The following conditions must be met before incision and suction is attempted:

1. The individual must be three hours or more from the nearest medical facility, and incision and suction must not delay evacuation.
2. The snake must have been clearly identified as a pit viper, and significant envenomation must have been manifested by pain and swelling.
3. Incision and suction can be initiated less than ten minutes after the bite, preferably sooner.
4. The necessary equipment is available, and a member of the party is familiar with its use.

The following procedure should be carried out:

1. A tourniquet should not be used because the hazards are significant and it is almost never applied correctly.
2. The skin should be washed and swabbed with an antiseptic.
3. The fang marks may be enlarged slightly with a sharply pointed scalpel blade (number eleven Bard-Parker) by pushing the tip of the blade through the punctures into the subcutaneous fat—no deeper. Larger incisions should not be made.
4. Suction must be applied with an extractor. Rubber bulbs or oral suction are not adequate. Suction should be applied for thirty minutes for adults and up to an hour for children.
5. After suction has been discontinued, the limb should be immobilized.

A person by himself in a remote area has no choice but to walk out. If a companion is present, the companion should make sure the person is warm and comfortable and then go for help, preferably a helicopter. If the party is large enough, the subject can be carried out. Jostling on a makeshift stretcher probably stimulates blood flow and venom absorption less than walking the same distance.

Antivenin Therapy

Antivenin against the venom of the attacking snake is the only specific treatment for poisonous snake bite. However, the antivenin currently available is prepared in horses, and many individuals are allergic to horse serum. As a result, the administration of antivenin can be hazardous and should not be attempted by anyone other than a physician, and even then only in situations (such as a hospital emergency room) where potentially lethal allergic reactions can be treated. Recent investigations have disclosed that allergic reactions of some type, mostly mild but occasionally severe, occur in seventy percent of antivenin recipients who were not previously allergic to horse serum.

A few individuals carry single vials of antivenin when traveling in snake-infested areas so that they can be prepared to treat themselves should they be bitten. This practice is dangerous for the following reasons:

1. A person who is bitten by a snake and who needs crotalid antivenin requires at least five to fifteen vials—sometimes as many as forty—not one.
2. Carrying antivenin could impart a false sense of security that could lead to inadequate precautions to avoid poisonous snakes.
3. If the antivenin were administered and a major allergic reaction occurred, the individual or others in his party would not be able to provide effective therapy.

The antivenin most widely available in the United States is a polyvalent, or general-purpose, crotalid antivenin made by Wyeth Laboratories that is effective against all North American pit vipers. A specific *Micrurus fulvius* antivenin, which should be used for bites by coral snakes, is made by the same company.

Coral Snake Bites

The coral snakes are the only elapids native to the United States. These snakes have a range largely restricted to the coastal states from southern North Carolina to Texas. The eastern coral snake inhabits this area from Mississippi eastward; the western coral snake is found in Louisiana and Texas. The Sonoran coral snake is found in a limited portion of southern Arizona.

These North American elapids are shy and rarely seen; bites are even less common. Reportedly, children may play with these snakes for hours without being bitten. Envenomation appears to occur in less than forty percent of the bites that are inflicted. Coral snake bites make up less than two percent of all U.S. snake bites.

Fatalities from coral snake bites apparently have not occurred since the development of specific *Micrurus fulvius* antivenin. This antivenin is effective for bites of the eastern coral snake *(Micrurus fulvius fulvius)* and the western coral snake *(Micrurus fulvius tenere)*. It is of little value for bites by the Sonoran coral snake *(Micruroides euryxanthus)*, but envenomation by this species is usually not very severe.

Coral snakes tend to bite and hang on, sometimes chewing for as long as a minute, which contrasts strikingly with the lightning attack of pit vipers. The bites are rarely associated with the local reaction—severe pain and swelling—typical of crotalid bites. Puncture marks from the fangs usually can not be identified, particularly if the person was intoxicated and can not provide a reliable account of the bite, which is a common occurrence. Some pain may be present and may radiate up the limb. Often the first sign of elapid envenomation is painful enlargement of the regional lymph nodes. With severe envenomation, numbness and weakness of the limb appear within one to two hours, sometimes less. Later signs and symptoms include drowsiness, apprehension, weakness, tremors of the tongue or other muscles, difficulty swallowing, nausea, and vomiting. Pronounced weakness of the eye or eyelid muscles may occur; pupils may be pinpoint in size. Breathing may be labored. Convulsions may occur. Eventually, in inadequately treated, severely envenomated persons, unconsciousness and paralysis are followed by death in shock from respiratory and cardiac failure.

Antivenin is the only effective therapy for coral snake bites and should be administered as quickly as possible without waiting for signs and symptoms of envenomation. The limb should be wrapped to immobilize the venom and should

The earliest symptom is pain or burning at the site of the bite, although some people experience relatively little pain. Shortly afterward the area begins to swell as fluid pours into the tissues. Bleeding usually produces a purple or green discoloration, but this change may take several hours to appear.

If no further symptoms develop, the envenomation is mild, and antiserum therapy is rarely needed. However, the individual should be taken to a hospital, even though he has only a mild reaction. Evidence of more severe envenomation may take several hours to develop.

Numbness or a tingling sensation about the mouth or tongue—sometimes extending into the scalp or involving the fingers and toes, and often associated with a metallic or rubbery taste—commonly follows the bite of eastern diamondback and some western rattlesnakes.

Following moderate envenomation, the swelling and discoloration extend further from the site of the bite, large blisters that contain clear or bloody fluid appear, and the regional lymph nodes, particularly in the armpit or the inguinal crease, become enlarged and tender. Severe envenomation is heralded by the development of a systemic reaction. The subject becomes weak and dizzy and develops signs of shock, particularly cold, clammy skin and a weak pulse.

Prehospital Care for Urban Crotalid Bites

Most of the poisonous snake bites within the United States occur in situations where hospitalization is less than two hours away. The average interval between bite and hospitalization has been reported to be thirty-five minutes. When a subject can be hospitalized in such a short time, the only treatment needed is limiting the spread of the venom and immobilizing the extremity. No other measures, particularly incision and suction, should be attempted.

Tourniquets have been recommended to help reduce spread of the venom, but rarely are applied correctly and commonly do more harm than good. Tourniquets that obstruct the flow of arterial blood to an extremity are too painful to be tolerated by a conscious person for more than a few minutes. If left on for an hour or more, they cause gangrene. Tourniquets that obstruct only the flow of venous blood also produce discomfort after a period of time and can increase bleeding or extravasation of blood at the site of the bite.

A properly applied tourniquet should only obstruct lymphatic flow. The tourniquet should be made from a band at least one inch wide and should not be so tight that a finger can not be inserted beneath it without difficulty. Such tourniquets can easily be applied too loosely or become too tight as swelling spreads up the limb. Because applying such tourniquets correctly seems almost impossible, many individuals have recommended that tourniquets not be applied at all.

Wrapping the bitten extremity snugly and immobilizing it with a splint is a treatment technique devised for inhibiting the spread of venom of Australian elapids. This procedure has proven effective in experimental studies and in clinical use only for those species and has not undergone controlled testing following crotalid bites, although it has been used for a few individuals.

Any kind of fabric, including an elastic bandage, is satisfactory. With most snake bites, venom is injected only into the subcutaneous (superficial) tissue, not into the underlying muscle. A snug fabric wrapping that compresses the subcutaneous fat and blood vessels eliminates most blood and lymph flow from those tissues and effectively immobilizes the venom without compromising blood flow to the limb. The wrap is not tight enough to interfere with arterial flow, and although it compresses the superficial veins, venous blood can still return through the deep veins.

An inflatable splint can be useful for this purpose because this device can both immobilize the extremity and apply pressure. The pressure in the splint must be rather high, approximately 50 to 60 mm Hg. Any available splint can be used and does not have to be as carefully applied as a splint for a fracture.

The immobilized extremity should be kept at the same level as the heart, and the person should be transported to a hospital with as little effort on his part as possible. Movement, even just walking, increases the circulation of blood and speeds the movement of venom away from the bite to the rest of the body. Furthermore, the effects of activity are frequently worse than would be expected from this consideration alone. The person should be lying still if possible. No drugs, including alcohol, should be administered; no other treatment should be attempted.

Because the venom is immobilized at the site of the bite by this type of wrapping, greater local damage is produced by pit viper venom. Therefore, wrapping should not be applied unless envenomation is known to be moderate or severe—the bite was inflicted by a large snake, and pain and swelling appear at once—and a hospital is many hours or days away.

After the individual reaches the hospital, the wrapping should not be removed from the extremity until preparations have been made to administer antivenin. If significant envenomation is known to have occurred, antivenin should be started before the wrapping is removed.

Prehospital Care for Wilderness Crotalid Bites

Few snake bites occur in truly remote wilderness situations, perhaps because people in such circumstances are more aware of the presence of poisonous snakes and try to avoid them. Hiking boots that cover the ankles prevent many bites. Furthermore, snakes, like all cold-blooded animals, must avoid extremes of heat or cold and are much less common at altitudes where temperatures drop to low levels at night.

The prehospital care for snake bite in a remote area is basically the same as that for an urban environment: immobilization and transportation (with as little exertion by the person who has been bitten as possible) to the nearest medical facility. However, in a truly remote situation where evacuation would require many hours or days, and the bite has been inflicted by a pit viper, incision and suction may be considered. This form of therapy is an ineffectual, stopgap measure. Under ideal conditions, incision and suction removes less than twenty percent of the venom. The risk of infection or damage to underlying tissues is considerable. However, after severe envenomation, particularly of a child or elderly adult, even that small benefit may be significant.