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Children are, by nature, playful, active, and curious—characteristics that frequently bring them into contact with members of the animal kingdom. On occasion, mammalian bites, arthropod stings and, less commonly, reptile envenomations are the outcome of these encounters. The spectrum of disease following these injuries includes clinical syndromes resulting from direct trauma, effects of toxins, immune phenomena, and transmitted infections. Understanding the determinants of disease and anticipating the clinical consequences prepare the clinician to evaluate and manage these injuries appropriately, whether they are caused by the bite of a highly evolved mammal or the sting of a flying insect.

Interestingly, despite the frequency with which these injuries occur, controversy has surrounded many aspects of evaluation and treatment. Debate continues over the use of prophylactic antibiotics after mammalian bites, indications for antivenom use in snakebites, and the appropriate wound management of brown recluse spider bites. In some cases, conflicting recommendations still exist in the literature. Presently, however, as the principles of evidence-based medicine are utilized to examine critically many of the limited studies and personal anecdotes on which management guidelines have been based, a clearer picture of what works and what doesn't work is emerging. This article will describe for the emergency physician the clinical conditions caused by bites and stings, identify the clinical issues of greatest importance in the acute care setting, and emphasize treatment recommendations that are based on strong evidence of efficacy.

— The Editor

Revenge of the Wild Kingdom: Animal Bites and Stings in Children

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Mammalian Bites

It is estimated that more than 5 million mammalian bites occur each year in the United States, with 15-20% of bite victims seeking medical attention.[1,2] These injuries account for roughly 1% of all emergency department (ED) visits. Children are particularly at risk for mammalian bites, as well as for other serious bite injuries, because of their size and behavioral characteristics.

Dog Bites. Dogs are responsible for 80-90% of mammalian bites.[1,2] The epidemiology of dog bites has been well studied. The typical pediatric victim is a boy between the ages of 5 and 9 years who provokes a family or neighborhood dog, although increasing numbers of unprovoked dog attacks are being reported.[1,3] Medium- and large-breed dogs, including German shep-

herds, pit bulls, huskies, and rottweilers, are implicated more frequently than other breeds.[4] In young children, more than three-quarters of bites involve the head and neck, while the extremities are the areas of the body most commonly injured in older children and adults. Children are at greatest risk for serious injury, with 70% of dog-bite-related fatalities occurring in victims younger than 10 years of age.[4-7]

The animal's large teeth and jaw muscles, which can generate compressive forces of more than 400 pounds per square inch, are responsible for the observed patterns of injuries. Dogs tear and crush tissue, producing lacerations, abrasions, avulsions, and crush injuries. Wound infection occurs in 3-18% of bites, and other complications (e.g., sepsis, septic arthritis, osteomyelitis, tenosynovitis, endophthalmitis, rabies, and tetanus) have been reported.[8] Dog-bite wounds to the head and face in young children have been associated with brain injury and meningitis.[6] In addition, because of the predilection for bites to the face, children are at significant risk for scarring and disfigurement.

Cat Bites. In contrast to dog bites, cat bites are relatively uncommon in children. Cats are responsible for about 10% of reported animal bites annually, and cat-bite victims are more frequently female, older than dog-bite victims (mean age 19.5 years), and bitten by an unknown or stray animal.[3,9] The cat's sharp teeth and claws, and relatively weak jaw muscles predispose the victim to scratches and puncture wounds.[10] In adults, more than 80% of cat bites are inflicted on the upper extremities and hands, while in pediatric patients, one-third of bites occur on the face and neck.[9] Because they are typically small, deep punctures, cat bites are particularly prone to infection, with infection rates as high as 28-80% reported in some studies.[8] Other complications are similar to those seen following dog bites. In addition, cats are the leading domestic carrier of rabies and are the reservoir for *Bartonella henselae*, the agent responsible for cat scratch disease.[11]

Human Bites. Human bites are even less common in the ED than dog and cat bites, but can be associated with complications. In the pediatric population, more than half of human bites occur during fights in children older than 10 years.[12,13] Other causes of "tooth-skin" contact include sports events, play activities, and child abuse.[12,14] While deep hand lacerations and avulsions predominate in adolescents and adults, human bite injuries in young children are usually abrasions involving the face and neck.[13] Wound infection, tenosynovitis, osteomyelitis, amputation, and transmission of various infectious pathogens, including hepatitis B, human immunodeficiency virus (HIV), and syphilis, are known complications of human bites.

Rodent Bites. The characteristic rat bite is a puncture wound on the finger or hand that occurs during sleep or while attempting to handle the animal.[15] Rat bites typically are seen in laboratory workers and among children living in poverty. Children younger than 10 years are at greatest risk, accounting for 69% of rat bites in one study.[16] Rat bites result in wound infection in fewer than 10% of cases, although they may be responsible for transmission of a variety of diseases, including plague (bubonic, pneumonic, septicemic, and meningeal), rat bite fever, leptospirosis, melioidosis, and tetanus.[11] Rabies transmission by rodents never has been reported in the U.S.[17]

Management. Although it is rare for a victim of a mammalian bite to require intervention for life-threatening injuries, this activity would be the priority in an acutely injured patient. Once the patient is stabilized, the primary goal of mammalian bite management is wound care that focuses on promotion of wound healing, detection of deep and/or occult injuries, and restoration of function of the injured area. *(See Figure 1.)* In addition, prophylaxis for a variety of potential viral and bacterial infections may be indicated, as determined by the clinical situation.

An appropriately directed history will provide information to facilitate clinical decision-making in the care of the bite victim. Information that should be obtained includes the type and immu-

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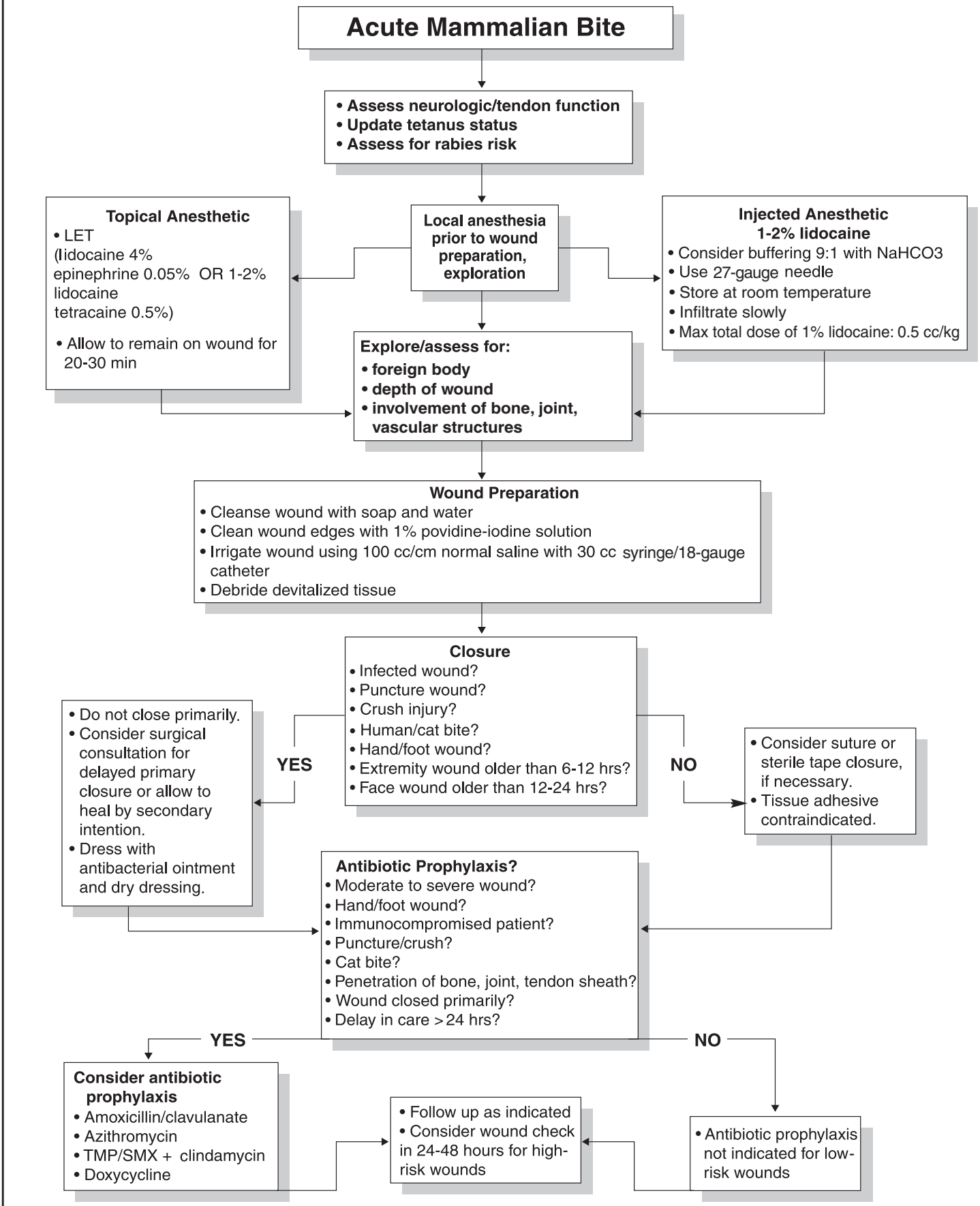
Figure 1. Treatment Algorithm for Acute Mammalian Bite



Key: TMP/SMX = trimethoprim/sulfamethoxizole

Table 1. Antibiotic Prophylaxis and Empiric Treatment of Infected Mammalian Bites in Children

ORAL DRUG	DOSAGE
• Amoxicillin/clavulanate	25-45 mg/kg/d BID
• Doxycycline	5 mg/kg/d BID
• Azithromycin	10 mg/kg/d on first day, then 5 mg/kg/d QD for 4 days
• Penicillin VK	25-50 mg/kg/d BID + dicloxicillin 12.5-25 mg/kg/d QID or cephalexin 25-100 mg/kg/d QID
• TMP/SMX	8-10 mg/kg/d TMP BID + clindamycin 10-30 mg/kg/d TID
• Cefuroxime	30 mg/kg/d BID

PARENTERAL DRUG	DOSAGE
• Ampicillin/sulbactam	100-200 mg/kg/d QID
• Doxycycline	5 mg/kg/d BID
• Cefuroxime	75-100 mg/kg/d TID
• Cefoxtin	80-160 mg/kg/d TID
• Ceftriaxone	50-100 mg/kg/d QD

Adapted from Smith PF, Meadowcroft AM, May DB. Treating mammalian bite wounds. *J Clin Pharm Ther* 2000;25:85-99.

nization status of the animal responsible for the bite, report of unusual behavior in the animal, the time and circumstances of the injury, the immunization status of the victim, and any other victim characteristics that would predispose the patient to infection (e.g., immunosuppression).

Physical examination should include careful inspection and exploration of the bite wound, with special attention to altered neurovascular function, joint capsule integrity, and signs or symptoms of compartment syndrome.[18] Radiologic studies may be indicated if concern exists for fracture, brain injury, or the presence of a foreign body in the wound (e.g., a tooth). Laboratory tests rarely are indicated in the evaluation of the acute, noninfected wound. Pretreatment cultures in this setting have a low predictive value for causative organisms in wounds that subsequently become infected.[19] Wounds with evidence of infection, however, should be cultured both aerobically and anaerobically.

Although current literature lacks large prospective studies to support many of the recommendations made for wound preparation, wound closure, and use of prophylactic antibiotics, most experts agree that the mainstays of bite wound management are cleansing, copious irrigation, and debridement of devitalized tissue.[19-22] Initial cleansing with soap and water has been shown to decrease the incidence of rabies infection.[17] Irrigation should be accomplished with sterile saline, a 19-gauge catheter, and a 20-30 cc syringe to generate adequate pressure to dislodge foreign or devitalized material without harming viable tissue. Tetanus immunization status should be updated according to standard guidelines.

Surgical closure of bite wounds remains a controversial topic, but a recent study suggests that it can be accomplished safely without apparent increase in infection risk in low-risk wounds.[23] It is discouraged, however, in wounds with a high risk for infection.[19,20] These include cat puncture wounds, closed fist, and other hand injuries from humans, dogs, or cats; significant crush or puncture wounds; and all bites in immunocompromised patients. Delayed primary closure or healing by secondary intention is recommended for bites such as these.

The use of prophylactic antibiotics in both high- and low-risk bite wounds has been studied, but consensus regarding efficacy is lacking because of numerous study limitations.[24-30] Of the randomized clinical trials published to date, the majority suffer from small sample size, high lost-to-follow-up rate, lack of standardized wound preparation, and failure to document patient compliance.[31] While the limited available evidence suggests possible benefit from antibiotic prophylaxis in human and hand bites only, there appears to be no effect in uninfected, low-risk, carefully prepared wounds.[31,32] However, most experts are more liberal in their recommendation for antibiotic use, encouraging their use for most high-risk bites.[19,21] When indicated, recommended antibiotics include those with a spectrum that can address the expected organisms, specifically *Pasturella multocida*, the pathogen cultured most commonly from dog and cat bites, as well as anaerobes, staphylococcus species, and streptococcus species.[8,19,21,33] While a variety of antibiotic combinations will provide appropriate coverage, amoxacillin/clavulanate is recommended most often. *(See Table 1.)* In the penicillin-allergic patient, azithromycin or doxycycline may be used in children older than 8 years.[19,20,21] While fluoroquinones have demonstrated activity against the most likely bite-related pathogens, their use is not recommended in children.

All infected wounds require antibiotic therapy. The broad-spectrum intravenous agents ampicillin/sulbactam, cefoxitin, and ceftriaxone provide coverage for the most common organisms in severe wound or invasive infections. They are reasonable empiric choices before culture identification of the infective pathogens is available.

Concern for rabies infection prompts many people to seek medical attention following animal bites. Risk for rabies is greatest after wild animal exposure, particularly to raccoons, skunks, and bats, although most post-exposure rabies prophylaxis given in the United States follows dog or cat bites. A recent report suggests that post-exposure rabies prophylaxis in the United States often is administered or withheld inappropriately, and the authors of the report encourage improved physician compliance with the current Centers for Disease Control and Prevention guidelines.[34] Current recommendations for rabies immunoprophylaxis are outlined in Tables 2 and 3.

Arthropods

The bites or stings of arthropods may cause injury as minor as local pruritus or as serious as anaphylaxis.[35] Of the 1 million species in the insect kingdom, the order Hymenoptera and the class Arachnida contain the few members that pose the greatest medical threat to humans. Luckily, most of these injuries are minor and require only supportive care. Awareness of the poten-

Table 2. Rabies Postexposure Prophylaxis Guide, Based Upon Evaluation and Disposition of Animal — U.S. 1999

DOGS, CATS, AND FERRETS

- If animal is healthy and available for 10 days observation, do not begin prophylaxis unless animal develops clinical signs of rabies.
- If animal develops clinical signs of rabies, immediately vaccinate patient.[a]
- If animal's condition is unknown (e.g., it escaped), consult public health officials.

BATS; SKUNKS, RACCOONS, FOXES, AND MOST OTHER CARNIVORES

- Regard as rabid unless animal proven negative by laboratory test. Consider immediate vaccination.[b]

LIVESTOCK; SMALL RODENTS; LAGOMORPHS (RABBITS AND HARES); LARGE RODENTS (WOODCHUCKS, BEAVERS); OTHER MAMMALS

- Consider each case individually; consult public health officials.
- Generally, the bites of squirrels, gerbils, hamsters, guinea pigs, rats, mice, other small rodents, rabbits and hares, and chipmunks rarely require antirabies prophylaxis.

[a] During the 10-day observation period, begin postexposure prophylaxis at the first sign of rabies in a dog, cat, or ferret that has bitten someone. If the animal exhibits clinical signs of rabies, it should be euthanized immediately and tested.

[b] The animal should be euthanized and tested as soon as possible. Holding for observation is not recommended. Discontinue vaccine if immunoflourescence test results of the animal are negative.

Source: Centers for Disease Control and Prevention. Rabies prevention-United States, 1999. *MMWR Morbid Mortal Wkly Rep* 1999;48(RR-1):1-21.

tial for severe reactions is important, however, as in rare situations aggressive intervention may be life-saving.

Hymenoptera. Honeybees, wasps, yellow jackets, and fire ants are found throughout the United States and are responsible for the largest number of insect bites brought to medical attention.[35] These insects envenomate their victims with immunoreactive substances that cause annoying local reactions and, in some cases, trigger synthesis of IgE antibodies that can mediate systemic anaphylaxis upon subsequent reexposure to the venom. Non-IgE immune mediated reactions also may follow exposure to hymenoptera venom, and include a serum sickness-like syndrome, Guillain-Barré syndrome, acute glomerulonephritis, thrombocytopenic purpura, and transverse myelitis.

Bees. A bee sting causes immediate pain and gradual development of local swelling, erythema, and pruritus. On occasion, these local reactions can be quite impressive, causing significant redness, warmth, and edema extending beyond the sting site and mimicking cellulitis. Non-anaphylactic systemic reactions, including nausea, vomiting, diarrhea, and fever, have been noted in adults following attacks by swarms. Bees attack their victims with barbed stingers, to which the venom glands are attached. The stinger remains in the wound and continues to inject venom for 10-20 seconds after the initial sting. Rapid removal of the stinger by flicking it from the skin (a credit card often is recommended as the instrument of choice) is important to prevent further envenomation, infection, or a foreign body reaction at the sting site.[36]

Wasps, Hornets, and Yellow Jackets. These insects have smooth stingers that typically are not retained in the wound, and therefore, can be used to inject venom repeatedly. Local and systemic reactions are similar to those seen following bee stings.

Fire Ants. Fire ants (*Solenopsis invictus, Solenopsis ricteri*) are found throughout the southern United States. These aggressive insects swarm from their hill when disturbed and attack the victim en masse, injecting venom that causes severe burning pain.[37] Each ant sting typically produces a small erythematous wheal surrounding a sterile pustule. Large local reactions are reported in 17-56% of patients, and may be mistaken for cellulitis. Anaphylaxis is estimated to occur in up to 1% of stings.[35,37]

Management. Treatment of Hymenoptera bites and stings primarily involves attention to local wound care and relief of pain and pruritus.[35] In addition, the clinician must be prepared to treat anaphylaxis, the potentially life-threatening immune reaction to hymenoptera venom. There are 40-150 deaths from insect sting-induced anaphylaxis yearly (although these occur mostly in adults), and it is estimated that 0.5-5% of the U.S. population has had a significant allergic reaction to bee stings.[35,38]

On presentation, the sting victim should be assessed for cardiovascular or respiratory dysfunction or other signs of anaphylaxis. Historical information, such as knowledge of previous allergic reactions, insect type, time and circumstances of the sting, and development of symptoms, will guide patient treatment. If the patient is stable, local wound management may proceed with inspection for and removal of the stinger in the case of bee stings, wound cleansing, application of ice, and administration of an oral antihistamine (e.g., diphenhydramine).

Anaphylaxis is the syndrome resulting from antigen-triggered, IgE-mediated release of histamine and other vasoactive substances from mast cells.[39] The clinical syndrome develops within 30 minutes of a sting and is characterized by symptoms in two or more organ systems. Life-threatening symptoms typically affect the cardiorespiratory systems, and include laryngeal edema with airway obstruction, bronchospasm, hypotension, or shock. Anaphylaxis symptoms manifested by other organ systems include urticaria, angioedema, vomiting, diarrhea, and altered mental status. Death results either from hypoxemia secondary to airway obstruction or from cardiac failure secondary to shock.

Anaphylaxis therapy is directed at relieving systemic effects of histamine and other mediators, suppressing further histamine release and mediator synthesis, and blocking histamine tissue receptors.[39] In dermal cases, patient comfort and relief from pruritus is achieved using antihistamines. In severe cases, however, cardiovascular and respiratory support may be required. The mainstays of therapy for anaphylaxis are rapid administration of epinephrine, antihistamines, corticosteroids, and fluid resuscitation. Anaphylaxis can have a biphasic clinical course, in which the

Table 3. Rabies Postexposure Prophylaxis Schedule — U.S. 1999

- All postexposure treatment should begin with immediate and thorough cleansing of all wounds with soap and water. If available, a virucidal agent such as a povidone-iodine solution should be used to irrigate the wounds.

PATIENT NOT PREVIOUSLY VACCINATED[%]

- **Rabies immune globulin (RIG):** Administer 20 IU/kg body weight. If anatomically feasible, infiltrate the full dose around the wound(s); any remaining volume should be administered intramuscularly (IM) at an anatomical site distant from the vaccine administration. RIG should not be administered in the same syringe as vaccine.

  Because RIG might partially suppress active production of antibody, give no more than the recommended dose.

- **Vaccine:** Human diploid cell vaccine (HDCV), rabies vaccine adsorbed (RVA), or purified chick embryo cell vaccine (PCEC) 1.0 mL IM (deltoid area[+]), one each on days 0[++], 3, 7, 14, and 28.

PATIENT PREVIOUSLY VACCINATED[%§]

- **RIG:** RIG should not be administered.

- **Vaccine:** HDCV, RVA, or PCEC 1.0 mL IM (deltoid area), one each on days 0[++] and 3.

[%] These regimens are applicable for all age groups, including children.
[+] The deltoid area is the only acceptable site of vaccination for adults and older children. For younger children, the outer aspect of the thigh may be used. Vaccine should never be administered in the gluteal area.
[++] Day 0 is the day the first dose of vaccine is administered.
[§] Any person with a history of preexposure vaccination with HDCV, RVA or PCEC; prior postexposure prophylaxis with HDCV, RVA, or PCEC; or previous vaccination with any other type of rabies vaccine and a documented history of antibody response to the prior vaccination.

Source: Centers for Disease Control and Prevention. Rabies prevention-United States, 1999. *MMWR Morbid Mortal Wkly Rep* 1999;48(RR-1):1-21.

patient's initial histamine-related symptoms resolve only to return several hours later.[40] These late symptoms are due to synthesized mediators like prostaglandins, leuko-trienes, and kinins. Because of the risk for relapse following a significant anaphylactic reaction, patients should be admitted to the hospital for 24 hours of observation, regardless of their initial response to therapy.

Patients experiencing Hymenoptera sting anaphylaxis of any severity should be considered for referral for for skin testing and desensitization therapy. Progressive desensitization is highly effective at preventing future anaphylactic reactions from Hymenoptera stings.[41] In addition, on discharge patients should be provided with prescriptions and instructions for epinephrine self-injectors, and be advised to wear Medic Alert bracelets.

Arachnidae. The family Arachnida includes spiders, ticks, and scorpions. Several members of this family can cause illness or injury in humans.

Black Widow Spider. The black widow spider (*Lactrodectus mactans, Lactrodectus hesperus*) is a nonaggressive insect that lives under rocks and in woodpiles throughout the continental United States. Only the female, which injects a potent neurotoxin at the bite site, is poisonous to humans. This spider measures 3-4 cm, and has a shiny black body, and has the characteristic red "hourglass" marking on her abdomen.

Although the bite itself usually is painless, patients may describe a vague burning sensation at the site, followed by regional lymph node tenderness.[42,43] Within 30-90 minutes after envenomation, severe muscle spasms of the abdomen, back, and chest develop, accompanied by restlessness and hypertension. Cholinergic symptoms may be present and include diaphoresis, increased salivation, lacrimation, vomiting, and diarrhea. These symptoms, which are due to venom-mediated synaptic acetylcholine and norepinephrine release, generally resolve in 24-72 hours. As the spider rarely is recovered for identification and the bite may be undetected, the diagnosis is based on clinical features. The observed symptom complex must be differentiated from appendicitis, peritonitis, renal colic, electrolyte disturbances, and cholinergic crisis from organophosphate poisoning or other toxins.

Management. Treatment is directed at circulatory support and muscle spasm relief. Mild symptoms may be managed with oral analgesics. More severe symptoms will require parenteral narcotics for pain and benzodiazepines for muscle spasms and, rarely, respiratory support. Most children with moderate to severe symptoms will require hospital admission for supportive care. Calcium gluconate, long touted as the antidote for symptoms related to black widow spider envenomation, has been found to be ineffective, as have methocarbamol and dantrolene.[35] In general, pain and spasm relief alone will relieve hypertension, but antivenin is available and indicated for hypertension or tachycardia that does not respond to supportive treatment. Skin testing should precede antivenin administration, as it is a horse-serum derived product, and anaphylaxis can result from its use. Wound care, if the wound is identified, includes local cleansing and tetanus prophylaxis.

Brown Recluse Spider. The brown recluse spider (*Loxsceles reclusa*) is the most familiar representative of a group of spiders responsible for the syndrome of "necrotic arachnidism."[35,43] These spiders inject proteolytic enzyme-rich venom into the bite site, which can cause extensive local skin necrosis and a variety of systemic symptoms.

The brown recluse spider is found in the Southeastern and Midwestern United States, especially Missouri, Arkansas, Oklahoma, and Kansas, where it lives in dark areas under rocks and in woodpiles. It is not aggressive, but bites defensively when disturbed. This nondescript, brown spider is 2-3 cm in diameter and displays a characteristic violin-shaped marking on its back.

The bite of a necrotizing spider frequently goes unnoticed by the victim for several hours, until local itching, redness, and pain occur at the site.[44] A blister soon develops, and during the next several days, the center of the lesion turns black, leading to a

slowly healing ulcer that remains after the eschar sloughs. Nausea, vomiting, fever, headache, arthralgias, and myalgias are common systemic features of this syndrome. Severe hemolytic anemia, seizures, renal failure, and shock are reported rarely. Children are bitten more frequently than adults and are more likely to develop systemic manifestations, especially hemolytic anemia.

Management. Treatment of brown recluse spider bites requires conscientious wound care, including ice to the bite site during the acute phase (which may limit necrosis by decreasing the enzymatic activity of the toxin), local cleansing, and tetanus prophylaxis, as well as management of systemic symptoms.[35,43,44] Skin grafting may be necessary for some lesions once the wound has stabilized. Specific modalities such as local steroid injection, systemic corticosteroids, early wide excision of the lesion, local infiltration with phentolamine, hyperbaric oxygen, and use of oral dapsone, which decreases the local infiltration of neutrophils into the envenomated area, have been advocated, but none have been found to improve the outcome of the lesion.[35] While routine laboratory testing typically is unhelpful, a complete blood count is recommended to evaluate for hemolytic anemia in children. Systemic steroids are useful in the management of hemolytic anemia resulting from envenomation.

Scorpions. Of the 650 species of scorpions in the world, only one species dangerous to humans is found in the United States. The scorpion *Centruroides exilicauda* makes its home in Arizona, Texas, Southern California, and Northern Mexico, and is responsible for the majority of deaths reported from scorpion envenomation. The scorpion is an insect that contains a potent neurotoxin in specialized glands at the base of its tail. Humans are stung when they disturb the scorpions in their hiding places (under rocks or logs), or in clothing or shoes. Children especially are vulnerable to the effects of the venom.

Scorpion venom causes acetylcholine and catecholamine release and calcium channel dysfunction. Following a sting, there is vague discomfort, tingling, and hyperesthesia at the site.[45] Within 60 minutes, hyperactivity, restlessness, roving eye movements, tachycardia, hypertension, and cholinergic symptoms of salivation, lacrimation, vomiting, bronchorrhea, and wheezing develop, persisting as long as 36 hours. In the absence of a bite history, the marked agitation and restlessness may suggest other etiologies, such as encephalitis, phenothiazine toxicity with dystonia, and seizure or movement disorders, while the cholinergic symptoms are suggestive of organophosphate intoxication.[46]

Management. Treatment is directed at supporting cardiorespiratory function and pain control. While most stings can be treated with oral analgesics, more severe systemic symptoms, especially in young children, may require more aggressive therapy. Bronchorrhea and impaired respiratory mechanics may necessitate airway protection and mechanical ventilation. Agitation and pain may require parenteral narcotics and benzodiazepines. Young children frequently will require hospitalization, monitoring, and sedation as their symptoms resolve. Non-FDA-approved goat serum antivenin is available in Arizona and has been shown to result in rapid resolution of life-threatening symptoms, but is associated with both anaphylactic and delayed hypersensitivity reactions.[45,47] It is recommended that its use be reserved for those patients with severe systemic symptoms.[45,47] Wound care should include local cleansing and tetanus prophylaxis.

Ticks. Ticks threaten human health as vectors for a variety of rickettsial, bacterial, and spirochetal diseases, most notably Lyme disease and Rocky Mountain spotted fever, and the toxin-mediated syndrome of tick paralysis.[48,49] These arthropods inhabit grassy fields throughout the United States. The bite itself is rarely cause for alarm, although granuloma formation is known to occur at the site. Generally, tick bites go unnoticed, and only about 50% of patients with proven tick-borne diseases relate a tick bite history.

Tick paralysis is characterized by motor weakness or acute ataxia that progresses into an ascending flaccid paralysis. Due to a neurotoxin elaborated at the bite site that blocks acetylcholine release at the neuromuscular junction, clinical symptoms disappear when the tick is removed. These neurologic symptoms must be distinguished from Guillain-Barré syndrome, poliomyelitis, spinal cord compression syndromes, and botulism.

Management. Management of tick bites most often involves tick removal, local wound care, and a decision regarding antibiotic prophylaxis for Lyme disease. The first two tasks are relatively straightforward, but the third is surrounded by controversy. While other methods of tick removal have been recommended, the most effective technique involves grasping the tick with forceps as close to the skin surface as possible and pulling with steady, gentle pressure until the tick releases.[50] This method is least likely to leave mouthparts behind or cause tick regurgitation into the wound, which may increase the risk of transmitted infection. The wound should be cleansed routinely, and tetanus prophylaxis provided if indicated.

At present, routine antibiotic prophylaxis for Lyme disease is not recommended.[51,52] The likelihood of developing Lyme disease after the bite of an Ixodes (deer) tick is estimated at 1-3.4%, and the disease can be treated effectively at the onset of the characteristic rash, erythema chronicum migrans. If, however, the decision is made to use prophylactic antibiotics because of endemicity of the disease, parental anxiety, or duration of tick attachment, amoxicillin (40 mg/kg/d divided TID for 10 days) in younger children or a single dose of doxycycline (200 mg) in children older than 8 years are the regimens of choice.[51-53]

Snakebites

Of the 45,000 snakebites reported each year in the United States, approximately 8000 are caused by venomous snakes.[54] Although the two families of indigenous poisonous snakes—Viperidae, subfamily crotalinae (pit vipers) and Elapidae—are distributed throughout the continental United States, most of these attacks occur in the Southeastern and Southwestern states. Pit vipers (rattlesnakes, water moccasins, and copperheads) are responsible for 90% of poisonous snakebites in the United States, with coral snakes (Elapidae) accounting for 3%.[54] Increasingly,

exotic snakebites, which account for 5% of reported bites, are presenting to medical attention, although not commonly in children.[54]

The majority of pediatric snakebite victims are 5- to 19-year-old males who are bitten on the hands or upper extremities while handling the snakes.[55] Younger children may present with bites to the feet or legs when they accidentally come into contact with a snake on the ground. Only 10-15 deaths are recorded yearly from snakebites, but while fewer than 10% of poisonous bites occur in children, 20% of the fatalities occur in the pediatric age group.[54,55] This presumably is due to the child's smaller size and the proportionately larger venom dose per kilogram.

Pit Vipers. Crotalid venoms are snake-specific combinations of hemo-, neuro-, nephro- and cardiotoxic peptides and necrotizing proteinases that allow a snake to immobilize, kill, and then digest an animal meal.[56] It is these venom components that are responsible for the multiple organ system dysfunction seen in the unfortunate human victim of a snake encounter.

An envenomated pit viper bite will be immediately painful, with erythema and swelling developing at the site in minutes.[54,56] Over the next several hours, vesicles and hemorrhagic bullae develop, and the swelling increases, in some cases progressing to involve the entire limb and trunk. Systemic manifestations of moderate envenomation include weakness, paresthesias, tachycardia, and hypotension; laboratory abnormalities include hemoconcentration, low fibrinogen level, and thrombocytopenia. In severe envenomation, the patient may develop shock from hypovolemia secondary to toxin-mediated endothelial leakage, hemorrhage, and respiratory distress, as well as anemia, acidosis, and toxin -mediated coagulopathy. In the absence of a snakebite history, the local reaction to pit viper envenomation can be mistaken for cellulitis, wound infection, deep venous thrombosis, or necrotic arachnidism, while the systemic effects may mimic septic shock, severe hemolytic anemia, or hemolytic-uremic syndrome.[56]

Elapidae. In contrast to crotaline venom, the primary constituents of coral snake venom are neurotoxins.[56] As a result, the clinical picture following envenomation by this snake is one of gradual weakness and paresthesias that may progress to flaccid paralysis. Because of an absence of proteolytic enzymes in the venom, these symptoms occur without local tissue destruction or pain at the bite site. The onset of neurologic symptoms may be delayed, with a sudden deterioration following a latent period of more than 12 hours reported in some cases. Ventilatory failure secondary to respiratory muscle weakness is the major complication of coral snake envenomation. In the absence of a snakebite history, the weakness and flaccid paralysis of coral snake envenomation may be mistaken for the neurologic manifestations seen in botulism, polio, Guillain-Barré syndrome, transverse myelitis, or spinal cord compression syndromes.

Management. The challenge for clinicians treating snakebite victims is first ascertaining that a poisonous snake inflicted the bite, and then determining if envenomation occurred. The differentiation of poisonous from non-poisonous snakes can be done by directly inspecting the (preferably dead) snake or from a witness's description. Nonpoisonous snakes have round pupils, small teeth instead of fangs, a rounded snout, and no rattle on the tail. The characteristics of the snake's coloration as illustrated in the mnemonic "Red on yellow, kill a fellow, red on black, venom lack" may help determine whether, in fact, a coral snake or another striped, non-poisonous snake inflicted the bite. Other information that will influence the patient's management includes time elapsed since the bite, therapy rendered in the field, development of symptoms, and victim characteristics such as tetanus immunization status.

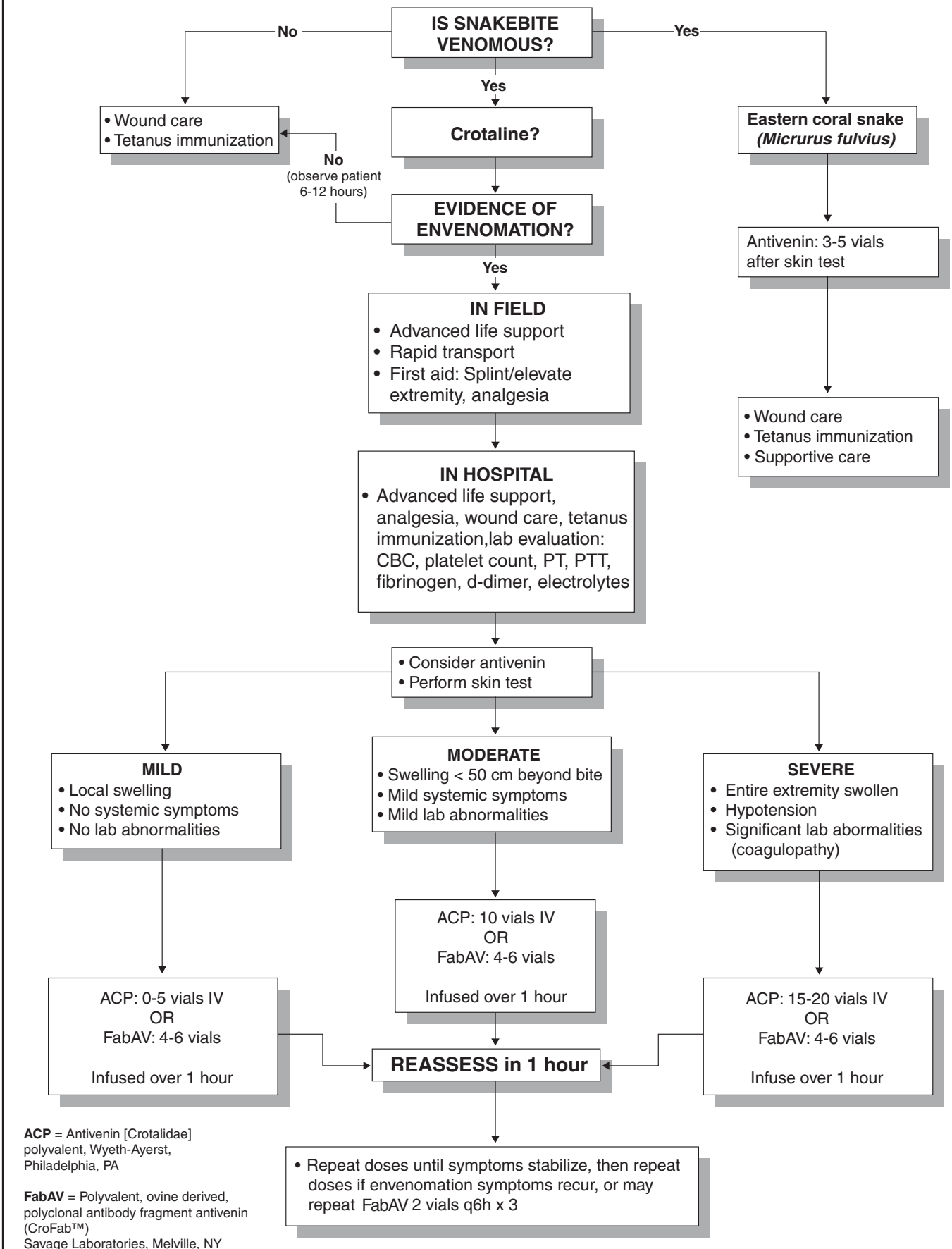
Inspection of a crotaline bite site usually will reveal if envenomation has occurred. However, 20% of pit viper bites are "dry" and will require nothing more than wound care. It is recommended that a patient be observed for 6-12 hours for any signs of envenomation before concluding that the bite is minor or dry.[54,56] Envenomation by a coral snake is confirmed by the development of neurologic symptoms. In addition to wound inspection, these victims require a complete physical and laboratory evaluation. Laboratory testing of the patient with an envenomated snakebite should include complete blood count, coagulation studies, type and cross match, serum electrolytes, blood urea nitrogen/creatinine, and urinalysis.

The goals of snakebite therapy include the treatment of systemic and local venom effects, venom inactivation, and prevention of long-term disability. An approach combining supportive care, conscientious wound management, and the appropriate use of antivenin will be most effective. *(See Figure 2.)* Very little controlled scientific data on methods of treatment exist, and many of the current recommendations are based on anecdotal reports.

Following a snakebite, the patient should be transported rapidly to a medical facility. In the prehospital environment, supportive care, including splinting the injured extremity, removing constricting clothing or jewelry, minimizing patient movement, and providing analgesia, is indicated.[57] Controversy surrounds the administration of other first aid measures such as the use of constriction bands (2- to 4-cm bands placed loosely above the bite to restrict lymphatic flow while allowing arterial and venous blood flow) and the use of continuous suction over the wound. Although an animal study has demonstrated some benefit from constriction bands, concern for arterial compression and ultimate neurovascular compromise as tissue edema progresses, has limited their use.[58] Regarding continuous suction, animal studies have demonstrated that when using appropriate equipment within 5-10 minutes of a bite, suction can remove 30-50% of radiolabeled venom.[59] However, more recent reports suggest that marketed suction devices are not large enough to cover both fang marks in many crotaline bites, and skin necrosis at the bite site has been observed.[60] Fang mark incisions no longer are advocated, as these do not hasten venom removal and can cause additional tissue and tendon damage if improperly performed. Arterial tourniquets (in contrast to constriction bands) are contraindicated.

In a medical facility, assessment of the wound and major organ function are the first priorities. Treatment of cardiovascular and respiratory dysfunction must be performed urgently. Following sta-

Figure 2. Treatment Algorithm for Snakebite



ACP = Antivenin [Crotalidae] polyvalent, Wyeth-Ayerst, Philadelphia, PA

FabAV = Polyvalent, ovine derived, polyclonal antibody fragment antivenin (CroFab™) Savage Laboratories, Melville, NY

bilization, wound care should proceed with irrigation, loose dressing, splinting for comfort, and tetanus immunization. Prophylactic use of broad-spectrum antibiotics has not been studied in randomized trials and remains controversial, although the available studies suggest a low incidence of infection in untreated wounds.[54] Fasciotomies are rarely necessary despite the impressive nature of the swelling.[61] Previously recommended therapies, including early wide excision of the wound and use of steroids, have not been shown to improve outcome, while cryotherapy and electroshock therapy have proven harmful.[61,62]

Treatment with antivenin depends on the type of snakebite. Use of Micrurus fulvius antivenin (Wyeth-Ayerst Pharmaceuticals, Philadelphia, PA) after known or suspected Eastern coral snakebite is advocated regardless of the wound characteristics.[56] Administration of three to five vials of antivenin given intravenously after skin testing neutralizes the maximum amount of venom injected by this snake and should be given prior to the progression of neurologic signs. Because the antivenin is dosed to neutralize an estimated quantity of venom, the same dose is administered to children as adults. There is no antivenin available for the treatment of Arizona coral snake bites. At present, an ovine-derived antibody fragment (Fab) antivenin to Micrurus fulvius is being evaluated and may prove more effective and safer than the presently available antivenin.[63]

Historically, the use of antivenin for pit viper envenomation has been a more controversial subject.[64] For the last 50 years, a single polyvalent horse-serum based antivenin, effective against all indigenous crotaline species (Antivenin [Crotalidae] polyvalent, Wyeth-Ayerst, Philadelphia, PA) has been the only antivenin available. Dosage is based on wound appearance, presence of systemic symptoms and coagulation abnormalities. Its use is associated with reduced swelling, reduced tissue damage, and reversal of coagulopathy. Unfortunately, the benefits of its use must be balanced against the 9-33% risk of immediate hypersensitivity reactions and nearly 100% incidence of delayed hypersensitivity reactions.[54]

Recently a new, safer product has become available that may make the clinical decision to administer antivenin easier as experience with the product increases.[64,65] This sheep serum derived (ovine) polyclonal, polyvalent antibody fragment (Fab) affinity-purified antivenom (FabAV (CroFab™), Savage Laboratories, Melville, NY) has been found effective in treating mild to moderate envenomations with fewer adverse reactions. The reported immediate hypersensitivity rate is 14% (with only mild to moderate reactions noted) and delayed hypersensitivity reactions developed in only 16% of study patients.[64] This product is delivered at a standard initial dose of 4-6 vials, and then re-dosed hourly until the envenomation symptoms have stopped progressing.[66] After stabilization, subsequent two-vial doses are delivered either based on recurrence of symptoms or on a scheduled basis. Admission to a critical care unit usually is necessary for patients with moderate to severe envenomation syndromes to ensure close monitoring of wound characteristics and coagulation parameters as well as timely administration of antivenin.

Conclusion

Mammal, snake, and insect bites and stings are common in children. Some of these injuries or their complications may be severe and require aggressive intervention. The initial management of all patients should employ the familiar principles of advanced life support, supportive care, and wound management. In addition, some patients will benefit from bite-specific therapeutic interventions such as antivenin or antibiotics. Familiarity with the most current evidence-based recommendations and modalities is important to providing optimal care for these patients.

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Physician CME Questions

41. Post-exposure rabies prophylaxis should be offered to a patient bitten by which animal?

A. A family dog
B. A laboratory rat
C. A wild bat
D. A pet rabbit

42. The primary reservoir for the pathogen *Bartonella henselae* is the:
A. dog.
B. cat.
C. horse.
D. mouse.

43. Which of the following mammalian bite wounds is at high-risk for bacterial infection?
A. A 15-year-old female with a cat bite to the tip of the thumb
B. A 3-year-old with an abrasion on the forehead from a classmate's tooth
C. A 10-year-old with a fresh 1 cm dog bite to the left cheek
D. A 5-year-old with a rat bite to the left thumb

44. The most common pathogen cultured from infected dog and cat bites is:
A. *Staphylococcus aureus*.
B. *Streptococcus viridans*.
C. *Pasturella multocida*.
D. *Bacteroides fragilis.*

45. Systemic symptoms of black widow spider envenomation include:
A. flaccid paralysis.
B. severe muscle cramping.
C. hemolytic anemia.
D. hypotension.

46. Appropriate treatment of a brown recluse spider bite includes:
A. early wound excision.
B. oral dapsone.
C. local wound cleansing.
D. wound infiltration with steroids.

47. The definitive treatment for tick paralysis is:
A. removal of the tick.
B. intravenous IgG.
C. intravenous corticosteroids.
D. oral doxycycline.

48. Validated first-aid measures for snakebite include:
A. splinting the injured extremity.
B. fang mark incisions.
C. arterial tourniquets.
D. intramuscular antivenin injection.

49. The most effective method of tick removal is:
A. burning the tick with a match.
B. gently pulling tick from the wound with forceps.
C. occlusion of the tick with petroleum jelly.
D. scraping the tick body with a credit card.

50. An appropriate antibiotic choice for cat-bite wound prophylaxis in the penicillin-allergic pediatric patient is:
A. cefazolin.
B. azithromycin.
C. amoxicillin/clavulanate.
D. trimethoprim-sulfamethoxizole.

In Future Issues:

Allergic Reactions

BIOTERRORISM WATCH
Preparing for and responding to biological, chemical and nuclear disasters

Traumatized health care providers may need stress counseling in horrific aftermath of bioterror attack

A severe test for a mentally tough profession

In a finding that is likely relevant to many other states, a recent tabletop exercise in Columbus, OH, found that the health care system may be better prepared to deal with bioterrorism victims than the traumatized frontline providers who give them care.

The exercise was conducted by the Ohio Senior Interagency Coordinating Group in Columbus.

After running a scenario involving intentional release of pneumonic plague at a rock concert, emergency preparedness officials discovered there was little in place to address the mental health needs of doctors and nurses in the horrific aftermath. In the exercise, an attack with *Yersinia pestis* resulted in 332 fatalities, 720 hospitalizations, and 4,300 people who were examined and released.

"How do you handle all of the nurses and doctors who have seen many, many deaths, who have tried to decrease panic by remaining calm, and who have survived this huge confusion and turmoil?" asks **Kay Ball**, RN, MSA, CNOR, FAAN, a participant in the exercise and perioperative consultant and educator at K & D Medical in Lewis Center, OH. "What about their mental health? That is something that we found that we are weak in. We really have to develop that better."

The hypothetical event began Friday, March 15, when a popular regional band performed at Shawnee State University in Portsmouth, OH. Approximately 2,000 students and community members went to see the band, which is known for its use of smoke and visual enhancements, according to the scenario. **(See tabletop timeline, p. 3.)**

"[The terrorists] aerosolized the agent in a fogging system and that is how it was spread throughout the building." says **Darren Price**, exercise training officer with the state of Ohio Emergency Management Agency in Columbus.

The players take their seats

The exercise had four groups of about nine people, each working at different tables as the events unfolded. The groups were health / medical, law enforcement, fire / emergency medical services, and government. An audience of about 150 people was on hand to observe and evaluate the exercise.

"The whole purpose was to determine our strengths and weaknesses through the disaster that happened," says Ball, who served as facilitator and discussion leader of the health / medical group. "The planning committee will meet and analyze what we learned from this, and then we will bring back everybody who participated."

The scenario was divided into three phases: incubation, response, and recovery. Each phase received about an hour of discussion at the tables, and all players received updated information at the same time. **(See tabletop tips, p. 2.)** The scenario was necessarily arbitrary but designed to

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test the state's resources at many levels, Price notes.

"Anytime, you are dealing with tabletop exercises there are a lot of assumptions and artificialities built in just to make it flow," he says. "We ask [participants] to bring their emergency operations procedures and plans, and to actually react based upon their plan."

While the exercise is still being analyzed, the mental health needs for medical providers became apparent in playing out the scenario. Part of the problem is the historic perception that health care workers must not succumb to the emotional toll of patient care, Ball says.

"Even in surgery today, if we lose a patient on the table, there is nothing really in place to talk about the trauma the practitioners are going through," she says. "We just think that we are these stalwart people and we can't crumble under emotional strains. That was one of the [identified] weaknesses."

In contrast, firefighters and emergency medical service workers had a more thorough stress debriefing process than their hospital-based counterparts.

"Within the hospitals themselves we really don't have the mental and spiritual health that we need," she says.

Moreover, the scenario projected widespread "psychological manifestations" in the affected area, with students withdrawing from school and residents reluctant to return to their homes. Bioterrorism response planners brainstormed about how to fight the problem, including bringing in celebrities and public officials to show it was safe to return to the stricken area.

The scenario included a short delay in determining the etiological agent, with chaos building before plague was confirmed as the infecting pathogen. Even with the new emphasis on bioterror education, that scenario is fairly realistic because so few clinicians have seen infections caused by the potential bioterrorism pathogens.

"The first problem was what kind of a bug was it?" Ball says. "Where do we send the cultures, and how fast can we get them back?

The scenario also had many students leaving on spring break. Given the anticipated exodus of people from the community — particularly into the neighboring states of Kentucky and West Virginia — there was no attempt to set up mass quarantine areas, Price says. Instead the national stockpile of antibiotics was called up and confirmed or suspect cases were treated and isolated.

"We looked at the issue of quarantine and determined it was not really feasible," he says. "You would have these large [quarantine] circles everywhere. We moved more toward isolation [of patients] at that point."

While identifying a weakness in mental health care, the planners found communications were strong between groups, there were no turf battles, and additional resources became available quickly.

"One of the strengths that we found was that we were able to get supplies in and to call in extra people," Ball says. "We were able to pull in lots of people very rapidly. We are learning how to work more with all of the other diverse factions."

Indeed, the exercise was set in a rural area so that resources would be taxed, reaching thresholds that would trigger state response, Price adds.

"We're better prepared today than we were yesterday," he says. ■

Bioterror tips for running a tabletop

Planners of a recent bioterrorism tabletop exercise in Columbus, OH, **(see cover story for more information)** offered the following tips for participants in the exercise:

- The scenario is plausible, and events occur as they are presented.
- There are no hidden agendas or trick questions.
- All players receive information at the same time.
- There is not a "textbook" solution. Varying viewpoints and possible disagreements are anticipated.
- Respond based on your knowledge or current plans and capabilities.
- Current agency or department policies and procedures should not limit discussion and development of key decisions.
- The outcome is neither intended to set precedents or reflect an organization's final position on specific issues.
- Assume cooperation and support from other responders and agencies.
- Speak up! Talk to your colleagues and ask questions. This is your chance to learn how other agencies in your community would respond in an emergency. ■

Dire straits: Plague released at concert

Tabletop scenario from first case to aftermath

Highlights of a recent bioterrorism tabletop exercise run by planners in Ohio **(see cover story for more information)** included the following timeline of events:

Sunday, March 17, 2002, Portsmouth, OH

8:00 a.m.: At the emergency department (ED) of Southern Ohio Medical Center (SOMC), a doctor has just come on duty and sees her first patient, a 22-year-old woman. The patient's sister says the woman has been complaining of chest pain and has a temperature of 102 degrees F. The sister worries that the patient may have caught the "bug" through her position at the Shawnee State University (SSU) dormitory mailroom where she works part time. A rapid flu test shows a negative result.

The physician is suspicious in light of the national anthrax cases five months earlier and orders a sputum and blood culture. Transport assistance is requested for sending the cultures to the Ohio Department of Health (ODH) laboratory for anthrax testing. The woman is admitted. The Portsmouth City Health Department and Scioto County District Board of Health are notified of the situation. In turn, the ODH and Ohio Emergency Management Agency (EMA) duty officer are called.

2:00 p.m.: The 22-year-old woman admitted to SOMC earlier this morning develops severe respiratory complications and dies. A full autopsy is ordered, and the physician awaits the preliminary results of the sputum and blood cultures. As the day progresses, local emergency medical services (EMS) become overwhelmed with patients presenting with flu-like symptoms. People presenting with the most severe symptoms, including high fever and difficulty breathing, are hospitalized; however, with many more sick waiting in the ED, the hospital beds and wards are filling rapidly.

5:00 p.m.: Traffic around SOMC becomes impassible, and several ambulances are severely hindered. Medical facilities request security assistance from local law enforcement agencies.

10:00 p.m.: Six patients admitted during the day with the severe flu-like symptoms also die. New cases continue to arrive at SOMC with an increase in the number of patients reporting each hour.

Monday, March 18

8:00 a.m.: Overnight, a public health emergency was declared in Scioto County. A request was made by Scioto County Health, via the Scioto County EMA and elected officials for state support in the growing crisis.

A Level 2 emergency status is reached in Scioto County. The state assessment room is activated to support the events in Scioto County.

10:00 a.m.: The preliminary tests of clinical specimens taken from the 22-year-old woman who died Sunday are complete. The ODH Lab notifies the local health departments that the specimens have tested negative for *Bacillus anthracis.* The laboratory begins rule-out testing for other pathogens.

3:00 p.m.: Epidemiological evidence points to an event three days earlier as a common activity of the majority of new patients. On Friday, March 15, a popular regional band performed at SSU in Portsmouth. The band is well known for use of visual enhancements. Approximately 2,000 students and community members attended the concert.

4:00 p.m.: Hospital supplies are insufficient to meet demand. Fifteen additional patients have died, and 111 are listed in critical condition. Reports now include similar symptoms among several health care workers and first responders. SOMC hospital beds are full.

5:30 p.m.: ODH Lab staff notifies Scioto County local health officials that the 22-year-old patient's cultures are preliminarily positive for *Yersinia pestis.* Local health officials inform local health care professionals and EMS personnel that, in order to prevent the spread of disease, patients having confirmed pneumonic plague should be isolated until sputum cultures are negative for *Y. pestis* bacilli.

Those suspected of having pneumonic plague should be isolated for 48 hours after antibiotic treatment begins.

Wednesday, March 27

It has been 10 days since the first victims arrived at SOMC and local clinics. There have been no further cases of illness identified in Scioto County in the past seven days.

Waiting for signs of recovery

Resources begin to flow into the area as a result of national public outreach. Visitors, however, avoid the area and the impact of the event on the local economy becomes apparent as local businesses are slow to reopen.

The psychological manifestations associated with this event are widespread. Although school reopens, many students withdraw from classes for the quarter. Local residents, still frightened and shocked, look to local and state officials for guidance as they attempt to return to normalcy. ■

Winds of war: Researchers track airborne anthrax

A strikingly rapid and wide dispersion

Struck by the surprising level of aerosolization after merely opening an envelope, Canadian researchers are now using a spore surrogate to study how airborne anthrax silently spreads within an office building, *Bioterrorism Watch* has learned.

Researchers are using *Bacillus globigii* spores to simulant the movements of *Bacillus anthracis* in a one-story research building at the Defence Research Establishment Suffield (DRES) at the Canadian Forces Base in Suffield, Alberta, says **Kent Harding,** chief scientist at DRES. "We will be looking at movement between actual offices along corridors using the *B. globigii* as a simulant. It is a spore-like material that is a well-accepted simulant used to assess and challenge biological detection apparatus." The DRES is on the cutting edge of bioterrorism research; scientists there were studying the dispersion of anthrax from envelopes prior to Sept. 11 and its aftermath. In response to an anthrax hoax mailing in Canada in February 2001, the DRES conducted a study last year using an 1,800 cubic foot test chamber to represent an office space. "We had a hoax letter in this country that closed down a major federal office building," he says. "We were interested in [determining] had it been a real infectious material in the envelope, what was the extent of the risk? We went to the scientific literature and really didn't find anything."

It was hypothesized that opening an envelope constituted a "passive form of dissemination" that would produce minimum aerosolization of spores unless additional energy was added via panic behavior or strong airflows, the researchers stated.[1]

"Our scenario was in a chamber, which was conducive to studying the movement of materials on air currents." Harding says. "An individual was given a stack of envelopes and told to keep opening them until powder fell out. When that happened, [he or she] stood quietly by the desk and didn't move for 10 minutes. We just looked at the movement of material around the room, just simply as a consequence of opening the envelope and pulling out a piece of standard 8½ by 11 paper folded in three." Almost immediately upon opening the envelope, a significant aerosol concentration was observed in the area of the "desk." It declined slowly over the 10-minute sampling period, but the high-resolution slit sampler plates used to measure the release became densely packed with bacterial colonies. In the study, significant numbers of respirable aerosol particles were released upon opening envelopes containing 0.1 g or 1.0 g of *B. globigii* spores. A potentially deadly dose could be inhaled within seconds of opening an anthrax spore-filled envelope. Also, the aerosol quickly spread throughout the room so that other workers, depending on their exact locations and the directional airflow within the office, would likely inhale doses. There was very heavy contamination on the back and front of clothing worn by the test subject.

"There was a large dose presented to the person opening the envelope, which was not unexpected," Harding says. "But what was surprising was the very rapid and extensive movement around that room simply as consequence of the movement of normal air currents. It distributed around the room very quickly and in fairly high quantity."

The researchers also found that the spores could escape from a sealed envelope, a phenomenon that caught U.S. investigators off-guard during the 2001 attacks. "We did note that in a standard envelope sealed in the usual way — just with licking the glue on the back of — that there are substantial openings on the back of the envelope," he says. "In fact, the 'envelope people' design them that way so you can get a letter opener inside. Spores did escape from those openings, but we never quantified that and never referred to it to anything more than an anecdotal manner."

The Centers for Disease Control and Prevention (CDC) in Atlanta was apparently unaware of the study during the initial stages of the U.S. anthrax attacks. Whether it would have made any difference is impossible to say, though some wonder if it would have resulted in more aggressive treatment of postal workers.[2] Regardless, the CDC decision to administer antibiotics to a broad range of people, not just those in the immediate exposure area, is reinforced by the study, Hawkins says. The Canadian researchers have now fully briefed the CDC about the study and their ongoing research.

References

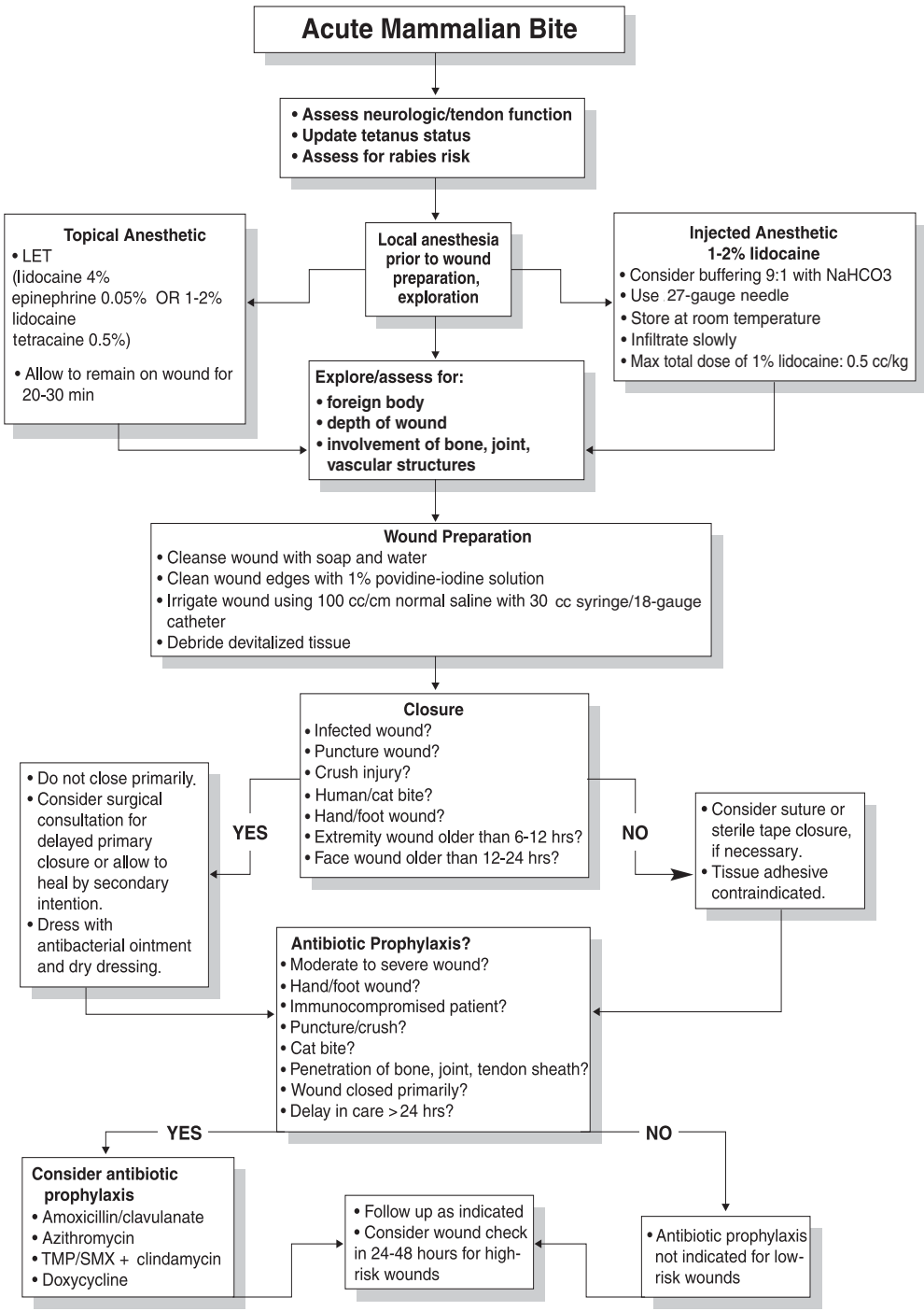
1. Defence Research Establishment Suffield. Kournikakis B, Armour SJ, Boulet CA, et al. Risk assessment of anthrax threat letters. September 2001. *Technical Report DRES TR-2001-048*.

2. Brown D. Agency with most need didn't get anthrax data. *Washington Post*, Feb. 11, 2002:A / 03. ■

PEDIATRIC Emergency Medicine Reports
The Practical Journal of Pediatric Emergency Medicine

Animal Bites and Stings

Treatment Algorithm for Acute Mammalian Bite



Key: TMP/SMX = trimethoprim/sulfamethoxizole

Antibiotic Prophylaxis and Empiric Treatment of Infected Mammalian Bites in Children

ORAL DRUG	DOSAGE
• Amoxicillin/clavulanate	25-45 mg/kg/d BID
• Doxycycline	5 mg/kg/d BID
• Azithromycin	10 mg/kg/d on first day, then 5 mg/kg/d QD for 4 days
• Penicillin VK	25-50 mg/kg/d BID + dicloxicillin 12.5-25 mg/kg/d QID or cephalexin 25-100 mg/kg/d QID
• TMP/SMX	8-10 mg/kg/d TMP BID + clindamycin 10-30 mg/kg/d TID
• Cefuroxime	30 mg/kg/d BID

PARENTERAL DRUG	DOSAGE
• Ampicillin/sulbactam	100-200 mg/kg/d QID
• Doxycycline	5 mg/kg/d BID
• Cefuroxime	75-100 mg/kg/d TID
• Cefoxtin	80-160 mg/kg/d TID
• Ceftriaxone	50-100 mg/kg/d QD

Adapted from Smith PF, Meadowcroft AM, May DB. Treating mammalian bite wounds. *J Clin Pharm Ther* 2000;25:85-99.

Rabies Postexposture Prophylaxis Guide, Based Upon Evaluation and Disposition of Animal — U.S. 1999

DOGS, CATS, AND FERRETS

- If animal is healthy and available for 10 days observation, do not begin prophylaxis unless animal develops clinical signs of rabies.
- If animal develops clinical signs of rabies, immediately vaccinate patient.[a]
- If animal's condition is unknown (e.g., it escaped), consult public health officials.

BATS; SKUNKS, RACCOONS, FOXES, AND MOST OTHER CARNIVORES

- Regard as rabid unless animal proven negative by laboratory test. Consider immediate vaccination.[b]

LIVESTOCK; SMALL RODENTS; LAGOMORPHS (RABBITS AND HARES); LARGE RODENTS (WOODCHUCKS, BEAVERS); OTHER MAMMALS

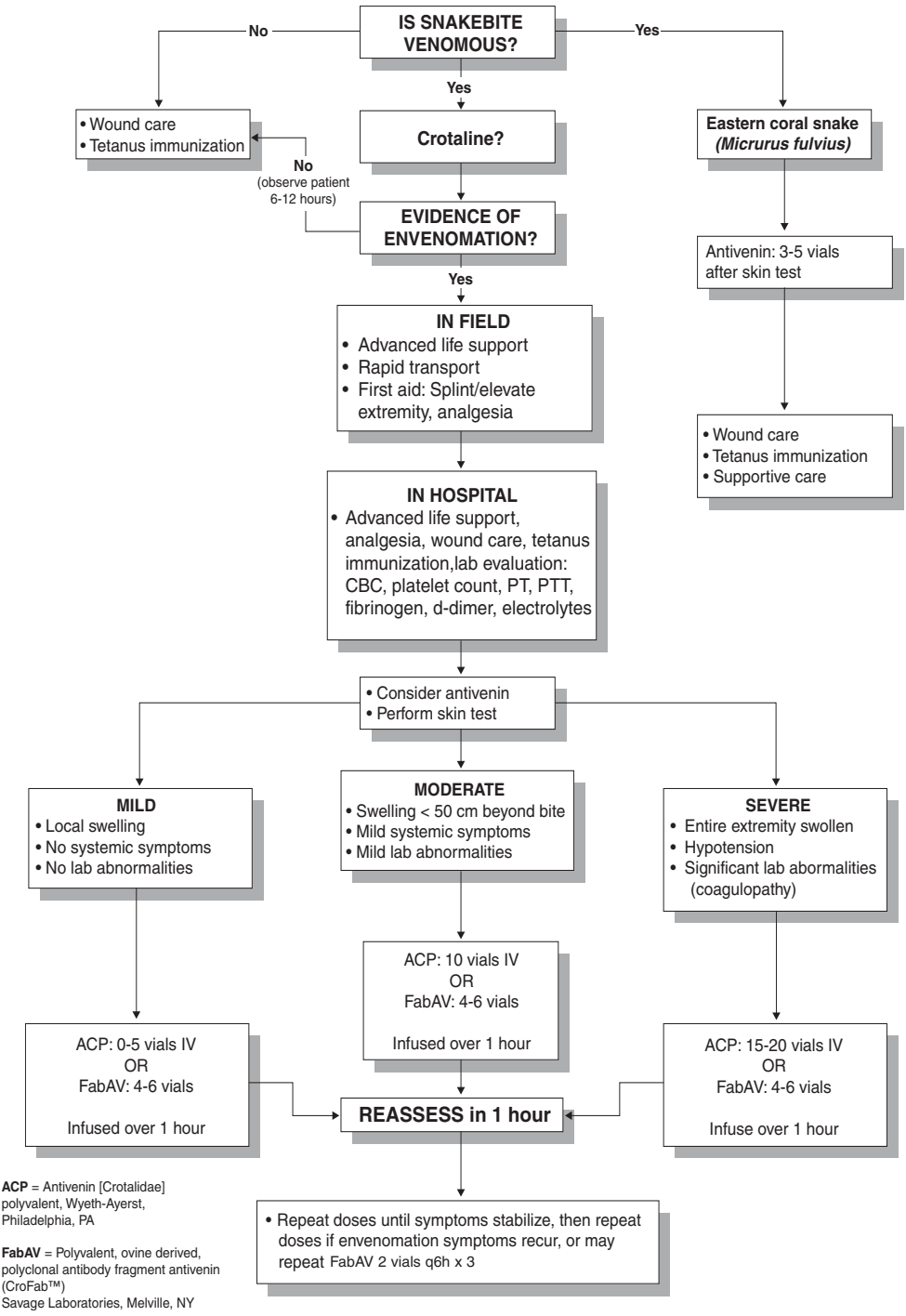
- Consider each case individually; consult public health officials.
- Generally, the bites of squirrels, gerbils, hamsters, guinea pigs, rats, mice, other small rodents, rabbits and hares, and chipmunks rarely require antirabies prophylaxis.

[a] During the 10-day observation period, begin postexposure prophylaxis at the first sign of rabies in a dog, cat, or ferret that has bitten someone. If the animal exhibits clinical signs of rabies, it should be euthanized immediately and tested.

[b] The animal should be euthanized and tested as soon as possible. Holding for observation is not recommended. Discontinue vaccine if immunoflourescence test results of the animal are negative.

Source: Centers for Disease Control and Prevention. Rabies prevention-United States, 1999. *MMWR Morbid Mortal Wkly Rep* 1999;48(RR-1): 1-21.

Treatment Algorithm for Snakebite



ACP = Antivenin [Crotalidae] polyvalent, Wyeth-Ayerst, Philadelphia, PA

FabAV = Polyvalent, ovine derived, polyclonal antibody fragment antivenin (CroFab™) Savage Laboratories, Melville, NY

Rabies Postexposure Prophylaxis Schedule — U.S. 1999

- All postexposure treatment should begin with immediate and thorough cleansing of all wounds with soap and water. If available, a virucidal agent such as a povidone-iodine solution should be used to irrigate the wounds.

PATIENT NOT PREVIOUSLY VACCINATED[%]

- **Rabies immune globulin (RIG):** Administer 20 IU/kg body weight. If anatomically feasible, infiltrate the full dose around the wound(s); any remaining volume should be administered intramuscularly (IM) at an anatomical site distant from the vaccine administration. RIG should not be administered in the same syringe as vaccine.
  Because RIG might partially suppress active production of antibody, give no more than the recommended dose.

- **Vaccine:** Human diploid cell vaccine (HDCV), rabies vaccine adsorbed (RVA), or purified chick embryo cell vaccine (PCEC) 1.0 mL IM (deltoid area[+]), one each on days 0[++], 3, 7, 14, and 28.

PATIENT PREVIOUSLY VACCINATED[%§]

- **RIG:** RIG should not be administered.

- **Vaccine:** HDCV, RVA, or PCEC 1.0 mL IM (deltoid area), one each on days 0[++] and 3.

[%] These regimens are applicable for all age groups, including children.
[+] The deltoid area is the only acceptable site of vaccination for adults and older children. For younger children, the outer aspect of the thigh may be used. Vaccine should never be administered in the gluteal area.
[++] Day 0 is the day the first dose of vaccine is administered.
[§] Any person with a history of preexposure vaccination with HDCV, RVA or PCEC; prior postexposure prophylaxis with HDCV, RVA, or PCEC; or previous vaccination with any other type of rabies vaccine and a documented history of antibody response to the prior vaccination.

Source: Centers for Disease Control and Prevention. Rabies prevention-United States, 1999. *MMWR Morbid Mortal Wkly Rep* 1999;48(RR-1):1-21.

Supplement to *Pediatric Emergency Medicine Reports*, May 2002: "Revenge of the Wild Kingdom: Animal Bites and Stings in Children." *Author*: **Martha S. Wright, MD,** Associate Professor of Pediatrics, Case Western Reserve University School of Medicine; Associate Director, Pediatric Emergency Medicine, Rainbow Babies and Children's Hospital, Cleveland, OH.