Part 10: First Aid

Introduction

In 2004 the American Heart Association (AHA) and the American Red Cross (ARC) cofounded the National First Aid Science Advisory Board (Table) to review and evaluate the scientific literature on first aid. The goals of the National First Aid Science Advisory Board are to reduce morbidity and mortality due to emergency events and to analyze the scientific evidence that answers the following questions:

- What are the most common emergency conditions that lead to significant morbidity and mortality?
- In which of these emergency conditions can morbidity or mortality be reduced by the intervention of a first aid provider?
- How strong is the scientific evidence that interventions performed by a first aid provider are safe, effective, and feasible?

Members of the National First Aid Science Advisory Board reviewed morbidity data from the US Centers for Disease Control and Prevention and first aid texts to identify common causes of injury and injury fatalities and selected the topics for evidence evaluation that are included in this section. The conflict of interest statements of the Board can be assessed through the website *http://www.C2005.org.* For further information about the evidence evaluation process, see Part 1: "Introduction." The information presented here represents a consensus summary of the scientific evidence relevant to common first aid interventions with consensus treatment recommendations.

Definition of First Aid

The National First Aid Science Advisory Board defined first aid as assessments and interventions that can be performed by a bystander (or by the patient/victim) with minimal or no medical equipment. The board defined a first aid provider as someone with formal training in first aid, emergency care, or medicine who provides first aid.

The board agreed that recommended assessments and interventions should be medically sound and based on scientific evidence or, in the absence of such evidence, on scientific consensus. Administration of first aid must not delay activation of the emergency medical services (EMS) system or other medical assistance when such assistance is required. It is recognized that certain conditions that can be treated with first aid may not require EMS involvement or assistance by other medical professionals. The National First Aid Science Advisory Board strongly believes that education in first aid should be universal: everyone can and should learn first aid.

The National First Aid Science Advisory Board recognized that the scope of first aid is not a purely scientific one and is related to both training and regulatory issues. The definition of scope is therefore variable, and it should be defined according to circumstances, need, and local regulatory requirements.

Future Directions

The evidence review by the National First Aid Science Advisory Board confirmed the paucity of scientific evidence on first aid subjects. Many of the following recommendations have been made by extrapolation from the experience of healthcare professionals or evidence derived from healthcare settings. Research is needed to ensure that future guidelines are based on a larger body of scientific evidence.

Overview

This document summarizes current evidence for evaluation and first aid interventions for medical, injury, and environmental emergencies. The broad range and number of topics reviewed and limitations of journal space require succinctness and brevity in science statements and treatment recommendations. This is not intended as a comprehensive review of every aspect of first aid. Rather, it is intended to evaluate the evidence available to support management of common problems.

Medical Emergencies

The experts reviewed published evidence to support the first aid use of oxygen and to support assistance with the use of asthma inhalers and epinephrine autoinjectors. Although there was no published information on the first aid application of any of these common adjuncts, some recommendations could be made to support assistance with asthma inhalers and epinephrine autoinjectors based on extrapolated evidence from use by laypersons.

Oxygen Administration[W264]

Consensus on Science

Although oxygen administration is a basic healthcare provider procedure, the reviewers found no studies that evaluated emergency oxygen administration by first aid providers. Many studies included oxygen as a professional treatment modality, but all identified studies were confounded by the heterogeneity of subject disease states and condition, diverse equipment needs, and multiple adjunctive treatments. These

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Organizations Represented on the National First Aid Science Advisory Board

Academy of Orthopaedic Surgeons
American Academy of Pediatrics
American Association of Poison Control Centers
American Burn Association
American College of Emergency Physicians
American College of Occupational and Environmental Medicine
American College of Surgeons
American Heart Association
Army Medical Command
The American Pediatric Surgical Association
American Red Cross
American Safety and Health Institute
Australian Resuscitation Council
Canadian Red Cross
International Association of Fire Chiefs
International Association of Fire Fighters
Medic First Aid International
Military Training Network
National Association of EMS Educators
National Association of EMS Physicians
National Association of EMTs
National Safety Council
Occupational Safety and Health Administration
Save a Life Foundation

variables prevent extrapolation of the results of any of the reviewed studies to first aid applications.

Treatment Recommendation
There is insufficient evidence to recommend for or against the use of oxygen by the first aid provider.

Assistance With Use of Inhalers[W253]

Consensus on Science
Severe asthma and deaths from asthma are increasing,[1] so it is likely that first aid responders will be asked to help victims with respiratory distress caused by asthma. Patients with asthma often use prescribed bronchodilator inhalers, but the reviewers found no studies evaluating the efficacy of first aid providers assisting patients in the use of these inhalers for breathing difficulty. Nonrandomized studies documented the ability of adults to appropriately self-administer bronchodilator medications (LOE 4)[2–4] and the ability of parents to correctly administer metered-dose inhalers to their children (LOE 4).[5] An important difference in the first aid situation, however, is that the first aid provider may not know the victim, the victim's medical history, or what medications the victim takes. Thus the studies regarding parents constitute LOE 7 (extrapolated) information applied to first aid.

Treatment Recommendation
Because the frequency and mortality from severe asthma is increasing[1] and bronchodilator therapy is safe and can be effective during episodes of severe asthma, the first aid rescuer should assist with administration of bronchodilator therapy.

Epinephrine Autoinjector[W199,W252]

Consensus on Science
A severe allergic reaction (anaphylaxis) can cause life-threatening airway edema and obstruction, vasodilation, and cardiovascular collapse. Although administration of epinephrine is a cornerstone of emergency management of severe allergic reactions, the reviewers found no studies of the safety, efficacy, or feasibility of first aid providers assisting with administration of epinephrine autoinjectors. Many adults and children with a history of anaphylaxis carry a prescribed epinephrine autoinjector.

Evidence from one small retrospective study (LOE 7)[6] reported that parents who administer epinephrine to their children via an autoinjector can do so safely and effectively. Evidence from other studies (LOE 7)[7–9] highlighted the need for additional education and retraining of parents and healthcare providers in the use of epinephrine autoinjectors.

Treatment Recommendation
Given the widespread use of epinephrine autoinjectors and their documented efficacy in the rapid delivery of epinephrine,[10] first aid providers may be trained to assist in the use of an epinephrine autoinjector for a victim of anaphylaxis when the victim has a prescribed autoinjector and the victim is unable to use it.

Recovery Position[W146A,W146B,W155,W274]

Consensus on Science
Although the recovery position is widely used in healthcare settings, the reviewers found no studies evaluating the safety, effectiveness, or feasibility of this position in unresponsive, breathing victims in the out-of-hospital setting. All identified studies of specific recovery positions used healthy, responsive adult volunteers (LOE 3–5), so results are at best extrapolated (LOE 7) to unresponsive victims.

Any recovery position used for the patient with known or suspected spinal injury should maintain a patent airway, stabilize the spine, and minimize movement of the victim. Two human prospective cohort studies in healthy adult volunteers (extrapolated from LOE 3)[11,12] suggest that the modified HAINES position results in more neutral position of the cervical spine than the traditional lateral recovery position. HAINES is an acronym for **H**igh **A**rm **IN** **E**ndangered **S**pine: the rescuer extends the victim's arm above the head and rolls the victim to the side, onto that arm, and then bends the victim's knees. The subjects in these studies were responsive (with presumably normal muscle tone), however, and had no head, neck, or cervical spine injury. In addition, the study of the HAINES position did not include study of the movement of patients to that position.

The recovery position was also reviewed by the Basic Life Support Task Force. For additional information see Part 2: "Adult Basic Life Support" and the associated worksheets.[W146A,W146B,W155]

Treatment Recommendation
The use of the recovery position with the victim lying on his or her side with the dependent hand placed in front of the

body is recommended for the unconscious victim with an intact airway, spontaneous respiration, and signs of circulation. This position is easy to teach, but conscious volunteers who were placed in the position developed some vessel and nerve compression (LOE 3).[13,14] Nerve and vessel injury can develop, particularly if the victim remains in the position for a long period of time.

The preferred position for the victim with known or suspected spinal injury is to stabilize the spine in the supine position and minimize movement of the victim. Use of the recovery position may be necessary if it is difficult to maintain a patent airway in the supine position, if the victim has secretions or emesis, or if the rescuer must leave the victim and there is no provider trained in spinal stabilization. If use of the recovery position is absolutely necessary, use the HAINES recovery position: extend the victim's arm above the head and roll the victim to the side so that the victim's head rests on that arm. Bend both legs to stabilize the victim.

Injury Emergencies

There was little published evidence about common first aid maneuvers to stabilize the cervical spine; control bleeding; and treat wounds, abrasions, burns, and musculoskeletal injuries. Because the consequences of spinal cord injury are severe, the experts developed consensus treatment recommendations for stabilization of the cervical spine based on extrapolation from healthcare provider experiences. Treatment of bleeding in the battlefield provided evidence regarding the use of pressure and tourniquets by trained lay rescuers and healthcare providers. But these results must be applied with caution to the first aid setting when medical assistance may be available within minutes.

The experts found that many "common sense" treatments for wounds, burns, musculoskeletal injuries, and dental and environmental injuries are supported by only low levels of evidence.

Cervical Spine Injuries

Cervical Spine Stabilization[W256,W257,W268,W269,W150A,W150B]

Consensus on Science

Approximately 2% of adult victims of blunt trauma evaluated in the emergency department suffer a spine injury (LOE 3),[15,16] and this risk is tripled in patients with craniofacial injury (LOE 4)[17] or a Glasgow Coma Scale score of <8 (LOE 4).[18]

EMS and emergency department personnel can correctly identify injury mechanisms that may produce spinal injury in adults (LOE 3[15,19,20]; LOE 4[21]) and in children.[22] EMS personnel can properly apply spinal immobilization devices in such circumstances (LOE 3),[23–25] although they may not accurately detect signs and symptoms of actual spinal injury (LOE 3[26–28]; LOE 4[29,30]). Results of these healthcare provider studies constitute only extrapolated evidence (LOE 7) for first aid actions. There are no studies showing that first aid providers can recognize potential or actual spinal injury.

There is no evidence that first aid rescuers can correctly use spinal immobilization devices. Although the failure to detect and immobilize cervical spine injury in hospitalized patients is associated with a 7-fold to 10-fold risk of secondary neurologic injury (LOE 3[31]; LOE 4[32]), it is not clear if the secondary injuries occur in the prehospital setting and can be prevented by spinal immobilization devices. A 5-year retrospective chart review (LOE 4)[33] with a multivariate analysis compared all patients with blunt traumatic spine or spinal cord injuries admitted to a trauma hospital in Malaysia with patients with similar injuries admitted to a US trauma hospital. Physicians blinded to hospital origin found less evidence of neurologic disability in the Malaysian patients, who were transported without spinal immobilization, than in the US patients, who were transported with spinal immobilization devices in place.

There is some evidence that spinal immobilization devices can be harmful. A retrospective chart review (LOE 4)[34] found that spinal immobilization devices masked life-threatening injuries. In addition, immobilization on a spine board restricted pulmonary function in healthy adults (LOE 3)[35] and children (LOE 3).[36] Application of a cervical collar increased intracranial pressure in healthy patients (LOE 3)[37] and patients with traumatic brain injury.[38]

Spine immobilization was also reviewed by the Basic Life Support Task Force. For additional information see Part 2: "Adult Basic Life Support" and the associated worksheets.[W150A,W150B]

Treatment Recommendation

Considering the serious consequences of spinal cord injury, most experts agree that spinal motion restriction should be the goal of early treatment of all patients at risk for spinal injury. The first aid provider should restrict spinal motion by manual spinal stabilization if there is any possibility of spinal injury.

In the absence of any evidence supporting the first aid use of immobilization devices and with some evidence suggesting potential harm even when these devices are used by healthcare providers, the first aid provider should refrain from use of spinal immobilization devices.

Severe Bleeding

Application of Pressure and Tourniquets[W254,W255]

Consensus on Science

Direct pressure. Although bleeding is a common first aid emergency and control of hemorrhage can be lifesaving, only 2 studies reported the efficacy of direct pressure to control hemorrhage in the prehospital or field hospital settings, and in both studies the pressure was applied by trained medical personnel. One retrospective case series (LOE 5)[39] described the technique of hemorrhage control by highly trained ambulance workers. Hemorrhage control was achieved by wrapping an adhesive elastic bandage applied directly over a collection of 4 × 4-inch gauze pads placed on the wound surface. The roll was wrapped around the body surface over the bleeding site until ongoing hemorrhage ceased. The pressure was effective in stopping bleeding in all cases with no complications. A second nonrandomized observational case series from a field hospital (LOE 4)[40] compared the efficacy of direct pressure applied by trained providers with an elastic bandage to control hemorrhage in 50 successive victims of traumatic amputations to the effectiveness of tourniquets used for 18 previous victims with traumatic amputations from mine explosions. Less ongoing bleeding, higher survival rates, and higher admission hemoglobin were observed in the 50 victims for whom bleeding was controlled with direct pressure compared with the 18 earlier victims who had bleeding controlled with a tourniquet. Four studies from cardiac catheterization experience (LOE 7, extrapolated from LOE 1 and 2),[41–44] one animal study (LOE 6),[45] and clinical experience document that direct pressure is an effective and safe method of controlling bleeding. The efficacy, feasibility, and safety of use of pressure points to control bleeding have never been subjected to any reported study, and there have been no published studies to determine if elevation of a bleeding extremity helps to control bleeding or causes harm.

Tourniquets. The use of tourniquets by a first aid provider to control bleeding is controversial. Tourniquets are routinely and safely used to obtain extremity ischemia for orthopedic and vascular surgical procedures in operating rooms where applied pressure and occlusion time are strictly measured and controlled and on the battlefield when occlusion time is carefully documented. But these results cannot be extrapolated to the first aid setting. Two studies illustrate the contradictory evidence reported about the effectiveness and safety of tourniquet use in the first aid setting. In a retrospective military field case series (LOE 5),[46] 110 tourniquets were applied to 91 soldiers by medical (47%) or nonmedical (53%) personnel. The tourniquets controlled bleeding in most (78%) of the victims, typically within 15 minutes. Penetrating trauma was the most common mechanism of injury, and ischemic time was 83 $\pm$ 52 minutes (range of 1 to 305 minutes). The rate of success was higher for medical staff compared with soldiers and for upper limbs (94%) compared with lower limbs (71%, $P<.01$). Neurologic complications of the tourniquet were reported in 7 limbs of 5 patients (5.5%) who had an ischemic time of 109 to 187 minutes. Complications included bilateral peroneal and radial nerve paralysis, 3 cases of forearm peripheral nerve damage, and 1 case of paresthesia and weakness of the distal foot.In the nonrandomized report (LOE 5)[40] of victims of traumatic amputation from mine explosions cited in the previous section, tourniquet use resulted in more bleeding, lower survival rates, and lower admission hemoglobin than direct pressure with an elastic bandage. Complications following tourniquet use in the operating room are well documented. Tourniquet use during surgical procedures has produced temporary (LOE 5)[47] or permanent (LOE 7)[48] injury to the underlying nerves and muscles (LOE 5)[49] and limb ischemia with resulting systemic complications, including acidemia and hyperkalemia (LOE 2).[50] Complications can include reperfusion injury (LOE 2)[51] and limb loss. These complications are related to the pressure applied (LOE 5)[52] and occlusion time (LOE 2).[50]

Treatment Recommendation

The first aid provider should try to control external bleeding by applying direct pressure.

There is insufficient evidence to recommend for or against the first aid use of pressure points or extremity elevation to control bleeding.

Tourniquets may be useful under some unique conditions (eg, battlefield conditions when rapid evacuation is required and ischemic time is carefully monitored). Additional studies are needed to identify those conditions and the indications and procedures for use. The method of application and best design of tourniquets is still under investigation.[53] There is insufficient evidence about the effectiveness, feasibility, and safety of tourniquets to recommend for or against their use by first aid providers to control bleeding.

Wounds and Abrasions

Wound Irrigation[W259,W266]

Consensus on Science

Wound irrigation is often used in the prehospital and hospital setting to clean wounds. There is strong evidence from human and animal studies that wound irrigation using clean running tap water is at least as effective as wound irrigation with normal saline. In 1 Cochrane meta-analysis (LOE 1),[54] 1 small randomized human study (LOE 2),[55] and 1 human case series (LOE 5),[56] irrigation with running tap water was more effective than irrigation with saline in improving wound healing and lowering infection rates. In 1 small randomized human study (LOE 2),[57] irrigation with tap water produced wound infection rates equivalent to that observed after irrigation with normal saline. Although many of these studies were performed in healthcare settings, running tap water is readily available to lay rescuers in the out-of-hospital setting.

Treatment Recommendation

Superficial wounds and abrasions should be irrigated with clean tap water.

Use of Antibiotic Ointment[W265]

Consensus on Science

Two prospective, randomized controlled studies compared the effectiveness of triple antibiotic ointment with single antibiotic ointment or no ointment in conditions comparable to first aid situations. In one human volunteer study (LOE 1)[58] of the effects of applied ointment to intradermal chemical blisters inoculated with a single organism (*Staphylococcus aureus*), contaminated blisters treated with triple antibiotic ointment healed significantly faster and with a lower infection rate than blisters treated with either single antibiotic ointment or no ointment. Both triple and single antibiotic ointments were superior to no treatment in promoting healing of the contaminated blisters. In a study (LOE 1)[59] of 59 children in a rural day care center, application of triple antibiotic ointment to minor skin trauma (eg, mosquito bites, abrasions) resulted in lower rates of one skin infection, streptococcal pyoderma, than the rates of that infection observed in children who received applications of placebo ointment (15% versus 47%).

Extrapolation of results from studies of surgically created wounds supports the use of antibiotic ointments. In 2 studies involving human volunteers with wounds that were created under sterile conditions (ie, dermabrasion or split-thickness skin graft donor sites), triple antibiotic ointment was superior to no ointment in minimizing pigment changes[60] and scarring.[61] These reports may not be relevant to the treatment of nonsurgical and probably nonsterile wounds in the first aid setting. Triple antibiotic ointment can eliminate coagulase-negative staphylococci underlying the skin surface (LOE 7),[62] but its impact on wound contamination and healing cannot be extrapolated from these studies.

Treatment Recommendation
Lay rescuers should apply antibiotic ointment or cream to cutaneous abrasions and wounds to promote faster healing with less risk of infection. The use of triple antibiotic ointment may be preferable to double- or single-agent antibiotic ointment or cream.

Thermal Burns

Cooling With Water[W247]

Consensus on Science
Immediate cooling of thermal burns with cold tap water is supported by a large number of observational clinical studies and controlled experiments in animals. Cooling may provide pain relief and reduce formation of edema, infection rates, depth of injury, and need for grafting and may promote more rapid healing. One small, controlled human volunteer study (LOE 3),[63] several large retrospective human studies (LOE 4[64]; LOE 5[65–67]), and multiple animal studies (LOE 6)[68–72] document consistent improvement in wound healing and reduced pain when burns are cooled with cold water (10°C to 25°C [50°F to 77°F). Several studies (LOE 6)[69,73] indicate that cooling of burns should begin as early as possible and continue at least until pain is relieved (LOE 5).[74]

There is limited (LOE 5) evidence that brief application of ice or ice water may be safe and effective for small burns in adults,[64,68,74,75] but prolonged application of ice or ice water may result in additional tissue injury (necrosis)[67] (LOE 5[76]; LOE 6[77]). Evidence from animal studies (LOE 6)[78] suggests that cooling of large burns ($\geq$20% of total body surface area) with ice or ice water for $\geq$10 minutes can result in hypothermia.

Treatment Recommendation
Cooling of burns with cold water as soon as possible is safe, feasible, and effective as a first aid treatment. First aid providers should avoid cooling burns with ice or ice water for $>$10 minutes, especially if burns are large ($>$20% total body surface area).

First Aid for Burn Blisters[W248]

Consensus on Science
There is no clear, evidence-based consensus on the treatment of burn blisters. Many treatment recommendations are based on level 5 or lower studies and common practice. Although many first aid guidelines recommend that burn blisters be left intact, some researchers suggest that burn blister fluid may retard healing, particularly when blisters are large ($>$2.5 cm) and thin-walled. One case control study (LOE 4)[79] looked at wound healing rates for intact blisters versus those in which fluid was drained and found that removal of burn blister fluid enhanced healing. In contrast, most animal data (LOE 6)[80–82] documents faster healing rates, significantly lower infection rates, and less scar tissue formation in animals with burn blisters left intact compared with those with debrided burn blisters.

Treatment Recommendation
Because the need for blister debridement is controversial and requires equipment and skills that are not consistent with first aid training, first aid providers should leave burn blisters intact and cover them loosely.

Musculoskeletal Injuries (Fractures, Sprains, and Contusions)

Stabilization[W260,W273]

Consensus on Science
There are numerous reports of the benefits of stabilization of extremities by trained providers, but it is impossible to extrapolate this data to the first aid provider. There is no evidence to support the hypothesis that realignment of a fractured extremity bone by a lay first aid provider is safe, effective, or feasible.

Treatment Recommendation
The first aid provider should assume that any injury to an extremity can include a potential bone fracture. The first aid provider may manually stabilize the injured extremity but should not attempt to straighten it.

Compression[W261]

Consensus on Science
The reviewers found no data to support the hypothesis that compression of an injured extremity is safe, effective, and feasible when performed by a first aid provider. Although it is widely accepted (LOE 7)[83] that compression of an injured extremity decreases edema, this concept has not been subjected to randomized trials. One small study (LOE 7)[84] with Doppler evaluation of blood flow to the toes of 10 healthy female volunteers suggests that moderate circumferential compression may compromise distal (toe) blood flow, but this information must be extrapolated to the first aid arena.

Treatment Recommendation
There is inadequate evidence to recommend for or against the use of a circumferential bandage to compress a closed soft-tissue injury and reduce formation of edema (Class Indeterminate).

Application of Cold[W262]

Consensus on Science
The basic principle in first aid for soft-tissue injuries is to decrease hemorrhage, edema, and pain. Cold therapy has been shown to reduce edema in animal[85,86] and human[87,88] studies. Cold therapy has been shown experimentally to reduce the temperature of various tissues, including muscles and joints in healthy[89–92] and postoperative[93] subjects. Ice therapy also contributes to reductions in arterial and soft-tissue blood flow along with bone metabolism as shown in nuclear medicine imaging studies.[94] It appears to be time dependent.[95]

The application of ice is effective for reducing pain, swelling, and duration of disability[87,96] after soft-tissue injury. There is good evidence to suggest that cold therapy reduces edema.[86,87,97] One postoperative study evaluating anterior cruciate ligament reconstruction suggested that cold therapy contributed to no objective benefit in the postoperative period related to length of hospital stay, range of motion, use of pain medication, and drain output.[93] However, there was a trend for a decrease in oral pain medication in the group of patients treated with ice bags. Other types of cold therapy, including cold gel,[98] frozen pea bags,[89] and other cold therapy delivery systems,[85,91] may also be beneficial. Some studies[85,89,99] showed that refreezable gel packs are inefficient. Cold therapy modalities that undergo a phase change seem to be more efficient in decreasing tissue temperature.[91]

Treatment Recommendation
Cooling is generally safe, effective, and feasible in first aid for a sprained joint and soft-tissue injury. Cold applied for >20 minutes may be detrimental, although there are several reports that suggest that longer application may continue to cool the joint without additional complications.[91]

There is insufficient information to make recommendations on optimal frequency, duration, and initial timing of cryotherapy after an acute injury.[100,101] Many textbooks are not consistent in their recommendations related to duration, frequency, and length of ice treatment.[100]

To prevent cold injury to the skin and superficial nerves, it is best to limit ice to periods ≤20 minutes at a time with a protective barrier.[102,103] A damp cloth or plastic bag barrier may be ideal, whereas cold is not conducted as well through padded elastic bandages.[100] Caution should be exercised when applying ice to an injury in a person with little subcutaneous fat, especially over areas of superficial peripheral nerves.[102,104]

Dental Injuries

Tooth Avulsion[W275]

Consensus on Science
The evidence reviewed included an expert opinion review article (LOE 7)[105] and extrapolated evidence from a study of survival of lip fibroblasts in various media (LOE 7).[106] Expert opinion and a study of tissue survival in mild versus salt solutions or other storage media supported placement of avulsed teeth in milk until reimplantation or other definitive care can be provided.

Treatment Recommendation
The consensus of the experts is that the potential harm from attempted reimplantation of an avulsed tooth outweighs the potential benefit, and that avulsed teeth should be stored in milk and transported with the injured victim to a dentist as quickly as possible.

Environmental Injuries

Relatively good animal data is available to evaluate the treatment of snakebite, but little evidence is available on which to base specific treatment recommendations for cold injuries.

Snakebite[W270,W271]

Consensus on Science
Although some first aid texts recommend that rescuers must remove venom from a snakebite, a controlled animal study (LOE 6)[107] showed no clinical benefit and earlier death in animals with snakebites that were treated with suction compared with animals with snakebites treated without suction. Two subsequent studies (LOE 5[108]; LOE 6[109]) showed that the application of suction resulted in the removal of some injected venom, but these reports did not examine clinical outcome. The use of a suction device on rattlesnake envenomation in a porcine model (LOE 6)[110] showed no benefit and suggested injury may occur with suction. A simulated snakebite study in human volunteers (LOE 5)[111] determined that a suction device recovered virtually no mock venom.

If a snakebite is from an elapid (eg, coral) snake, first aid treatment includes application of pressure immobilization. The landmark article by Sutherland (LOE 6)[112] showed that pressure immobilization after elapid snakebites retarded venom uptake in monkeys. In a human study Howarth (LOE 3)[113] showed that lymphatic flow and mock venom uptake can be safely reduced by proper application of pressure (40 to 70 mm Hg for upper limbs, 55 to 70 mm Hg for lower limbs) and immobilization and that either alone is insufficient. Pressure bandages should not be applied too tightly because they will restrict blood flow. A recent study in pigs (LOE 6)[114] documented improved survival rates with application of moderate pressure and immobilization.

Treatment Recommendation
First aid providers should not apply suction to snakebite envenomation sites.

Properly performed pressure immobilization is recommended for first aid treatment of elapid snakebites. The first aid provider creates this pressure by applying a snug bandage that allows a finger to slip under the bandage.

Cold Injuries

Hypothermia[W267]

Consensus on Science
The goals of care for the victim of hypothermia are to stop the fall in core temperature, establish a steady, safe rewarming rate, and support cardiorespiratory function.[115] Although there is a general belief that hypothermic patients should be rewarmed, there is very little data to support any specific method or timing of rewarming in the out-of-hospital setting.

One small in-hospital study[116] of adult patients with hypothermia randomized to warming with forced-air convective covers plus warmed IV fluids versus cotton blankets plus warmed IV fluids documented that forced-air rewarming (using an air-filled blanket) raised the core temperature faster than passive rewarming and produced no additional complications. In a prospective randomized study[117] of 8 healthy volunteers who were anesthetized and cooled to 33°C (91.4°F) (shivering was prevented with administration of meperidine) core temperature increased more rapidly with active rewarming using a resistive heating blanket than with passive rewarming using reflective foil. It is difficult to extrapolate these results to all victims of hypothermia in the first aid setting. The need for lay rescuers to institute fast or active rewarming in the prehospital setting has not been established.

In a retrospective chart review (LOE 4),[118] prehospital rewarming strategies did not affect outcome of hypothermic patients admitted through the emergency department. Active prehospital rewarming may lead to increased complications such as the "afterdrop phenomenon," in which vasodilation results in increased perfusion of cold extremities and delivery of acidotic blood to the central circulation.[119]

This topic was also reviewed by the Basic Life Support Task Force. For additional information see Part 2: "Adult Basic Life Support," and the related worksheet.[W162A]

Treatment Recommendation
The first aid provider should provide passive warming (using blankets) as feasible for victims of hypothermia. Victims should be transported to a facility where active rewarming can be initiated. If the victim is in a remote location far from medical help, the first aid rescuer may initiate active rewarming.

Frostbite[W267]

Consensus on Science
There is little published evidence about the first aid treatment of frostbite. One opinion review with a case report[120] suggests that the frostbitten body part should be rewarmed in the prehospital setting only if there is no chance of refreezing. Other consensus opinion reviews[121] suggest that the frostbitten part should not be rubbed or massaged because this can increase tissue damage.

Treatment Recommendation
The first aid provider should rewarm a frostbitten body part unless there is a possibility that it might refreeze.

Poisoning

Poisoning can be caused by solids, liquids, gases, and vapors. Solids and liquids are ingested or absorbed through the skin, whereas gases and vapors are typically inhaled (vapors can also be absorbed through the skin). This evidence evaluation process did not review the evidence surrounding first aid for inhaled toxins.

Water irrigation was shown to be effective for topical chemical or caustic burns. Some common first aid treatments for ingested poisons, such as drinking water or administration of syrup of ipecac, are not supported by evidence and may be harmful, so they are not recommended. There was inadequate evidence to recommend for or against the use of activated charcoal in the first aid setting.

Toxic Exposure and Chemical Burns

Water Irrigation[W258,W259]

Consensus on Science
Irrigation of the skin and eye after exposure to caustic agents can reduce the severity of tissue damage. Evidence from multiple studies examining alkali and acid exposure to both the eye (LOE 1–8)[122–127] and the skin (LOE 4–6)[128–134] document improved outcome when water irrigation is rapidly administered in first aid treatment. One nonrandom case series (LOE 5)[134] of immediate (first aid) versus delayed (healthcare provider) skin irrigation documented a lower incidence of full-thickness burns and 50% reduction in length of hospital stay with immediate and copious irrigation of skin chemical burns. Animal evidence (LOE 6) also supports water irrigation to reduce toxic exposure from acid burns to the skin[124,130] and eye.[122,123] In a study of rats with acid skin burns,[130] water irrigation within 1 minute of the burn prevented any drop in tissue pH, whereas delayed irrigation allowed a progressively more significant fall in tissue pH.

Treatment Recommendation
To treat skin or eye exposure to acid or alkali, the first aid provider should immediately irrigate the skin or eye with copious amounts of tap water.

Ingested Poisons

Water and Gastrointestinal Decontamination[W249,W250,W251]

Consensus on Science
As noted in the *ECC Guidelines 2000,*[135] there is no human evidence to support the administration of water or milk after the ingestion of a poison. Although animal studies of caustic (acid or alkali) ingestions have documented reduced esophageal tissue injury following lavage with or ingestion of saline, cola, orange juice, water or milk, outcome data was limited to tissue pH studies or tissue injury and did not evaluate survival rates. In addition, these studies did not address ingestion of noncaustic substances. Because the poisoned patient may have an altered level of consciousness that compromises airway protective reflexes, expert opinion suggests that administration of anything by mouth may be harmful.

Three randomized clinical trials (LOE 2) in children[136] and adults[137,138] have shown no benefit and possible harm from the administration of syrup of ipecac after toxic ingestion. In 2 studies[136,138] administration of ipecac delayed the use of activated charcoal and in 1 trial[138] increased charcoal emesis and length of stay. One prospective, randomized clinical trial (LOE 2)[139] of 200 adults treated for ingestion in the emergency department with either ipecac plus activated charcoal or ipecac alone documented higher complication rates and higher incidence of aspiration pneumonia among adults who received ipecac alone. A large retrospective study of 752 602 children in the American Association of Poison Control Center Toxic Exposure Surveillance System Database (LOE 4)[140] was unable to document improvement in outcome or reduction in healthcare use related to administration of syrup of ipecac for potentially toxic ingestions. Administration of syrup of ipecac has been associated with harm in case reports (LOE 5)[141–144] and clinical studies (LOE 2).[139]

Administration of activated charcoal to animals immediately after drug ingestion can reduce the amount of drug absorbed, but effectiveness varies and decreases over time.[145,146] The published experience pertaining to first aid administration of activated charcoal is limited. Although 1 prospective uncontrolled study (LOE 4)[147] and 2 retrospective case series(LOE 5)[148,149] suggest that activated charcoal may be safely administered to children at home and can reduce the time to activated charcoal administration, activated charcoal was rarely recommended for childhood poisonings and was successfully administered to only two thirds of the victims.[147] Studies in healthy children document that children will not take the recommended dose of activated charcoal.[150] Although a retrospective chart review (LOE 5)[151] of 878 patients who received multiple doses of activated charcoal in the hospital documented a low incidence of complications, aspiration did occur in this study, and the results are likely to be worse in the prehospital setting with no healthcare providers in attendance. Some reports of aspiration of activated charcoal were identified,[151–153] but the precise incidence of this complication is unknown.

Treatment Recommendation

The administration of water or milk to the victim of ingested poison is not recommended.

Based on lack of evidence of benefit and documentation of potential harm, syrup of ipecac is not recommended for toxic ingestions.

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

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W150B. *http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.105.170522/DC250*
W155. *http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.105.170522/DC257*
W162A. *http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.105.170522/DC269*
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W274. *http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.105.170522/DC447*
W275. *http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.105.170522/DC448*