</a>
First Aid	FA-104C	Does the use of wet dressings (I) compared with dry dressings (C) improve healing and pain control (O) in patients after thermal injuries (P)?	Application of dressing for thermal burn	Adam J. Singer, Jeff Guy	<a href="http://circ.ahajournals.org/site/C2010/FA-104C.pdf">http://circ.ahajournals.org/site/C2010/FA-104C.pdf</a>
First Aid	FA-1201A	In a patient (P) experiencing difficulty breathing, does administration of a bronchodilator (I) compared with not administration (C) improve outcome (O)?	Bronchodilator administration	Rita Herrington, Jeff Woodin	<a href="http://circ.ahajournals.org/site/C2010/FA-1201A.pdf">http://circ.ahajournals.org/site/C2010/FA-1201A.pdf</a>
First Aid	FA-1204A	In patients with chest pain (P), does helping administer aspirin (I), compared with not administering aspirin (C), improve outcomes (O)?	Lay rescuer medication administration	Rita Herrington	<a href="http://circ.ahajournals.org/site/C2010/FA-1204A.pdf">http://circ.ahajournals.org/site/C2010/FA-1204A.pdf</a>
First Aid	FA-1204B	In patients with chest pain (P), does helping administer aspirin (I), compared with not administering aspirin (C), improve outcomes (O)?	Lay rescuer medication administration	Adam J. Singer	<a href="http://circ.ahajournals.org/site/C2010/FA-1204B.pdf">http://circ.ahajournals.org/site/C2010/FA-1204B.pdf</a>
First Aid	FA-1301B	Does irrigation of eyes exposed to a toxin with water compared to other substances improve outcome?	Irrigation of eyes	Ralph Shenefelt	<a href="http://circ.ahajournals.org/site/C2010/FA-1301B.pdf">http://circ.ahajournals.org/site/C2010/FA-1301B.pdf</a>
First Aid	FA-1401B	In persons with acute skin exposure to potentially toxic substances, does irrigation with ambient temperature, not specifically sterilized water compared with no irrigation lead to less morbidity and/or mortality?	Irrigation of skin for toxic substance exposure	Kristian L. Arnold	<a href="http://circ.ahajournals.org/site/C2010/FA-1401B.pdf">http://circ.ahajournals.org/site/C2010/FA-1401B.pdf</a>
First Aid	FA-1601A	What is the optimal position for a person in shock? Does elevating the legs improve outcome?	Optimal position for shock victim	Jonathan L. Epstein	<a href="http://circ.ahajournals.org/site/C2010/FA-1601A.pdf">http://circ.ahajournals.org/site/C2010/FA-1601A.pdf</a>
First Aid	FA-1601C	What is the optimal position for a person in shock? Does elevating the legs improve outcome?	Optimal position for shock victim	Susanne Schunder-Tatzber	<a href="http://circ.ahajournals.org/site/C2010/FA-1601C.pdf">http://circ.ahajournals.org/site/C2010/FA-1601C.pdf</a>
First Aid	FA-1705A	In hypohydrated individuals (P) does providing fluids (I) as compared to providing no fluids (C) decrease symptoms (O)? In hypohydrated individuals (P) does a carbohydrate-electrolyte beverage (I) compared to water (C) rehydrate individuals (O)?	Carbohydrate-electrolyte vs water in dehydration	Susan W. Yeargin	<a href="http://circ.ahajournals.org/site/C2010/FA-1705A.pdf">http://circ.ahajournals.org/site/C2010/FA-1705A.pdf</a>
First Aid	FA-1706A	In victims with heat exhaustion or heat syncope (P) what treatment (I) as opposed to no treatment (C) decreases/resolves symptoms (O)?	Best fluid for oral rehydration	Susan W. Yeargin	<a href="http://circ.ahajournals.org/site/C2010/FA-1706A.pdf">http://circ.ahajournals.org/site/C2010/FA-1706A.pdf</a>
First Aid	FA-1801A	Is there a treatment for human or animal bites that improves outcome?	First aid for human and animal bites	Jeffrey D. Ferguson	<a href="http://circ.ahajournals.org/site/C2010/FA-1801A.pdf">http://circ.ahajournals.org/site/C2010/FA-1801A.pdf</a>
First Aid	FA-1806-1B	In individuals who have received a jellyfish sting (P), does the application of heat or cold (I) decrease pain or prevent worsening (O) as compared to not applying heat or cold (C)?	Temperature treatment for jellyfish sting	Neal Pollock, Jeanette Previdi, Karyl Reid, Rick Caissie	<a href="http://circ.ahajournals.org/site/C2010/FA-1806-1B.pdf">http://circ.ahajournals.org/site/C2010/FA-1806-1B.pdf</a>
First Aid	FA-1806-2B	In individuals who have received a jellyfish sting (P), does the application of a topical (i.e. vinegar, baking soda, meat tenderizer, or commercial product) (I) decrease pain or prevent worsening (O) as compared to not applying a topical (C)?	Topical application for jellyfish sting	Neal Pollock, Jeanette Previdi, Karyl Reid, Rick Caissie	<a href="http://circ.ahajournals.org/site/C2010/FA-1806-2B.pdf">http://circ.ahajournals.org/site/C2010/FA-1806-2B.pdf</a>
First Aid	FA-1806-3B	In individuals who have received a jellyfish sting (P), does the application of a pressure immobilization bandage (I) decrease pain or prevent worsening (O) as compared to not applying a pressure immobilization bandage (C)?	Pressure immobilization bandage for jellyfish sting	Neal Pollock, Jeanette Previdi, Karyl Reid, Rick Caissie	<a href="http://circ.ahajournals.org/site/C2010/FA-1806-3B.pdf">http://circ.ahajournals.org/site/C2010/FA-1806-3B.pdf</a>
First Aid	FA-2001A	In breathing but unresponsive victims (P), does positioning the victim in a lateral, side-lying, recovery position (i.e. lateral recumbent or modified HAINES) (I) decrease complications (O) as compared to leaving them in a supine position (C)?	Positioning breathing but unresponsive victim	Jeanette Previdi, Karyl Reid	<a href="http://circ.ahajournals.org/site/C2010/FA-2001A.pdf">http://circ.ahajournals.org/site/C2010/FA-2001A.pdf</a>
First Aid	FA-201B	In a patient who ingests a potentially poisonous substance (P), does the administration of activated charcoal (I), when compared to no administration (C), improve that patient's outcome (O)?		Christopher P. Holstege, Jeffrey D. Ferguson	<a href="http://circ.ahajournals.org/site/C2010/FA-201B.pdf">http://circ.ahajournals.org/site/C2010/FA-201B.pdf</a>

(Continued)

CoSTR Part 13: Worksheet Appendix, *Continued*

Task Force	WS ID	PICO Title	Short Title	Authors	URL
First Aid	FA-202A	In victims with oral caustic substance poisoning, does the early administration of milk or water as compared to nothing by mouth, improve outcome?	Use of milk or water for oral caustic poisoning	Christopher P. Holstege	<a href="http://circ.ahajournals.org/site/C2010/FA-202A.pdf">http://circ.ahajournals.org/site/C2010/FA-202A.pdf</a>
First Aid	FA-203B	In victims with oral poisoning does the administration of syrup of ipecac by lay public improve outcome?	Early ipecac administration in oral poisoning	Sue O. Kell, Christopher P. Holstege	<a href="http://circ.ahajournals.org/site/C2010/FA-203B.pdf">http://circ.ahajournals.org/site/C2010/FA-203B.pdf</a>
First Aid	FA-2101A	In First Aid Training (P), does the use of simulation (I) when compared with not using simulation (C) improve the participant effectiveness (O)?	Simulated patients in First Aid training	Pascal Cassan, Sue O. Kell, Daniel Meyran, Vincent Hubert, Cara B. Doughty	<a href="http://circ.ahajournals.org/site/C2010/FA-2101A.pdf">http://circ.ahajournals.org/site/C2010/FA-2101A.pdf</a>
First Aid	FA-2101B	In First Aid Training (P), does the use of simulation (I) when compared with not using simulation (C) improve the participant effectiveness (O)?	Simulated patients in First Aid training	Sue O. Kell	<a href="http://circ.ahajournals.org/site/C2010/FA-2101B.pdf">http://circ.ahajournals.org/site/C2010/FA-2101B.pdf</a>
First Aid	FA-2102A	In First Aid Training, which techniques of monitoring and evaluation of progress and performance is able to show the improvement of the participant skills?	Monitoring and evaluation of First Aid performance	Pascal Cassan, Daniel Meyran, Vincent Hubert	<a href="http://circ.ahajournals.org/site/C2010/FA-2102A.pdf">http://circ.ahajournals.org/site/C2010/FA-2102A.pdf</a>
First Aid	FA-2103A	In First Aid Training (P) how frequently are retraining/update sessions required (I) in order to maintain the participant's skills (O).	First Aid retraining	Pascal Cassan, Daniel Meyran, Vincent Hubert	<a href="http://circ.ahajournals.org/site/C2010/FA-2103A.pdf">http://circ.ahajournals.org/site/C2010/FA-2103A.pdf</a>
First Aid	FA-2201A	Helmet removal after motorcycle accident—When? How? One—helper/ two helper techniques?	Motorcycle helmet removal	David Berry	<a href="http://circ.ahajournals.org/site/C2010/FA-2201A.pdf">http://circ.ahajournals.org/site/C2010/FA-2201A.pdf</a>
First Aid	FA-2301B	Which position might be the best for victims of possible head injury if they are unconsciousness?	Positioning possible head injury	Hong Shen	<a href="http://circ.ahajournals.org/site/C2010/FA-2301B.pdf">http://circ.ahajournals.org/site/C2010/FA-2301B.pdf</a>
First Aid	FA-2401A	What is the best first aid treatment of an open chest wound?	First aid treatment for open chest wound	Hong Shen	<a href="http://circ.ahajournals.org/site/C2010/FA-2401A.pdf">http://circ.ahajournals.org/site/C2010/FA-2401A.pdf</a>
First Aid	FA-302A	Does the administration of a second dose of injectable epinephrine improve outcome from a severe allergic reaction?	Second dose of injectable epinephrine	Kristian L. Arnold	<a href="http://circ.ahajournals.org/site/C2010/FA-302A.pdf">http://circ.ahajournals.org/site/C2010/FA-302A.pdf</a>
First Aid	FA-302B	Does the administration of a second dose of injectable epinephrine improve outcome from a severe allergic reaction?	Second dose of injectable epinephrine	Brad Yeargin	<a href="http://circ.ahajournals.org/site/C2010/FA-302B.pdf">http://circ.ahajournals.org/site/C2010/FA-302B.pdf</a>
First Aid	FA-303B	Can the first aid provider appropriately recognize the signs and symptoms of anaphylaxis?	Recognition of anaphylaxis	Jonathan L. Epstein, Norda Ratcliff	<a href="http://circ.ahajournals.org/site/C2010/FA-303B.pdf">http://circ.ahajournals.org/site/C2010/FA-303B.pdf</a>
First Aid	FA-401C	In a bleeding victim do direct pressure, indirect pressure (pressure points), or elevation of the bleeding part help control bleeding as compared to doing nothing?	Control of bleeding	Leon Chameides, Jeff Guy, Jeffrey L. Pellegrino	<a href="http://circ.ahajournals.org/site/C2010/FA-401C.pdf">http://circ.ahajournals.org/site/C2010/FA-401C.pdf</a>
First Aid	FA-402C	When direct pressure fails to stop bleeding does the administration of a tourniquet improve outcome?	Tourniquet if direct pressure fails	Leon Chameides, Jeff Guy, Jeffrey L. Pellegrino	<a href="http://circ.ahajournals.org/site/C2010/FA-402C.pdf">http://circ.ahajournals.org/site/C2010/FA-402C.pdf</a>
First Aid	FA-402D	When direct pressure fails to stop bleeding does the administration of a tourniquet improve outcome?	Tourniquet if direct pressure fails	Susanne Schunder-Tatzber	<a href="http://circ.ahajournals.org/site/C2010/FA-402D.pdf">http://circ.ahajournals.org/site/C2010/FA-402D.pdf</a>
First Aid	FA-403A	In which circumstances are the application of a tourniquet appropriate?	Appropriate circumstances for tourniquet	Jeffrey S. Guy, Jeffrey L. Pellegrino	<a href="http://circ.ahajournals.org/site/C2010/FA-403A.pdf">http://circ.ahajournals.org/site/C2010/FA-403A.pdf</a>
First Aid	FA-403C	In which circumstances are the application of a tourniquet appropriate?	Appropriate circumstances for tourniquet	Leon Chameides	<a href="http://circ.ahajournals.org/site/C2010/FA-403C.pdf">http://circ.ahajournals.org/site/C2010/FA-403C.pdf</a>
First Aid	FA-404B	In patients with severe external bleeding (P), does the application of topical haemostatic agents (I) when compared with usual care (C) improve outcome? (O).	Topical hemostatic agents if direct pressure fails	Barbara Caracci	<a href="http://circ.ahajournals.org/site/C2010/FA-404B.pdf">http://circ.ahajournals.org/site/C2010/FA-404B.pdf</a>
First Aid	FA-404C	In patients with severe external bleeding (P), does the application of topical haemostatic agents (I) when compared with usual care (C) improve outcome? (O).	Topical hemostatic agents if direct pressure fails	Richard N. Bradley	<a href="http://circ.ahajournals.org/site/C2010/FA-404C.pdf">http://circ.ahajournals.org/site/C2010/FA-404C.pdf</a>
First Aid	FA-404D	In patients with severe external bleeding (P), does the application of topical haemostatic agents (I) when compared with usual care (C) improve outcome? (O).	Topical hemostatic agents if direct pressure fails	Pascal Cassan	<a href="http://circ.ahajournals.org/site/C2010/FA-404D.pdf">http://circ.ahajournals.org/site/C2010/FA-404D.pdf</a>
First Aid	FA-501A	In victims with suspected cervical spinal injury does spinal immobilization benefit the patient over doing nothing in outcome?	Spine immobilization	William Smith, Juan Acosta, Arthur Cooper, Paul Satterlee	<a href="http://circ.ahajournals.org/site/C2010/FA-501A.pdf">http://circ.ahajournals.org/site/C2010/FA-501A.pdf</a>
First Aid	FA-501D	In victims with suspected cervical spinal injury does spinal immobilization benefit the patient over doing nothing in outcome?	Spine immobilization	Paul Satterlee, William Smith, Arthur Cooper, Juan Acosta	<a href="http://circ.ahajournals.org/site/C2010/FA-501D.pdf">http://circ.ahajournals.org/site/C2010/FA-501D.pdf</a>
First Aid	FA-502E	In victims with trauma, when should one suspect cervical spinal injury?	Cervical spine injury prognostication	Jonathan I. Groner, William Smith	<a href="http://circ.ahajournals.org/site/C2010/FA-502E.pdf">http://circ.ahajournals.org/site/C2010/FA-502E.pdf</a>

(Continued)



CoSTR Part 13: Worksheet Appendix, *Continued*

Task Force	WS ID	PICO Title	Short Title	Authors	URL
First Aid	FA-503A	In victims suspected to have spinal injury, what method(s) should be used for spinal motion restriction by the first aid provider? Which are effective methods of spinal motion restriction in persons with suspected cervical spinal injury?	Spinal motion restriction methods in suspected cervical spine injury	William Smith, William Raynovich, Juan Acosta, Arthur Cooper	<a href="http://circ.ahajournals.org/site/C2010/FA-503A.pdf">http://circ.ahajournals.org/site/C2010/FA-503A.pdf</a>
First Aid	FA-601A	In a patient with a closed joint injury (P), does the application of a compression bandage by a lay rescuer (I) decrease pain and swelling as compared to not applying a compression bandage (O)?	Compression bandage	Rick Caissie	<a href="http://circ.ahajournals.org/site/C2010/FA-601A.pdf">http://circ.ahajournals.org/site/C2010/FA-601A.pdf</a>
First Aid	FA-601B	In a patient with a closed joint injury (P), does the application of a compression bandage by a lay rescuer (I) decrease pain and swelling as compared to not applying a compression bandage (O)?	Compression bandage	Rita Herrington	<a href="http://circ.ahajournals.org/site/C2010/FA-601B.pdf">http://circ.ahajournals.org/site/C2010/FA-601B.pdf</a>
First Aid	FA-602A	Does straightening angulated suspected long bone fractures when compared with immobilizing in found position, improve the (management of pain; safer transport; prognosis)?	Suspected long bone fracture	Jeffrey L. Pellegrino	<a href="http://circ.ahajournals.org/site/C2010/FA-602A.pdf">http://circ.ahajournals.org/site/C2010/FA-602A.pdf</a>
First Aid	FA-602B	Does straightening angulated suspected long bone fractures when compared with immobilizing in found position, improve the (management of pain; safer transport; prognosis)?	Suspected long bone fracture	Kristian L. Arnold	<a href="http://circ.ahajournals.org/site/C2010/FA-602B.pdf">http://circ.ahajournals.org/site/C2010/FA-602B.pdf</a>
First Aid	FA-603C	Does cooling of a musculoskeletal injury improve outcome? And if so, what is the optimal method of cooling?	Cooling musculoskeletal injury	Keiichi Ikegami, Cara B. Doughty	<a href="http://circ.ahajournals.org/site/C2010/FA-603C.pdf">http://circ.ahajournals.org/site/C2010/FA-603C.pdf</a>
First Aid	FA-604A	In individuals with musculoskeletal injury (P) does heat application (I) as opposed to no treatment (C) improve tissue healing? In individuals with musculoskeletal injury (P) which type of heat application (I) compared to other methods is more effective (C) and improves healing better (O)?	Heating musculoskeletal injury	Blaine C. Long	<a href="http://circ.ahajournals.org/site/C2010/FA-604A.pdf">http://circ.ahajournals.org/site/C2010/FA-604A.pdf</a>
First Aid	FA-604B	In individuals with musculoskeletal injury (P) does heat application (I) as opposed to no treatment (C) improve tissue healing? In individuals with musculoskeletal injury (P) which type of heat application (I) compared to other methods is more effective (C) and improves healing better (O)?	Heating musculoskeletal injury	Lisa S. Jutte	<a href="http://circ.ahajournals.org/site/C2010/FA-604B.pdf">http://circ.ahajournals.org/site/C2010/FA-604B.pdf</a>
First Aid	FA-605A	In patients with suspected extremity fractures (P), does stabilization (I) compared to no stabilization (C) reduce pain and lead to better functional recovery (O)?	Stabilizing extremity	Richard N. Bradley	<a href="http://circ.ahajournals.org/site/C2010/FA-605A.pdf">http://circ.ahajournals.org/site/C2010/FA-605A.pdf</a>
First Aid	FA-606B	What is the appropriate method of preservation of the amputated part?	Preservation of amputated body part	Andrew MacPherson	<a href="http://circ.ahajournals.org/site/C2010/FA-606B.pdf">http://circ.ahajournals.org/site/C2010/FA-606B.pdf</a>
First Aid	FA-701A	In patients with difficulty breathing or complaints of chest pain, does administration of oxygen improve outcome?	Oxygen administration	Louis Gonzales	<a href="http://circ.ahajournals.org/site/C2010/FA-701A.pdf">http://circ.ahajournals.org/site/C2010/FA-701A.pdf</a>
First Aid	FA-801B	Does the use of a topical agent and/or dressing (I) for superficial wounds (I) improve healing (O) when compared to no topical therapy (C)?	Topical agent or dressing	Adam J. Singer, Cara B. Doughty, Samantha Roberts	<a href="http://circ.ahajournals.org/site/C2010/FA-801B.pdf">http://circ.ahajournals.org/site/C2010/FA-801B.pdf</a>
First Aid	FA-802B	Does the use of irrigation (I) compared with no irrigation (C) improve healing (O) in patients with superficial wounds (P)?	Irrigation of a superficial wound	Adam J. Singer	<a href="http://circ.ahajournals.org/site/C2010/FA-802B.pdf">http://circ.ahajournals.org/site/C2010/FA-802B.pdf</a>
First Aid	FA-901B	Does rewarming of a localized cold injury (frostbite) improve outcome?	Rewarming frostbite	Eunice M. Singletary, Olav Aasland	<a href="http://circ.ahajournals.org/site/C2010/FA-901B.pdf">http://circ.ahajournals.org/site/C2010/FA-901B.pdf</a>
First Aid	FA-902B	In patients with frostbite, does the use of an anti-inflammatory, when compared with usual care, improve outcome?	Anti-inflammatory and frostbite	Eunice M. Singletary, Olav Aasland	<a href="http://circ.ahajournals.org/site/C2010/FA-902B.pdf">http://circ.ahajournals.org/site/C2010/FA-902B.pdf</a>

## References

- 2005 International Consensus on Cardiopulmonary Resuscitation And Emergency Cardiovascular Care Science With Treatment Recommendations, Section 2 Part 10: First Aid. *Circulation*. 2005;112:III-115–III-125.
- Mauil KI, Osmand AP, Mauil CD. Liquid caustic ingestions: An in vitro study of the effects of buffer, neutralization, and dilution. *Ann Emerg Med*. 1985;14:1160–1162.
- Homan CS, Maitra SR, Lane BP, Geller ER. Effective treatment of acute alkali injury of the rat esophagus with early saline dilution therapy. *Ann Emerg Med*. 1993;22:178–182.
- Homan CS, Maitra SR, Lane BP, Thode HC, Sable M. Therapeutic effects of water and milk for acute alkali injury of the esophagus. *Ann Emerg Med*. 1994;24:14–20.
- Homan CS, Maitra SR, Lane BP, Thode HC Jr, Davidson L. Histopathologic evaluation of the therapeutic efficacy of water and milk dilution for esophageal acid injury. *Acad Emerg Med*. 1995;2:587–591.
- Homan CS, Singer AJ, Henry MC, Thode HC Jr. Thermal effects of neutralization therapy and water dilution for acute alkali exposure in canines. *Acad Emerg Med*. 1997;4:27–32.
- Homan CS, Singer AJ, Thomajan C, Henry MC, Thode HC Jr. Thermal characteristics of neutralization therapy and water dilution for strong acid ingestion: An in-vivo canine model. *Acad Emerg Med*. 1998;5:286–292.
- Kulig K, Bar-Or D, Cantrill SV, Rosen P, Rumack BH. Management of acutely poisoned patients without gastric emptying. *Ann Emerg Med*. 1985;14:562–567.
- Pond SM, Lewis-Driver DJ, Williams GM, Green AC, Stevenson NW. Gastric emptying in acute overdose: A prospective randomised controlled trial. *Med J Aust*. 1995;163:345–349.
- Caravati EM. Unintentional acetaminophen ingestion in children and the potential for hepatotoxicity. *J Toxicol Clin Toxicol*. 2000;38:291–296.
- Czajka PA, Russell SL. Nonemetic effects of ipecac syrup. *Pediatrics*. 1985;75:1101–1104.

12. Kornberg AE, Dolgin J. Pediatric ingestions: Charcoal alone versus ipecac and charcoal. *Ann Emerg Med.* 1991;20:648–651.
13. Bond G. Home syrup of ipecac use does not reduce emergency department use or improve outcome. *Pediatrics.* 2003;112:1061–1064.
14. Spiller HA, Rodgers GC Jr. Evaluation of administration of activated charcoal in the home. *Pediatrics.* 2001;108:E100.
15. Lamminpaa A, Vilksa J, Hoppu K. Medical charcoal for a child's poisoning at home: Availability and success of administration in Finland. *Hum Exp Toxicol.* 1993;12:29–32.
16. Scharman EJ, Cloonan HA, Durbach-Morris LF. Home administration of charcoal: Can mothers administer a therapeutic dose? *J Emerg Med.* 2001;21:357–361.
17. Kim JS, Sinacore JM, Pongracic JA. Parental use of EpiPen for children with food allergies. *J Allergy Clin Immunol.* 2005;116:164–168.
18. Sicherer SH, Simons FE. Quandaries in prescribing an emergency action plan and self-injectable epinephrine for first-aid management of anaphylaxis in the community. *J Allergy Clin Immunol.* 2005;115:575–583.
19. Pouessel G, Deschilde A, Castelain C, Sardet A, Sagot-Bevenot S, de Saue-Boeuf A, Thumerelle C, Santos C. Parental knowledge and use of epinephrine auto-injector for children with food allergy. *Pediatr Allergy Immunol.* 2006;17:221–226.
20. Rainbow J, Browne GJ. Fatal asthma or anaphylaxis? *Emerg Med J.* 2002;19:415–417.
21. Sicherer SH, Simons FE. Self-injectable epinephrine for first-aid management of anaphylaxis. *Pediatrics.* 2007;119:638–646.
22. Klein JS, Yocum MW. Underreporting of anaphylaxis in a community emergency room. *J Allergy Clin Immunol.* 1995;95:637–638.
23. Gaca AM, Frush DP, Hohenhaus SM, Luo X, Ancarana A, Pickles A, Frush KS. Enhancing pediatric safety: Using simulation to assess radiology resident preparedness for anaphylaxis from intravenous contrast media. *Radiology.* 2007;245:236–244.
24. Gold MS, Sainsbury R. First aid anaphylaxis management in children who were prescribed an epinephrine autoinjector device (EpiPen). *J Allergy Clin Immunol.* 2000;106:171–176.
25. Korenblat P, Lundie MJ, Dankner RE, Day JH. A retrospective study of epinephrine administration for anaphylaxis: How many doses are needed? *Allergy Asthma Proc.* 1999;20:383–386.
26. Uguz A, Lack G, Pumphrey R, Ewan P, Warner J, Dick J, Briggs D, Clarke S, Reading D, Hourihane J. Allergic reactions in the community: A questionnaire survey of members of the anaphylaxis campaign. *Clin Exp Allergy.* 2005;35:746–750.
27. Rudders SA, Banerji A, Corel B, Clark S, Camargo CA Jr. Multicenter study of repeat epinephrine treatments for food-related anaphylaxis. *Pediatrics.* 2010;125:e711–e718.
28. Pumphrey RS. Lessons for management of anaphylaxis from a study of fatal reactions. *Clin Exp Allergy.* 2000;30:1144–1150.
29. Horowitz BZ, Jadallah S, Derlet RW. Fatal intracranial bleeding associated with prehospital use of epinephrine. *Ann Emerg Med.* 1996;28:725–727.
30. Davis CO, Wax PM. Prehospital epinephrine overdose in a child resulting in ventricular dysrhythmias and myocardial ischemia. *Pediatr Emerg Care.* 1999;15:116–118.
31. Anchor J, Settignano RA. Appropriate use of epinephrine in anaphylaxis. *Am J Emerg Med.* 2004;22:488–490.
32. Ellis AK, Day JH. Incidence and characteristics of biphasic anaphylaxis: A prospective evaluation of 103 patients. *Ann Allergy Asthma Immunol.* 2007;98:64–69.
33. Longphre JM, Denoble PJ, Moon RE, Vann RD, Freiberger JJ. First aid normobaric oxygen for the treatment of recreational diving injuries. *Undersea Hyperb Med.* 2007;34:43–49.
34. Madias JE, Hood WB Jr. Reduction of precordial ST-segment elevation in patients with anterior myocardial infarction by oxygen breathing. *Circulation.* 1976;53:1198–1200.
35. Rawles JM, Kenmure AC. Controlled trial of oxygen in uncomplicated myocardial infarction. *BMJ.* 1976;1:1121–1123.
36. Nicholson C. A systematic review of the effectiveness of oxygen in reducing acute myocardial ischaemia. *J Clin Nurs.* 2004;13:996–1007.
37. Austin KG, Mengelkoch L, Hansen J, Shahady E, Sirithienthad P, Panton L. Comparison of oxygenation in peripheral muscle during submaximal aerobic exercise, in persons with COPD and healthy, matched-control persons. *Int J Chron Obstruct Pulmon Dis.* 2006;1:467–475.
38. Zijlstra F, Ernst N, De Boer M-J, Nibbering E, Suryapranata H, Hoorntje JCA, Dambrink J-HE, Van't Hof AWJ, Verheugt FWA. Influence of prehospital administration of aspirin and heparin on initial patency of the infarct-related artery in patients with acute ST elevation myocardial infarction. *J Am Coll Cardiol.* 2002;39:1733–1737.
39. ISIS-2 (Second International Study of Infarct Survival) Collaborative Group. Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2. *Lancet.* 1988;2:349–360.
40. Barbash IM, Freemark D, Gottlieb S, Hod H, Hasin Y, Battler A, Crystal E, Matetzky S, Boyko V, Mandelzweig L, Behar S, Leor J. Outcome of myocardial infarction in patients treated with aspirin is enhanced by pre-hospital administration. *Cardiology.* 2002;98:141–147.
41. Wilcox RG, von der Lippe G, Olsson CG, Jensen G, Skene AM, Hampton JR. Trial of tissue plasminogen activator for mortality reduction in acute myocardial infarction. Anglo-Scandinavian Study of Early Thrombolysis (ASSET). *Lancet.* 1988;2:525–530.
42. Blake WE, Stillman BC, Eizenberg N, Briggs C, McMeeken JM. The position of the spine in the recovery position—an experimental comparison between the lateral recovery position and the modified HAINES position. *Resuscitation.* 2002;53:289–297.
43. Gunn BD, Eizenberg N, Silberstein M, McMeeken JM, Tully EA, Stillman BC, Brown DJ, Gutteridge GA. How should an unconscious person with a suspected neck injury be positioned? *Prehospital Disaster Med.* 1995;10:239–244.
44. Fulstow R, Smith GB. The new recovery position, a cautionary tale. *Resuscitation.* 1993;26:89–91.
45. Rathgeber J, Panzer W, Gunther U, Scholz M, Hoefl A, Bahr J, Kettler D. Influence of different types of recovery positions on perfusion indices of the forearm. *Resuscitation.* 1996;32:13–17.
46. Turner S, Turner I, Chapman D, Howard P, Champion P, Hatfield J, James A, Marshall S, Barber S. A comparative study of the 1992 and 1997 recovery positions for use in the UK. *Resuscitation.* 1998;39:153–160.
47. Doxey J. Comparing 1997 Resuscitation Council (UK) recovery position with recovery position of 1992 European Resuscitation Council guidelines: A user's perspective. *Resuscitation.* 1998;39:161–169.
48. Kumar P, Touquet R. Perils of the recovery position: Neurapraxia of radial and common peroneal nerve. *J Accid Emerg Med.* 1996;13:69–70.
49. Leaves S, Donnelly P, Lester C, Assar D. Resuscitation: Trainees' adverse experiences of the new recovery position. *BMJ.* 1998;316:1748–1749.
50. Adnet F, Borron SW, Finot MA, Minadeo J, Baud FJ. Relation of body position at the time of discovery with suspected aspiration pneumonia in poisoned comatose patients. *Crit Care Med.* 1999;27:745–748.
51. Ryan AD, Larsen PD, Galletly DC. Comparison of heart rate variability in supine, and left and right lateral positions. *Anaesthesia.* 2003;58:432–436.
52. Gaffney FA, Bastian BC, Thal ER, Atkins JM, Blomqvist CG. Passive leg raising does not produce a significant or sustained autotransfusion effect. *J Trauma.* 1982;22:190–193.
53. Ostrow CL. Use of the Trendelenburg position by critical care nurses: Trendelenburg survey. *Am J Crit Care.* 1997;6:172–176.
54. Reich DL, Konstadt SN, Raissi S, Hubbard M, Thys DM. Trendelenburg position and passive leg raising do not significantly improve cardiopulmonary performance in the anesthetized patient with coronary artery disease. *Crit Care Med.* 1989;17:313–317.
55. Johnson BA, Stark II, phase II. Positive changes and lingering uncertainties. *MGMA Connex.* 2004;4:48–51, 41.
56. Shammas A, Clark AP. Trendelenburg positioning to treat acute hypotension: Helpful or harmful? *Clin Nurse Spec.* 2007;21:181–187.
57. Wong DH, O'Connor D, Tremper KK, Zaccari J, Thompson P, Hill D. Changes in cardiac output after acute blood loss and position change in man. *Crit Care Med.* 1989;17:979–983.
58. Wong DH, Tremper KK, Zaccari J, Hajduczek J, Konchigeri HN, Hufstetler SM. Acute cardiovascular response to passive leg raising. *Crit Care Med.* 1988;16:123–125.
59. Boulain T, Achard JM, Teboul JL, Richard C, Perrotin D, Ginies G. Changes in BP induced by passive leg raising predict response to fluid loading in critically ill patients. *Chest.* 2002;121:1245–1252.
60. Teboul JL, Monnet X. Prediction of volume responsiveness in critically ill patients with spontaneous breathing activity. *Curr Opin Crit Care.* 2008;14:334–339.
61. Hoffman JR, Mower WR, Wolfson AB, Todd KH, Zucker MI; National Emergency X-Radiography Utilization Study Group. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. *N Engl J Med.* 2000;343:94–99.

62. Viccellio P, Simon H, Pressman BD, Shah MN, Mower WR, Hoffman JR. A prospective multicenter study of cervical spine injury in children. *Pediatrics*. 2001;108:E20.
63. Touger M, Gennis P, Nathanson N, Lowery DW, Pollack CV Jr., Hoffman JR, Mower WR. Validity of a decision rule to reduce cervical spine radiography in elderly patients with blunt trauma. *Ann Emerg Med*. 2002;40:287–293.
64. Panacek EA, Mower WR, Holmes JF, Hoffman JR. Test performance of the individual NEXUS low-risk clinical screening criteria for cervical spine injury. *Ann Emerg Med*. 2001;38:22–25.
65. Stiell IG, Wells GA, Vandemheen KL, Clement CM, Lesiuk H, De Maio VJ, Laupacis A, Schull M, McKnight RD, Verbeek R, Brison R, Cass D, Dreyer J, Eisenhauer MA, Greenberg GH, MacPhail I, Morrison L, Reardon M, Worthington J. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA*. 2001;286:1841–1848.
66. Pieretti-Vanmarcke R, Velmahos GC, Nance ML, Islam S, Falcone RA Jr, Wales PW, Brown RL, Gaines BA, McKenna C, Moore FO, Goslar PW, Inaba K, Barmparas G, Scaife ER, Metzger RR, Brockmeyer DL, Upperman JS, Estrada J, Lanning DA, Rasmussen SK, Danielson PD, Hirsh MP, Consani HF, Stylianos S, Pineda C, Norwood SH, Bruch SW, Drongowski R, Barraco RD, Pasquale MD, Hussain F, Hirsch EF, McNeely PD, Fallat ME, Foley DS, Iacono JA, Bennett HM, Waxman K, Kam K, Bakhos L, Petrovick L, Chang Y, Masiakos PT. Clinical clearance of the cervical spine in blunt trauma patients younger than 3 years: A multi-center study of the American Association for the Surgery of Trauma. *J Trauma*. 2009;67:543–549; discussion 549–550.
67. Domeier RM, Evans RW, Swor RA, Hancock JB, Fales W, Krohmer J, Frederiksen SM, Shork MA. The reliability of prehospital clinical evaluation for potential spinal injury is not affected by the mechanism of injury. *Prehosp Emerg Care*. 1999;3:332–337.
68. Domeier RM, Evans RW, Swor RA, Rivera-Rivera EJ, Frederiksen SM. Prehospital clinical findings associated with spinal injury. *Prehosp Emerg Care*. 1997;1:11–15.
69. Sahni R, Menegazzi JJ, Mosesso VN. Paramedic evaluation of clinical indicators of cervical spinal injury. *Prehosp Emerg Care*. 1997;1:16–18.
70. Brown LH, Gough JE, Simonds WB. Can ems providers adequately assess trauma patients for cervical spinal injury? *Prehosp Emerg Care*. 1998;2:33–36.
71. Pennardt AM, Zehner WJ Jr. Paramedic documentation of indicators for cervical spine injury. *Prehospital Disaster Med*. 1994;9:40–43.
72. Meldon SW, Brant TA, Cydulka RK, Collins TE, Shade BR. Out-of-hospital cervical spine clearance: Agreement between emergency medical technicians and emergency physicians. *J Trauma*. 1998;45:1058–1061.
73. Muhr MD, Seabrook DL, Wittwer LK. Paramedic use of a spinal injury clearance algorithm reduces spinal immobilization in the out-of-hospital setting. *Prehosp Emerg Care*. 1999;3:1–6.
74. Stroh G, Braude D. Can an out-of-hospital cervical spine clearance protocol identify all patients with injuries? An argument for selective immobilization. *Ann Emerg Med*. 2001;37:609–615.
75. Domeier RM, Frederiksen SM, Welch K. Prospective performance assessment of an out-of-hospital protocol for selective spine immobilization using clinical spine clearance criteria. *Ann Emerg Med*. 2005;46:123–131.
76. Domeier RM, Swor RA, Evans RW, Hancock JB, Fales W, Krohmer J, Frederiksen SM, Rivera-Rivera EJ, Schork MA. Multicenter prospective validation of prehospital clinical spinal clearance criteria. *J Trauma*. 2002;53:744–750.
77. Burton JH, Harmon NR, Dunn MG, Bradshaw JR. EMS provider findings and interventions with a statewide EMS spine-assessment protocol. *Prehosp Emerg Care*. 2005;9:303–309.
78. Burton JH, Dunn MG, Harmon NR, Hermanson TA, Bradshaw JR. A statewide, prehospital emergency medical service selective patient spine immobilization protocol. *J Trauma*. 2006;61:161–167.
79. Hauswald M, Ong G, Tandberg D, Omar Z. Out-of-hospital spinal immobilization: Its effect on neurologic injury. *Acad Emerg Med*. 1998;5:214–219.
80. Crosby ET. Tracheal intubation in the cervical spine-injured patient. *Can J Anaesth*. 1992;39:105–109.
81. Bohlman HH. Acute fractures and dislocations of the cervical spine. An analysis of three hundred hospitalized patients and review of the literature. *J Bone Joint Surg Am*. 1979;61:1119–1142.
82. Sundheim SM, Cruz M. The evidence for spinal immobilization: An estimate of the magnitude of the treatment benefit. *Ann Emerg Med*. 2006;48:217–218; author reply 218–219.
83. Podolsky S, Baraff LJ, Simon RR, Hoffman JR, Larmon B, Ablon W. Efficacy of cervical spine immobilization methods. *J Trauma*. 1983;23:461–465.
84. Brimacombe J, Keller C, Kunzel KH, Gaber O, Boehler M, Puhlinger F. Cervical spine motion during airway management: A cinefluoroscopic study of the posteriorly destabilized third cervical vertebrae in human cadavers. *Anesth Analg*. 2000;91:1274–1278.
85. Bivins HG, Ford S, Bezmalinovic Z, Price HM, Williams JL. The effect of axial traction during orotracheal intubation of the trauma victim with an unstable cervical spine. *Ann Emerg Med*. 1988;17:25–29.
86. Tung KY, Chen ML, Wang HJ, Chen GS, Peck M, Yang J, Liu CC. A seven-year epidemiology study of 12,381 admitted burn patients in Taiwan—using the Internet registration system of the Childhood Burn Foundation. *Burns*. 2005;31(suppl 1):S12–S17.
87. Berberian GM. Temporary regional surface cooling and long-term hep- arinization in the therapy of burns. *Surgery*. 1960;48:391–393.
88. Li C, Yu D, Li MS. [Clinical and experiment study of cooling therapy on burned wound]. *Zhonghua Yi Xue Za Zhi*. 1997;77:586–588.
89. Matthews RN, Radakrishnan T. First-aid for burns. *Lancet*. 1987; 1:1371.
90. Nguyen NL, Gun RT, Sparnon AL, Ryan P. The importance of immediate cooling—a case series of childhood burns in Vietnam. *Burns*. 2002;28:173–176.
91. Grounds M. Immediate surface cooling in treatment of burns. *Med J Aust*. 1967;2:846–847.
92. lung OS, Wade FV. The treatment of burns with ice water, pHisoHex, and partial hypothermia. *Ind Med Surg*. 1963;32:365–370.
93. Rose HW. Initial cold water treatment for burns. *Northwest Med*. 1936; 35:267–270.
94. Shulman AG. Ice water as primary treatment of burns: Simple method of emergency treatment of burns to alleviate pain, reduce sequelae, and hasten healing. *JAMA*. 1960;173:1916–1919.
95. Bartlett N, Yuan J, Holland AJ, Harvey JG, Martin HC, La Hei ER, Arbuckle S, Godfrey C. Optimal duration of cooling for an acute scald contact burn injury in a porcine model. *J Burn Care Res*. 2008;29: 828–834.
96. Yuan J, Wu C, Holland AJ, Harvey JG, Martin HC, La Hei ER, Arbuckle S, Godfrey TC. Assessment of cooling on an acute scald burn injury in a porcine model. *J Burn Care Res*. 2007;28:514–520.
97. Blomgren I, Eriksson E, Bagge U. Effect of cold water immersion on oedema formation in the scalded mouse ear. *Burns Incl Therm Inj*. 1982;9:17–20.
98. Boykin JV Jr, Eriksson E, Sholley MM, Pittman RN. Cold-water treatment of scald injury and inhibition of histamine-mediated burn edema. *J Surg Res*. 1981;31:111–123.
99. Courtice FC. The effect of local temperature on fluid loss in thermal burns. *J Physiol*. 1946;104:321–345.
100. Cuttle L, Kempf M, Kravchuk O, Phillips GE, Mill J, Wang XQ, Kimble RM. The optimal temperature of first aid treatment for partial thickness burn injuries. *Wound Repair Regen*. 2008;16:626–634.
101. de Camara DL, Raine T, Robson MC. Ultrastructural aspects of cooled thermal injury. *J Trauma*. 1981;21:911–919.
102. Ferrer JM Jr, Crikelair GF, Armstrong D. Some effects of cooling on scald burns in the rat. *Surg Forum*. 1962;13:486–487.
103. Huang HM, Wang JH, Yang L, Yi ZH. [Effect of local treatment with cooling and spray film on early edema of superficial II degree scald burns in rats]. *Nan Fang Yi Ke Da Xue Xue Bao*. 2009;29:804–806.
104. Jandera V, Hudson DA, de Wet PM, Innes PM, Rode H. Cooling the burn wound: Evaluation of different modalities. *Burns*. 2000;26: 265–270.
105. King TC, Price PB. Surface cooling following extensive burns. *JAMA*. 1963;183:677–678.
106. King TC, Price PB, Reynolds LE. Local edema and capillary permeability associated with burn wounds. *Surg Forum*. 1956;6:80–84.
107. King TC, Zimmerman JM. Optimum temperatures for postburn cooling. *Arch Surg*. 1965;91:656–657.
108. King TC, Zimmerman JM. First-aid cooling of the fresh burn. *Surg Gynecol Obstet*. 1965;120:1271–1273.
109. Langohr JL, Rosenfeld L, et al. Effect of therapeutic cold on the circulation of blood and lymph in thermal burns; an experimental study. *Arch Surg*. 1949;59:1031–1044.
110. Moore DH, Worf DL. Effect of temperature on the transfer of serum proteins into tissues injured by tourniquet and by scald. *Am J Physiol*. 1952;170:616–623.

111. Ofeigsson OJ. Observations and experiments on the immediate cold water treatment for burns and scalds. *Br J Plast Surg*. 1959;12:104–119.
112. Ofeigsson OJ. First-aid treatment of scalds and burns by water cooling. *Postgrad Med*. 1961;30:330–338.
113. Ofeigsson OJ. Water cooling: First-aid treatment for scalds and burns. *Surgery*. 1965;57:391–400.
114. Ofeigsson OJ, Mitchell R, Patrick RS. Observations on the cold water treatment of cutaneous burns. *J Pathol*. 1972;108:145–150.
115. Raine TJ, Heggens JP, Robson MC, London MD, Johns L. Cooling the burn wound to maintain microcirculation. *J Trauma*. 1981;21:394–397.
116. Rajan V, Bartlett N, Harvey JG, Martin HC, La Hei ER, Arbuckle S, Godfrey C, Holland AJ. Delayed cooling of an acute scald contact burn injury in a porcine model: Is it worthwhile? *J Burn Care Res*. 2009;30:729–734.
117. Reynolds LE, Brown CR, Price PB. Effect of local chilling in the treatment of burns. *Surg Forum*. 1956;6:85–87.
118. Saranto JR, Rubayi S, Zawacki BE. Blisters, cooling, antithromboxanes, and healing in experimental zone-of-stasis burns. *J Trauma*. 1983;23:927–933.
119. Shulman AG, Wagner K. Effect of cold water immersion on burn edema in rabbits. *Surg Gynecol Obstet*. 1962;115:557–560.
120. Wiedeman MP, Brigham MP. The effects of cooling on the microvasculature after thermal injury. *Microvasc Res*. 1971;3:154–161.
121. Venter TH, Karpelowsky JS, Rode H. Cooling of the burn wound: The ideal temperature of the coolant. *Burns*. 2007;33:917–922.
122. Zhang LY, Li YJ, Luo BD, Li YL, Lin N. [Skin temperature changes in Wistar rats with second-degree scald injury in hot and humid environment after cooling therapy]. *Di Yi Jun Yi Da Xue Xue Bao*. 2004;24:1120–1122.
123. Purdue GF, Layton TR, Copeland CE. Cold injury complicating burn therapy. *J Trauma*. 1985;25:167–168.
124. Sawada Y, Urushidate S, Yotsuyanagi T, Ishita K. Is prolonged and excessive cooling of a scalded wound effective? *Burns*. 1997;23:55–58.
125. Baxter H, More RH. The effect of the local reduction of temperature on scald burns in the rat. *Ann Surg*. 1947;125:177–193.
126. Swain AH, Azadian BS, Wakeley CJ, Shakespeare PG. Management of blisters in minor burns. *BMJ (Clin Res Ed)*. 1987;295:181.
127. Forage AV. The effects of removing the epidermis from burnt skin. *Lancet*. 1962;2:690–693.
128. Cope O. The treatment of the surface burns. *Ann Surg*. 1943;117:885–893.
129. Gimbel NS, Kapetansky DI, Weissman F, Pinkus HK. A study of epithelialization in blistered burns. *AMA Arch Surg*. 1957;74:800–803.
130. Wheeler ES, Miller TA. The blister and the second degree burn in guinea pigs: The effect of exposure. *Plast Reconstr Surg*. 1976;57:74–83.
131. Singer AJ, Mohammad M, Tortora G, Thode H CJ, McClain SA. Octyl-cyanoacrylate for the treatment of contaminated partial-thickness burns in swine: A randomized controlled experiment. *Acad Emerg Med*. 2000;7:222–227.
132. Singer AJ, Thode H CJ, McClain SA. The effects of epidermal debridement of partial-thickness burns on infection and reepithelialization in swine. *Acad Emerg Med*. 2000;7:114–119.
133. Lehmann KG, Heath-Lange SJ, Ferris ST. Randomized comparison of hemostasis techniques after invasive cardiovascular procedures. *Am Heart J*. 1999;138:1118–1125.
134. Koreny M, Riedmuller E, Nikfardjam M, Siostrzonek P, Mullner M. Arterial puncture closing devices compared with standard manual compression after cardiac catheterization: Systematic review and meta-analysis. *JAMA*. 2004;291:350–357.
135. Upponi SS, Ganeshan AG, Warakaulle DR, Phillips-Hughes J, Boardman P, Uberoi R. Angioseal versus manual compression for haemostasis following peripheral vascular diagnostic and interventional procedures—a randomized controlled trial. *Eur J Radiol*. 2007;61:332–334.
136. Simon A, Bumgarner B, Clark K, Israel S. Manual versus mechanical compression for femoral artery hemostasis after cardiac catheterization. *Am J Crit Care*. 1998;7:308–313.
137. Walker SB, Cleary S, Higgins M. Comparison of the FemoStop device and manual pressure in reducing groin puncture site complications following coronary angioplasty and coronary stent placement. *Int J Nurs Pract*. 2001;7:366–375.
138. Mlekusch W, Dick P, Haumer M, Sabeti S, Minar E, Schillinger M. Arterial puncture site management after percutaneous transluminal procedures using a hemostatic wound dressing (Clo-Sur P.A.D.) versus conventional manual compression: A randomized controlled trial. *J Endovasc Ther*. 2006;13:23–31.
139. Yadav JS, Ziada KM, Almany S, Davis TP, Castaneda F. Comparison of the QuickSeal Femoral Arterial Closure System with manual compression following diagnostic and interventional catheterization procedures. *Am J Cardiol*. 2003;91:1463–1466, A1466.
140. Sava J, Velmahos GC, Karaikakakis M, Kirkman P, Toutouzias K, Sarkisyan G, Chan L, Demetriades D. Abdominal insufflation for prevention of exsanguination. *J Trauma*. 2003;54:590–594.
141. Jaskille A, Schechner A, Park K, Williams M, Wang D, Sava J. Abdominal insufflation decreases blood loss and mortality after porcine liver injury. *J Trauma*. 2005;59:1305–1308; discussion 1308.
142. Velmahos GC, Spaniolas K, Duggan M, Alam HB, Tabbara M, de Moya M, Vosburgh K. Abdominal insufflation for control of bleeding after severe splenic injury. *J Trauma*. 2007;63:285–288; discussion 288–290.
143. Naimer SA, Chemla F. Elastic adhesive dressing treatment of bleeding wounds in trauma victims. *Am J Emerg Med*. 2000;18:816–819.
144. Naimer SA, Nash M, Niv A, Lapid O. Control of massive bleeding from facial gunshot wound with a compact elastic adhesive compression dressing. *Am J Emerg Med*. 2004;22:586–588.
145. Pillgram-Larsen J, Mellesmo S. [Not a tourniquet, but compressive dressing: Experience from 68 traumatic amputations after injuries from mines]. *Tidsskr Nor Laegeforen*. 1992;112:2188–2190.
146. Naimer SA, Anat N, Katif G. Evaluation of techniques for treating the bleeding wound. *Injury*. 2004;35:974–979.
147. Swan KG Jr, Wright DS, Barbaggioanni SS, Swan BC, Swan KG. Tourniquets revisited. *J Trauma*. 2009;66:672–675.
148. Lakstein D, Blumenfeld A, Sokolov T, Lin G, Bssorai R, Lynn M, Ben-Abraham R. Tourniquets for hemorrhage control on the battlefield: A 4-year accumulated experience. *J Trauma*. 2003;54:S221–S225.
149. Beekley AC, Sebesta JA, Blackburne LH, Herbert GS, Kauvar DS, Baer DG, Walters TJ, Mullenix PS, Holcomb JB. Prehospital tourniquet use in operation Iraqi freedom: Effect on hemorrhage control and outcomes. *J Trauma*. 2008;64:S28–S37; discussion S37.
150. Kragh JF Jr, Walters TJ, Baer DG, Fox CJ, Wade CE, Salinas J, Holcomb JB. Practical use of emergency tourniquets to stop bleeding in major limb trauma. *J Trauma*. 2008;64:S38–S49; discussion S49–S50.
151. Kokki H, Vaatainen U, Penttila I. Metabolic effects of a low-pressure tourniquet system compared with a high-pressure tourniquet system in arthroscopic anterior cruciate ligament reconstruction. *Acta Anaesthesiol Scand*. 1998;42:418–424.
152. Wakai A, Wang JH, Winter DC, Street JT, O'Sullivan RG, Redmond HP. Tourniquet-induced systemic inflammatory response in extremity surgery. *J Trauma*. 2001;51:922–926.
153. Savvidis E, Parsch K. [Prolonged transitory paralysis after pneumatic tourniquet use on the upper arm]. *Unfallchirurg*. 1999;102:141–144.
154. Landi A, Saracino A, Pinelli M, Caserta G, Facchini MC. Tourniquet paralysis in microsurgery. *Ann Acad Med Singapore*. 1995;24(suppl):89–93.
155. Mohler LR, Pedowitz RA, Lopez MA, Gershuni DH. Effects of tourniquet compression on neuromuscular function. *Clin Orthop*. 1999:213–220.
156. Kalish J, Burke P, Feldman J, Agarwal S, Glantz A, Moyer P, Serino R, Hirsch E. The return of tourniquets: Original research evaluates the effectiveness of prehospital tourniquets for civilian penetrating extremity injuries. *JEMS*. 2008;33:44–46, 49–50, 52, 54.
157. Kragh JF Jr, Baer DG, Walters TJ. Extended (16-hour) tourniquet application after combat wounds: A case report and review of the current literature. *J Orthop Trauma*. 2007;21:274–278.
158. King RB, Philips D, Blitz S, Logsetty S. Evaluation of possible tourniquet systems for use in the Canadian Forces. *J Trauma*. 2006;60:1061–1071.
159. Wenke JC, Walters TJ, Greydanus DJ, Pusateri AE, Convertino VA. Physiological evaluation of the U.S. Army one-handed tourniquet. *Mil Med*. 2005;170:776–781.
160. Calkins D, Snow C, Costello M, Bentley TB. Evaluation of possible battlefield tourniquet systems for the far-forward setting. *Mil Med*. 2000;165:379–384.
161. Walters TJ, Wenke JC, Kauvar DS, McManus JG, Holcomb JB, Baer DG. Effectiveness of self-applied tourniquets in human volunteers. *Prehosp Emerg Care*. 2005;9:416–422.
162. Swanson AB, Livengood LC, Sattel AB. Local hypothermia to prolong safe tourniquet time. *Clin Orthop Relat Res*. 1991:200–208.
163. Kelly C, Creagh T, Grace PA, Bouchier-Hayes D. Regional hypothermia protects against tourniquet neuropathy. *Eur J Vasc Surg*. 1992;6:288–292.

164. Irving GA, Noakes TD. The protective role of local hypothermia in tourniquet-induced ischaemia of muscle. *J Bone Joint Surg Br*. 1985; 67:297–301.
165. McManus J, Hurtado T, Pusateri A, Knoop KJ. A case series describing thermal injury resulting from zeolite use for hemorrhage control in combat operations. *Prehosp Emerg Care*. 2007;11:67–71.
166. Rhee P, Brown C, Martin M, Salim A, Plurad D, Green D, Chambers L, Demetriades D, Velmahos G, Alam H. QuikClot use in trauma for hemorrhage control: Case series of 103 documented uses. *J Trauma*. 2008;64:1093–1099.
167. Wedmore I, McManus JG, Pusateri AE, Holcomb JB. A special report on the chitosan-based hemostatic dressing: Experience in current combat operations. *J Trauma*. 2006;60:655–658.
168. Ersoy G, Kaynak MF, Yilmaz O, Rodoplu U, Maltepe F, Gokmen N. Hemostatic effects of microporous polysaccharide hemosphere in a rat model with severe femoral artery bleeding. *Adv Ther*. 2007;24:485–492.
169. Acheson EM, Kheirabadi BS, Deguzman R, Dick EJ Jr, Holcomb JB. Comparison of hemorrhage control agents applied to lethal extremity arterial hemorrhages in swine. *J Trauma*. 2005;59:865–874; discussion 874–865.
170. Ahuja N, Ostomel TA, Rhee P, Stucky GD, Conran R, Chen Z, Al-Mubarak GA, Velmahos G, Demoya M, Alam HB. Testing of modified zeolite hemostatic dressings in a large animal model of lethal groin injury. *J Trauma*. 2006;61:1312–1320.
171. Alam HB, Uy GB, Miller D, Koustova E, Hancock T, Inocencio R, Anderson D, Llorente O, Rhee P. Comparative analysis of hemostatic agents in a swine model of lethal groin injury. *J Trauma*. 2003;54:1077–1082.
172. Alam HB, Chen Z, Jaskille A, Querol RI, Koustova E, Inocencio R, Conran R, Seufert A, Ariaban N, Toruno K, Rhee P. Application of a zeolite hemostatic agent achieves 100% survival in a lethal model of complex groin injury in swine. *J Trauma*. 2004;56:974–983.
173. Arnaud F, Tomori T, Saito R, McKeague A, Prusaczyk WK, McCarron RM. Comparative efficacy of granular and bagged formulations of the hemostatic agent QuikClot. *J Trauma*. 2007;63:775–782.
174. Arnaud F, Teranishi K, Tomori T, Carr W, McCarron R. Comparison of 10 hemostatic dressings in a groin puncture model in swine. *J Vasc Surg*. 2009;50:632–639, 639.e631.
175. Carraway JW, Kent D, Young K, Cole A, Friedman R, Ward KR. Comparison of a new mineral based hemostatic agent to a commercially available granular zeolite agent for hemostasis in a swine model of lethal extremity arterial hemorrhage. *Resuscitation*. 2008;78:230–235.
176. Fan Y, Sun H, Pei G, Ruan C. Haemostatic efficacy of an ethyl-2-cyanoacrylate-based aerosol in combination with tourniquet application in a large wound model with an arterial injury. *Injury*. 2008;39:61–66.
177. Gustafson SB, Fulkerson P, Bildfell R, Aguilera L, Hazzard TM. Chitosan dressing provides hemostasis in swine femoral arterial injury model. *Prehosp Emerg Care*. 2007;11:172–178.
178. Jackson MR, Friedman SA, Carter AJ, Bayer V, Burge JR, MacPhee MJ, Drohan WN, Alving BM. Hemostatic efficacy of a fibrin sealant-based topical agent in a femoral artery injury model: A randomized, blinded, placebo-controlled study. *J Vasc Surg*. 1997;26:274–280.
179. Kheirabadi BS, Edens JW, Terrazas IB, Estep JS, Klemcke HG, Dubick MA, Holcomb JB. Comparison of new hemostatic granules/powders with currently deployed hemostatic products in a lethal model of extremity arterial hemorrhage in swine. *J Trauma*. 2009;66:316–326; discussion 327–318.
180. Holcomb J, MacPhee M, Hetz S, Harris R, Pusateri A, Hess J. Efficacy of a dry fibrin sealant dressing for hemorrhage control after ballistic injury. *Arch Surg*. 1998;133:32–35.
181. Kozen BG, Kircher SJ, Henao J, Godinez FS, Johnson AS. An alternative hemostatic dressing: Comparison of CELOX, HemCon, and QuikClot. *Acad Emerg Med*. 2008;15:74–81.
182. Larson MJ, Bowersox JC, Lim RC Jr, Hess JR. Efficacy of a fibrin hemostatic bandage in controlling hemorrhage from experimental arterial injuries. *Arch Surg*. 1995;130:420–422.
183. Li MR, Deng G, Yu YR. [Effect of adiponectin on endothelial dysfunction in obese rats]. *Sichuan Da Xue Xue Bao Yi Xue Ban*. 2009;40:612–614, 627.
184. Sambasivan CN, Cho SD, Zink KA, Differding JA, Schreiber MA. A highly porous silica and chitosan-based hemostatic dressing is superior in controlling hemorrhage in a severe groin injury model in swine. *Am J Surg*. 2009;197:576–580; discussion 580.
185. Velmahos GC, Tabbara M, Spaniolas K, Duggan M, Alam HB, Serra M, Sun L, de Luis J. Self-expanding hemostatic polymer for control of exsanguinating extremity bleeding. *J Trauma*. 2009;66:984–988.
186. Ward KR, Tiba MH, Holbert WH, Blocher CR, Draucker GT, Proffitt EK, Bowlin GL, Ivatury RR, Diegelmann RF. Comparison of a new hemostatic agent to current combat hemostatic agents in a swine model of lethal extremity arterial hemorrhage. *J Trauma*. 2007;63:276–283; discussion 283–274.
187. Abarbanell NR. Prehospital midhigh trauma and traction splint use: Recommendations for treatment protocols. *Am J Emerg Med*. 2001;19:137–140.
188. Anderson GH, Harper WM, Connolly CD, Badham J, Goodrich N, Gregg PJ. Preoperative skin traction for fractures of the proximal femur. A randomised prospective trial. *J Bone Joint Surg Br*. 1993;75:794–796.
189. Finsen V, Borset M, Buvik GE, Hauke I. Preoperative traction in patients with hip fractures. *Injury*. 1992;23:242–244.
190. Resch S, Bjarnetoft B, Thorngren KG. Preoperative skin traction or pillow nursing in hip fractures: A prospective, randomized study in 123 patients. *Disabil Rehabil*. 2005;27:1191–1195.
191. Yip DK, Chan CF, Chiu PK, Wong JW, Kong JK. Why are we still using pre-operative skin traction for hip fractures? *Int Orthop*. 2002;26:361–364.
192. Parker MJ, Handoll HH. Pre-operative traction for fractures of the proximal femur in adults. *Cochrane Database Syst Rev*. 2006;3:CD000168.
193. Rosen JE, Chen FS, Hiebert R, Koval KJ. Efficacy of preoperative skin traction in hip fracture patients: A prospective, randomized study. *J Orthop Trauma*. 2001;15:81–85.
194. Auerbach PS, Geehr EC, Ryu RK. The reel splint: Experience with a new traction splint apparatus in the prehospital setting. *Ann Emerg Med*. 1984;13:419–422.
195. Kenny C. Compartment pressures, limb length changes and the ideal spherical shape: A case report and in vitro study. *J Trauma*. 2006;61:909–912.
196. Chu RS, Browne GJ, Lam LT. Traction splinting of femoral shaft fractures in a paediatric emergency department: Time is of the essence? *Emerg Med (Fremantle)*. 2003;15:447–452.
197. Cote DJ, Prentice WE Jr, Hooker DN, Shields EW. Comparison of three treatment procedures for minimizing ankle sprain swelling. *Phys Ther*. 1988;68:1072–1076.
198. Basur RL, Shephard E, Mouzas GL. A cooling method in the treatment of ankle sprains. *Practitioner*. 1976;216:708–711.
199. Hocutt JE Jr, Jaffe R, Rylander CR, Beebe JK. Cryotherapy in ankle sprains. *Am J Sports Med*. 1982;10:316–319.
200. Ayata R, Shiraki H, et al. The effects of icing after exercise on jumper's knee. *Jpn J Phys Fitness Sports Med*. 2007;56:125–130.
201. Dykstra JH, Hill HM, Miller MG, Cheatham CC, Michael TJ, Baker RJ. Comparisons of cubed ice, crushed ice, and wetted ice on intramuscular and surface temperature changes. *J Athl Train*. 2009;44:136–141.
202. Kanlayanaphotporn R, Janwantanakul P. Comparison of skin surface temperature during the application of various cryotherapy modalities. *Arch Phys Med Rehabil*. 2005;86:1411–1415.
203. Merrick MA, Jutte LS, Smith ME. Cold modalities with different thermodynamic properties produce different surface and intramuscular temperatures. *J Athl Train*. 2003;38:28–33.
204. Graham CA, Stevenson J. Frozen chips: An unusual cause of severe frostbite injury. *Br J Sports Med*. 2000;34:382–383.
205. Moeller JL, Monroe J, McKeag DB. Cryotherapy-induced common peroneal nerve palsy. *Clin J Sport Med*. 1997;7:212–216.
206. Bassett FH III, Kirkpatrick JS, Engelhardt DL, Malone TR. Cryotherapy-induced nerve injury. *Am J Sports Med*. 1992;20:516–518.
207. Bleakley CM, McDonough SM, MacAuley DC, Bjordal J. Cryotherapy for acute ankle sprains: A randomised controlled study of two different icing protocols. *Br J Sports Med*. 2006;40:700–705; discussion 705.
208. Claus EE, Fusco CF, Ingram T, Ingersoll CD, Edwards JE, Melham TJ. Comparison of the effects of selected dressings on the healing of standardized abrasions. *J Athl Train*. 1998;33:145–149.
209. Beam JW. Occlusive dressings and the healing of standardized abrasions. *J Athl Train*. 2008;43:600–607.
210. Hinman CD, Maibach H. Effect of air exposure and occlusion on experimental human skin wounds. *Nature*. 1963;200:377–378.
211. Davis SC, Eaglstein WH, Cazzaniga AL, Mertz PM. An octyl-2-cyanoacrylate formulation speeds healing of partial-thickness wounds. *Dermatol Surg*. 2001;27:783–788.

212. Eaglstein WH, Davis SC, Mehle AL, Mertz PM. Optimal use of an occlusive dressing to enhance healing. Effect of delayed application and early removal on wound healing. *Arch Dermatol*. 1988;124:392–395.
213. Winter GD. Formation of the scab and the rate of epithelization of superficial wounds in the skin of the young domestic pig. *Nature*. 1962;193:293–294.
214. Dire DJ, Welsh AP. A comparison of wound irrigation solutions used in the emergency department. *Ann Emerg Med*. 1990;19:704–708.
215. Moscati R, Mayrose J, Fincher L, Jehle D. Comparison of normal saline with tap water for wound irrigation. *Am J Emerg Med*. 1998;16:379–381.
216. Bansal BC, Wiebe RA, Perkins SD, Abramo TJ. Tap water for irrigation of lacerations. *Am J Emerg Med*. 2002;20:469–472.
217. Valente JH, Forti RJ, Freundlich LF, Zandieh SO, Crain EF. Wound irrigation in children: Saline solution or tap water? *Ann Emerg Med*. 2003;41:609–616.
218. Moscati RM, Mayrose J, Reardon RF, Janicke DM, Jehle DV. A multicenter comparison of tap water versus sterile saline for wound irrigation. *Acad Emerg Med*. 2007;14:404–409.
219. Longmire AW, Broom LA, Burch J. Wound infection following high-pressure syringe and needle irrigation. *Am J Emerg Med*. 1987;5:179–181.
220. Angeras MH, Brandberg A, Falk A, Seeman T. Comparison between sterile saline and tap water for the cleaning of acute traumatic soft tissue wounds. *Eur J Surg*. 1992;158:347–350.
221. Fernandez R, Griffiths R. Water for wound cleansing. *Cochrane Database Syst Rev*. 2008:CD003861.
222. Hamer ML, Robson MC, Krizek TJ, Southwick WO. Quantitative bacterial analysis of comparative wound irrigations. *Ann Surg*. 1975;181:819–822.
223. Stevenson TR, Thacker JG, Rodeheaver GT, Bacchetta C, Edgerton MT, Edlich RF. Cleansing the traumatic wound by high pressure syringe irrigation. *JACEP*. 1976;5:17–21.
224. Green VA, Carlson HC, Briggs RL, Stewart JL. A comparison of the efficacy of pulsed mechanical lavage with that of rubber-bulb syringe irrigation in removal of debris from avulsive wounds. *Oral Surg Oral Med Oral Pathol*. 1971;32:158–164.
225. Grower MF, Bhaskar SN, Horan MJ, Cutright DE. Effect of water lavage on removal of tissue fragments from crush wounds. *Oral Surg Oral Med Oral Pathol*. 1972;33:1031–1036.
226. Gross A, Cutright DE, Bhaskar SN. Effectiveness of pulsating water jet lavage in treatment of contaminated crushed wounds. *Am J Surg*. 1972;124:373–377.
227. Rodeheaver GT, Pettry D, Thacker JG, Edgerton MT, Edlich RF. Wound cleansing by high pressure irrigation. *Surg Gynecol Obstet*. 1975;141:357–362.
228. Ernst AA, Gershoff L, Miller P, Tilden E, Weiss SJ. Warmed versus room temperature saline for laceration irrigation: A randomized clinical trial. *South Med J*. 2003;96:436–439.
229. Anglen J, Apostoles PS, Christensen G, Gainor B, Lane J. Removal of surface bacteria by irrigation. *J Orthop Res*. 1996;14:251–254.
230. Kompa S, Schareck B, Tymper J, Wustemeyer H, Schrage NF. Comparison of emergency eye-wash products in burned porcine eyes. *Graefes Arch Clin Exp Ophthalmol*. 2002;240:308–313.
231. Kompa S, Redbrake C, Hilgers C, Wustemeyer H, Schrage N, Remky A. Effect of different irrigating solutions on aqueous humour pH changes, intraocular pressure and histological findings after induced alkali burns. *Acta Ophthalmol Scand*. 2005;83:467–470.
232. Rihawi S, Frentz M, Schrage NF. Emergency treatment of eye burns: Which rinsing solution should we choose? *Graefes Arch Clin Exp Ophthalmol*. 2006;244:845–854.
233. Spoler F, Frentz M, Forst M, Kurz H, Schrage NF. Analysis of hydrofluoric acid penetration and decontamination of the eye by means of time-resolved optical coherence tomography. *Burns*. 2008;34:549–555.
234. McCulley JP. Ocular hydrofluoric acid burns: Animal model, mechanism of injury and therapy. *Trans Am Ophthalmol Soc*. 1990;88:649–684.
235. Gerasimo P, LaRoche P, Mathieu L, Hall A. In vitro decontamination of cobalt-60 exposed pigs eyes with Diphoterines vs water. *Defense Technical Information Center Compilation Part Notice ADP013403 [about 6 p.]*. 2001. Available at: <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADP013403&Location=U2&doc=GetTRDoc.pdf>.
236. Kaplan MM, Cohen D, Koprowski H, Dean D, Ferrigan L. Studies on the local treatment of wounds for the prevention of rabies. *Bull World Health Organ*. 1962;26:765–775.
237. Dean DJ, Baer GM, Thompson WR. Studies on the local treatment of rabies-infected wounds. *Bull World Health Organ*. 1963;28:477–486.
238. Callahan ML. Treatment of common dog bites: Infection risk factors. *JACEP*. 1978;7:83–87.
239. Sutherland SK, Coulter AR, Harris RD. Rationalisation of first-aid measures for elapid snakebite. *Lancet*. 1979;1:183–185.
240. Howarth DM, Southee AE, Whyte IM. Lymphatic flow rates and first-aid in simulated peripheral snake or spider envenomation. *Med J Aust*. 1994;161:695–700.
241. German BT, Hack JB, Brewer K, Meggs WJ. Pressure-immobilization bandages delay toxicity in a porcine model of eastern coral snake (*Micurus fulvius fulvius*) envenomation. *Ann Emerg Med*. 2005;45:603–608.
242. Bush SP, Green SM, Laack TA, Hayes WK, Cardwell MD, Tanen DA. Pressure immobilization delays mortality and increases intracompartmental pressure after artificial intramuscular rattlesnake envenomation in a porcine model. *Ann Emerg Med*. 2004;44:599–604.
243. Norris RL, Ngo J, Nolan K, Hooker G. Physicians and lay people are unable to apply pressure immobilization properly in a simulated snakebite scenario. *Wilderness Environ Med*. 2005;16:16–21.
244. Simpson ID, Tanwar PD, Andrade C, Kochar DK, Norris RL. The Ebbinghaus retention curve: Training does not increase the ability to apply pressure immobilisation in simulated snake bite—implications for snake bite first aid in the developing world. *Trans R Soc Trop Med Hyg*. 2008;102:451–459.
245. Grayson RR. A technic for using suction in cases of snake bite. *Mo Med*. 1953;50:763–764.
246. Leopold RS, Huber GS. Ineffectiveness of suction in removing snake venom from open wounds. *US Armed Forces Med J*. 1960;11:682–685.
247. Lawrence WT, Giannopoulos A, Hansen A. Pit viper bites: Rational management in locales in which copperheads and cottonmouths predominate. *Ann Plast Surg*. 1996;36:276–285.
248. Alberts MB, Shalit M, LoGalbo F. Suction for venomous snakebite: A study of “mock venom” extraction in a human model. *Ann Emerg Med*. 2004;43:181–186.
249. Bush SP, Hegewald KG, Green SM, Cardwell MD, Hayes WK. Effects of a negative pressure venom extraction device (extractor) on local tissue injury after artificial rattlesnake envenomation in a porcine model. *Wilderness Environ Med*. 2000;11:180–188.
250. Holstege CP, Singletary EM. Images in emergency medicine. Skin damage following application of suction device for snakebite. *Ann Emerg Med*. 2006;48:105, 113.
251. Mianzan HW, Fenner PJ, Cornelius PF, Ramirez FC. Vinegar as a disarming agent to prevent further discharge of the nematocysts of the stinging hydromedusa *Olindias sambaquiensis*. *Cutis*. 2001;68:45–48.
252. Burnett JW, Rubinstein H, Calton GJ. First aid for jellyfish envenomation. *South Med J*. 1983;76:870–872.
253. Thomas CS, Scott SA, Galanis DJ, Goto RS. Box jellyfish (*Carybdea alata*) in Waikiki: The analgesic effect of Sting-Aid, Adolph’s meat tenderizer and fresh water on their stings: A double-blinded, randomized, placebo-controlled clinical trial. *Hawaii Med J*. 2001;60:205–207, 210.
254. Nomura JT, Sato RL, Ahern RM, Snow JL, Kuwaye TT, Yamamoto LG. A randomized paired comparison trial of cutaneous treatments for acute jellyfish (*Carybdea alata*) stings. *Am J Emerg Med*. 2002;20:624–626.
255. Loten C, Stokes B, Worsley D, Seymour JE, Jiang S, Isbister GK. A randomised controlled trial of hot water (45 degrees C) immersion versus ice packs for pain relief in bluebottle stings. *Med J Aust*. 2006;184:329–333.
256. Yoshimoto CM, Yanagihara AA. Cnidarian (coelenterate) envenomations in Hawai’i improve following heat application. *Trans R Soc Trop Med Hyg*. 2002;96:300–303.
257. Atkinson PR, Boyle A, Hartin D, McAuley D. Is hot water immersion an effective treatment for marine envenomation? *Emerg Med J*. 2006;23:503–508.
258. Thomas J. Dermatology in the new millennium. *Indian J Dermatol Venereol Leprol*. 2001;67:100–103.
259. Exton DR, Fenner PJ, Williamson JA. Cold packs: Effective topical analgesia in the treatment of painful stings by *Physalia* and other jellyfish. *Med J Aust*. 1989;151:625–626.
260. Pereira AS, Kenney KB, Cohen MS, Hall JE, Eron JJ, Tidwell RR, Dunn JA. Simultaneous determination of lamivudine and zidovudine concentrations in human seminal plasma using high-performance liquid chromatography and tandem mass spectrometry. *J Chromatogr B Biomed Sci Appl*. 2000;742:173–183.

261. Seymour J, Carrette T, Cullen P, Little M, Mulcahy RF, Pereira PL. The use of pressure immobilization bandages in the first aid management of cubozoan envenomings. *Toxicon*. 2002;40:1503–1505.
262. Malhotra MS, Mathew L. Effect of rewarming at various water bath temperatures in experimental frostbite. *Aviat Space Environ Med*. 1978;49:874–876.
263. Purkayastha SS, Chhabra PC, Verma SS, Selvamurthy W. Experimental studies on the treatment of frostbite in rats. *Indian J Med Res*. 1993;98:178–184.
264. Purkayastha SS, Bhaumik G, Chauhan SK, Banerjee PK, Selvamurthy W. Immediate treatment of frostbite using rapid rewarming in tea decoction followed by combined therapy of pentoxifylline, aspirin & vitamin C. *Indian J Med Res*. 2002;116:29–34.
265. Fuhrman FA, Crismon JM. Studies on gangrene following cold injury: Treatment of cold injury by means of immediate rapid warming. *J Clin Invest*. 1947;26:476–485.
266. Entin MA, Baxter H. Influence of rapid warming on frostbite in experimental animals. *Plast Reconstr Surg (1946)*. 1952;9:511–524.
267. Fuhrman FA, Fuhrman GJ. The treatment of experimental frostbite by rapid thawing; a review and new experimental data. *Medicine (Baltimore)*. 1957;36:465–487.
268. Martinez Villen G, Garcia Bescos G, Rodriguez Sosa V, Morandeira Garcia JR. Effects of haemodilution and rewarming with regard to digital amputation in frostbite injury: An experimental study in the rabbit. *J Hand Surg Br*. 2002;27:224–228.
269. Mills WJ Jr, Whaley R, Fish W. Frostbite: Experience with rapid rewarming and ultrasonic therapy: Part II: 1960. *Alaska Med*. 1993;35:10–18.
270. Mills WJ Jr, Whaley R, Fish W. Frostbite: Experience with rapid rewarming and ultrasonic therapy: Part III: 1961. *Alaska Med*. 1993;35:19–27.
271. Bilgic S, Ozkan H, Ozenc S, Safaz I, Yildiz C. Treating frostbite. *Can Fam Physician*. 2008;54:361–363.
272. Sands WA, Kimmel WL, Wurtz BR, Stone MH, McNeal JR. Comparison of commercially available disposable chemical hand and foot warmers. *Wilderness Environ Med*. 2009;20:33–38.
273. Twomey JA, Peltier GL, Zera RT. An open-label study to evaluate the safety and efficacy of tissue plasminogen activator in treatment of severe frostbite. *J Trauma*. 2005;59:1350–1354; discussion 1354–1355.
274. Bruen KJ, Ballard JR, Morris SE, Cochran A, Edelman LS, Saffle JR. Reduction of the incidence of amputation in frostbite injury with thrombolytic therapy. *Arch Surg*. 2007;142:546–551; discussion 551–543.
275. Heggors JP, Robson MC, Manavalen K, Weingarten MD, Carethers JM, Boertman JA, Smith DJ Jr, Sachs RJ. Experimental and clinical observations on frostbite. *Ann Emerg Med*. 1987;16:1056–1062.
276. Robson MC, Heggors JP. Evaluation of hand frostbite blister fluid as a clue to pathogenesis. *J Hand Surg Am*. 1981;6:43–47.
277. Ozyazgan I, Tercan M, Melli M, Bekerecioglu M, Ustun H, Gunay GK. Eicosanoids and inflammatory cells in frostbitten tissue: Prostacyclin, thromboxane, polymorphonuclear leukocytes, and mast cells. *Plast Reconstr Surg*. 1998;101:1881–1886.
278. Talwar JR, Gulati SM. Non-steroid anti-inflammatory agents in the management of cold injury. *Indian J Med Res*. 1972;60:1643–1652.
279. Cummings R, Lykke AW. The effects of anti-inflammatory drugs on vascular exudation evoked by cold injury. *Pathology*. 1973;5:117–122.
280. Raine R, London M, Goluch L, Heggors J, Robson M. Anti-prostaglandins and anti-thromboxane for treatment of frostbite. *Surg Forum*. 1980;31:557–559.
281. Berg A, Aas P, Gustafsson T, Reed RK. Effect of alpha-trinositol on interstitial fluid pressure, oedema generation and albumin extravasation in experimental frostbite in the rat. *Br J Pharmacol*. 1999;126:1367–1374.
282. McCauley RL, Hing DN, Robson MC, Heggors JP. Frostbite injuries: A rational approach based on the pathophysiology. *J Trauma*. 1983;23:143–147.
283. Foray J. Mountain frostbite: Current trends in prognosis and treatment (from results concerning 1261 cases). *Int J Sports Med*. 1992;13(suppl 1):S193–S196.
284. Kenefick RW, O'Moore KM, Mahood NV, Castellani JW. Rapid IV versus oral rehydration: Responses to subsequent exercise heat stress. *Med Sci Sports Exerc*. 2006;38:2125–2131.
285. Michell MW, Oliveira HM, Kinsky MP, Vaid SU, Herndon DN, Kramer GC. Enteral resuscitation of burn shock using World Health Organization oral rehydration solution: A potential solution for mass casualty care. *J Burn Care Res*. 2006;27:819–825.
286. Barclay RL, Depew WT, Vanner SJ. Carbohydrate-electrolyte rehydration protects against intravascular volume contraction during colonic cleansing with orally administered sodium phosphate. *Gastrointest Endosc*. 2002;56:633–638.
287. Currell K, Urch J, Cerri E, Jentjens RL, Blannin AK, Jeukendrup AE. Plasma deuterium oxide accumulation following ingestion of different carbohydrate beverages. *Appl Physiol Nutr Metab*. 2008;33:1067–1072.
288. Jeukendrup AE, Currell K, Clarke J, Cole J, Blannin AK. Effect of beverage glucose and sodium content on fluid delivery. *Nutr Metab (Lond)*. 2009;6:9.
289. Evans GH, Shirreffs SM, Maughan RJ. Postexercise rehydration in man: The effects of osmolality and carbohydrate content of ingested drinks. *Nutrition*. 2009;25:905–913.
290. Greenleaf JE, Jackson CG, Geelen G, Keil LC, Hinghofer-Szalkay H, Whittam JH. Plasma volume expansion with oral fluids in hypohydrated men at rest and during exercise. *Aviat Space Environ Med*. 1998;69:837–844.
291. Maughan RJ, Leiper JB. Sodium intake and post-exercise rehydration in man. *Eur J Appl Physiol Occup Physiol*. 1995;71:311–319.
292. Merson SJ, Maughan RJ, Shirreffs SM. Rehydration with drinks differing in sodium concentration and recovery from moderate exercise-induced hypohydration in man. *Eur J Appl Physiol*. 2008;103:585–594.
293. Shirreffs SM, Taylor AJ, Leiper JB, Maughan RJ. Post-exercise rehydration in man: Effects of volume consumed and drink sodium content. *Med Sci Sports Exerc*. 1996;28:1260–1271.
294. Shirreffs SM, Watson P, Maughan RJ. Milk as an effective post-exercise rehydration drink. *Br J Nutr*. 2007;98:173–180.
295. Ringsted C, Lippert F, Hesselheldt R, Rasmussen MB, Mogensen SS, Frost T, Jensen ML, Jensen MK, Van der Vleuten C. Assessment of advanced life support competence when combining different test methods—reliability and validity. *Resuscitation*. 2007;75:153–160.
296. Spooner BB, Fallaha JF, Kocierz L, Smith CM, Smith SC, Perkins GD. An evaluation of objective feedback in basic life support (BLS) training. *Resuscitation*. 2007;73:417–424.
297. Sutton RM, Donoghue A, Myklebust H, Srikantan S, Byrne A, Priest M, Zoltani Z, Helfaer MA, Nadkarni V. The voice advisory manikin (VAM): An innovative approach to pediatric lay provider basic life support skill education. *Resuscitation*. 2007;75:161–168.
298. Dine CJ, Gersh RE, Leary M, Riegel BJ, Bellini LM, Abella BS. Improving cardiopulmonary resuscitation quality and resuscitation training by combining audiovisual feedback and debriefing. *Crit Care Med*. 2008;36:2817–2822.
299. Capone PL, Lane JC, Kerr CS, Safar P. Life supporting first aid (LSFA) teaching to Brazilians by television spots. *Resuscitation*. 2000;47:259–265.
300. Wayne DB, Butter J, Siddall VJ, Fudala MJ, Linquist LA, Feinglass J, Wade LD, McGaghie WC. Simulation-based training of internal medicine residents in advanced cardiac life support protocols: A randomized trial. *Teach Learn Med*. 2005;17:210–216.
301. Ahlberg G, Enochsson L, Gallagher AG, Hedman L, Hogman C, McClusky DA, III, Ramel S, Smith CD, Arvidsson D. Proficiency-based virtual reality training significantly reduces the error rate for residents during their first 10 laparoscopic cholecystectomies. *Am J Surg*. 2007;193:797–804.
302. Ali J, Adam RU, Sammy I, Ali E, Williams JI. The simulated trauma patient teaching module—does it improve student performance? *J Trauma*. 2007;62:1416–1420.
303. Dalley P, Robinson B, Weller J, Caldwell C. The use of high-fidelity human patient simulation and the introduction of new anesthesia delivery systems. *Anesth Analg*. 2004;99:1737–1741, table of contents.
304. Mayo PH, Hackney JE, Mueck JT, Ribaldo V, Schneider RF. Achieving house staff competence in emergency airway management: Results of a teaching program using a computerized patient simulator. *Crit Care Med*. 2004;32:2422–2427.
305. Wik L, Thowsen J, Steen PA. An automated voice advisory manikin system for training in basic life support without an instructor. A novel approach to CPR training. *Resuscitation*. 2001;50:167–172.
306. Lee SK, Pardo M, Gaba D, Sowb Y, Dicker R, Straus EM, Khaw L, Morabito D, Krummel TM, Knudson MM. Trauma assessment training with a patient simulator: A prospective, randomized study. *J Trauma*. 2003;55:651–657.
307. Owen H, Mugford B, Follows V, Plummer JL. Comparison of three simulation-based training methods for management of medical emergencies. *Resuscitation*. 2006;71:204–211.

308. Steadman RH, Coates WC, Huang YM, Matevosian R, Larmon BR, McCullough L, Ariel D. Simulation-based training is superior to problem-based learning for the acquisition of critical assessment and management skills. *Crit Care Med*. 2006;34:151–157.
309. Shavit I, Keidan I, Hoffmann Y, Mishuk L, Rubin O, Ziv A, Steiner IP. Enhancing patient safety during pediatric sedation: The impact of simulation-based training of nonanesthesiologists. *Arch Pediatr Adolesc Med*. 2007;161:740–743.
310. Knudson MM, Khaw L, Bullard MK, Dicker R, Cohen MJ, Staudenmayer K, Sadjadi J, Howard S, Gaba D, Krummel T. Trauma training in simulation: Translating skills from SIM time to real time. *J Trauma*. 2008;64:255–263; discussion 263–254.
311. Wang XP, Martin SM, Li YL, Chen J, Zhang YM. [Effect of emergency care simulator combined with problem-based learning in teaching of cardiopulmonary resuscitation]. *Zhonghua Yi Xue Za Zhi*. 2008;88:1651–1653.
312. Wheeler DW, Degnan BA, Murray LJ, Dunling CP, Whittlestone KD, Wood DF, Smith HL, Gupta AK. Retention of drug administration skills after intensive teaching. *Anaesthesia*. 2008;63:379–384.
313. Dayal AK, Fisher N, Magrane D, Goffman D, Bernstein PS, Katz NT. Simulation training improves medical students' learning experiences when performing real vaginal deliveries. *Simul Healthc*. 2009;4:155–159.
314. Domuracki KJ, Moule CJ, Owen H, Kostandoff G, Plummer JL. Learning on a simulator does transfer to clinical practice. *Resuscitation*. 2009;80:346–349.
315. Rogers PL, Jacob H, Thomas EA, Harwell M, Willenkin RL, Pinsky MR. Medical students can learn the basic application, analytic, evaluative, and psychomotor skills of critical care medicine. *Crit Care Med*. 2000;28:550–554.
316. Perkins GD, Augre C, Rogers H, Allan M, Thickett DR. CPREzy: an evaluation during simulated cardiac arrest on a hospital bed. *Resuscitation*. 2005;64:103–108.
317. Schneider T, Mauer D, Diehl P, Eberle B, Dick W. Does standardized mega-code training improve the quality of pre-hospital advanced cardiac life support (ACLS)? *Resuscitation*. 1995;29:129–134.
318. Farah R, Stiner E, Zohar Z, Eisenman A, Zveibil F. [The importance of CPR training for assessing the knowledge and skills of hospital medical and nursing personnel]. *Harefuah*. 2007;146:529–533, 574.
319. Kurrek MM, Devitt JH, Cohen M. Cardiac arrest in the OR: how are our ACLS skills? *Can J Anaesth*. 1998;45:130–132.
320. Lester CA, Donnelly PD, Assar D. Lay CPR trainees: Retraining, confidence and willingness to attempt resuscitation 4 years after training. *Resuscitation*. 2000;45:77–82.
321. Curran VR, Aziz K, O'Young S, Bessell C. Evaluation of the effect of a computerized training simulator (ANAKIN) on the retention of neonatal resuscitation skills. *Teach Learn Med*. 2004;16:157–164.
322. Woollard M, Whitfield R, Newcombe RG, Colquhoun M, Vetter N, Chamberlain D. Optimal refresher training intervals for AED and CPR skills: a randomised controlled trial. *Resuscitation*. 2006;71:237–247.
323. Berden HJ, Willems FF, Hendrick JM, Pijls NH, Knape JT. How frequently should basic cardiopulmonary resuscitation training be repeated to maintain adequate skills? *BMJ*. 1993;306:1576–1577.

---

KEY WORDS: arrhythmia ■ cardiac arrest ■ cardiopulmonary resuscitation ■ resuscitation



**Part 13: First Aid: 2010 American Heart Association and American Red Cross International Consensus on First Aid Science With Treatment Recommendations**  
David Markenson, Jeffrey D. Ferguson, Leon Chameides, Pascal Cassan, Kin-Lai Chung, Jonathan L. Epstein, Louis Gonzales, Mary Fran Hazinski, Rita Ann Herrington, Jeffrey L. Pellegrino, Norda Ratcliff and Adam J. Singer  
on behalf of the First Aid Chapter Collaborators

*Circulation*. 2010;122:S582-S605

doi: 10.1161/CIRCULATIONAHA.110.971168

*Circulation* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Copyright © 2010 American Heart Association, Inc. All rights reserved.

Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:

[http://circ.ahajournals.org/content/122/16\\_suppl\\_2/S582](http://circ.ahajournals.org/content/122/16_suppl_2/S582)

An erratum has been published regarding this article. Please see the attached page for:

</content/122/21/2227.full.pdf>

</content/125/15/e585.full.pdf>

Data Supplement (unedited) at:

[http://circ.ahajournals.org/content/suppl/2010/11/16/122.16\\_suppl\\_2.S582.DC1](http://circ.ahajournals.org/content/suppl/2010/11/16/122.16_suppl_2.S582.DC1)

**Permissions:** Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Circulation* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the [Permissions and Rights Question and Answer](#) document.

**Reprints:** Information about reprints can be found online at:

<http://www.lww.com/reprints>

**Subscriptions:** Information about subscribing to *Circulation* is online at:

<http://circ.ahajournals.org/subscriptions/>

# Correction

In the article by Markenson et al, “Part 13: First Aid: 2010 American Heart Association and American Red Cross International Consensus on First Aid Science With Treatment Recommendations,” which published online October 18, 2010, and appeared with the October 19, 2010, issue of the journal (*Circulation*. 2010;122(suppl 2):S582–S605), several corrections were needed.

On page S583, in the Table, the American Safety and Health Institute and Medic First Aid should be listed as members of the International First Aid Science Advisory Board Member Organizations. The word “(Observer)” has been deleted from both entries.

The American Heart Association and the American Red Cross regret listing these organizations as observers.

These corrections have been made to the current online version of the article, which is available at [http://circ.ahajournals.org/cgi/reprint/122/16\\_suppl\\_2/S582](http://circ.ahajournals.org/cgi/reprint/122/16_suppl_2/S582).

**DOI: 10.1161/CIR.0b013e318205da07**

# Correction

In the article by Markenson et al, “Part 13: First Aid: 2010 American Heart Association and American Red Cross International Consensus on First Aid Science With Treatment Recommendations,” which published online October 18, 2010, and appeared with the October 19, 2010, issue of the journal (*Circulation*. 2010;122[suppl 2]:S582–S605), a correction was needed:

On page S589, in the left column, in the paragraph under “Snake Bite,” line 18, the sentence read, “Two LOE 5 animal studies<sup>241,242</sup> demonstrated ....” It has been changed to read, “One LOE 5 animal study<sup>242</sup> demonstrated ....”

Worksheet FA-1001A has been updated. Its callout is listed on page S589 in the left column under the heading “Snake Bite” and in the Appendix on page S596. A direct link to it is: <http://circ.ahajournals.org/site/C2010/FA-1001A.pdf>.

The correction to the text has been made to the current online version of the article, which is available at [http://circ.ahajournals.org/content/122/16\\_suppl\\_2/S582](http://circ.ahajournals.org/content/122/16_suppl_2/S582).

# Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION



## Correction

*Circulation* 2012, 125:e586

doi: 10.1161/CIR.0b013e3182558447

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 72514

Copyright © 2012 American Heart Association. All rights reserved. Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://circ.ahajournals.org/content/125/15/e586>

Subscriptions: Information about subscribing to *Circulation* is online at  
<http://circ.ahajournals.org/subscriptions/>

Permissions: Permissions & Rights Desk, Lippincott Williams & Wilkins, a division of Wolters Kluwer Health, 351 West Camden Street, Baltimore, MD 21202-2436. Phone: 410-528-4050. Fax: 410-528-8550. E-mail:  
[journalpermissions@lww.com](mailto:journalpermissions@lww.com)

Reprints: Information about reprints can be found online at  
<http://www.lww.com/reprints>

# Correction

In the article “Appendix: Evidence-Based Worksheets: 2010 International Consensus on Cardio-pulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations and 2010 American Heart Association and American Red Cross International Consensus on First Aid Science With Treatment Recommendations” which published online October 18, 2010, and appeared with the October 19, 2010, issue of the journal (*Circulation*. 2010;122[suppl 2]:S606–S638), several corrections were needed in the worksheet by Holstege, No. FA-1001A:

1. On page 4, first paragraph, line 5: “. . . (i.e. German 2004, LOE 5) . . .” has been changed to “. . . (i.e. German 2005, LOE 5). . .”
2. On page 4, second paragraph, line 3: “. . . (German 2005, LOE 5; Bush 2004, LOE 5) . . .” has been changed to “. . . (Bush 2004, LOE 5). . .”

The worksheet is listed in the table on page S636 of the article.

These corrections have been made to the current online version of the worksheet, which is available at <http://circ.ahajournals.org/site/C2010/FA-1001A.pdf>.