Cultivating the Prehospital Care of Agricultural Emergencies

by Bryan E. Bledsoe, DO, EMT-P, and Keith Bundick, EMT-P

Despite its many large urban centers, the United States is still very much a rural nation. In vast rural areas, agriculture, or the science and art of farming and ranching to produce crops and livestock, is a principle occupation involving approximately 3,100,000 workers.1 These figures include workers in the forestry and fishing industries.

Contrary to the idyllic image it may evoke, agriculture is a dangerous occupation. In fact, the National Safety Council reports that agriculture is the second most dangerous industry in the United States, following only mining and quarrying in the number of lives lost per 100,000 workers.2 In 1990, 42 deaths per 100,000 agricultural workers were reported, compared with nine deaths per 100,000 workers for all industries. In addition to the 1,300 agricultural deaths that occurred in 1990, another 120,000 agricultural workers are estimated to have suffered disabling injuries during the same year.

Case Presentation

In a small rural community, a 53-year-old farmer is mowing a pasture when the mower attached to his tractor malfunctions. With the tractor motor still running, he climbs down to inspect the power-takeoff (PTO) mechanism. The farmer notes that a piece of baling wire is jammed in the PTO coupling device, preventing the mechanism from turning properly. As he reaches to remove the wire, the PTO starts turning normally, and his coat sleeve becomes entangled in the device. Suddenly, his entire left arm is pulled into the rapidly turning mechanism, amputating his hand above the wrist. The farmer immediately falls free from the tractor and briefly loses consciousness.

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Minutes later, the farmer awakens and walks approximately 200 yards to his house. There, he summons emergency medical services, and an EMT/paramedic crew is dispatched. On arrival at the farm, the crew members find the patient seated on the porch. After quickly conducting a primary assessment, they conduct a secondary assessment, which reveals amputation through the distal forearm with relatively minor bleeding. The patient is completely alert and appears to be in only minimal pain. Vital signs are: blood pressure—130/90; pulse—110; and respirations—28. The responders control the bleeding with direct pressure, administer high-flow oxygen via a non-rebreather mask, begin an IV of lactated Ringer’s and apply a bulky sterile dressing to the stump.

While the paramedic prepares the patient for transport, the EMT goes into the pasture and locates the tractor, which is still running. He turns the tractor off and begins to search for the amputated hand. The EMT sees a piece of tissue hanging from below the tractor and finds the intact hand resting on the tractor frame. He retrieves the hand, rinses it with sterile saline and wraps it in a moistened towel. He then places it inside a watertight plastic bag in a bucket containing water and a small amount of ice. The crew then transports the patient and his amputated hand to the local community hospital.

On arrival at the hospital, the ED physician quickly evaluates the patient and the amputated hand. The patient’s vitals are unchanged, and the amputated hand is in good condition and is relatively clean (see Figure 1). Examination of the stump shows that the forearm muscles have retracted proximally, or toward their points of attachment, exposing the radius and ulna (see Figure 2). Due to the good condition of the hand, the physician determines that the patient is a candidate for its replantation and requires the services of a hand surgeon located at another hospital.

ED staff members clean and dress the stump and hand, after which they place the hand in a sealed bag in a cold-water bath for transport. The patient is given a tetanus booster, IV antibiotics and IV narcotics for his pain. After only 23 minutes in the ED, the patient is transferred via ground ambulance to a large medical center, where a hand surgeon assumes his care. The patient is taken immediately to surgery, and the hand is successfully

Cooperation between ground and air medical services is especially beneficial in rural areas, where long response and transport times are all too common.
replanted (see Figure 3). His subsequent hospital stay is uneventful, and the patient slowly regains considerable function in his hand. Within six months, he resumes limited farming activity.

**Discussion**

For many reasons, agriculture is a hazardous occupation. Agricultural workers, such as farmers and ranchers, tend to be independent and resourceful people who work alone or with only one or two other workers, typically family members. The farmer or rancher must be a jack-of-all-trades: businessman, mechanic, veterinarian, heavy equipment operator and laborer, for starts.

The environment in which agriculturists work is rarely constant. Work is often performed in areas that are difficult to access and where radio and telephone communications may be non-existent, such as in fields, wooded areas, barns, animal enclosures, grain bins and on rural roads and highways. Each setting has its own unique set of hazards and risks.

Farmers in particular are exposed to dangerous equipment that is designed to work the soil, process crops and move heavy items, such as livestock and grain. As many farms are family owned and operated and, technically, have no outside employees, they do not fall under OSHA labor-safety regulations. Thus, their equipment often has minimal or poorly working safety guards and other protective devices. In addition, some farmers lack formal training in the proper operation of farm equipment and machinery, placing them at increased risk for injury. Boredom and high noise levels are also present in agricultural work, which can contribute to the incidence of accidents.

Adding to the hazards, agricultural workers are often exposed to hazardous chemicals, mainly in the form of pesticides, herbicides and fertilizers. These chemicals are typically much stronger than similar chemicals used in an urban home.

Again, because many farms are still family owned and the workplace is also the home, much work is performed by children, either those of the farmer or those of migrant farm workers. Therefore, in addition to traditional childhood risks, farm children face significant risks associated with agricultural work. The exact number of children injured and killed in agricultural accidents is not known, because those under age 14 are not included in disability statistics. However, it has been estimated that, in 1985, farm injuries killed 300 children and adolescents in the United States, with another 23,500 suffering non-fatal trauma.

**Farm Equipment**

Various types of agricultural machinery can be found on farms and ranches depending on their geographical location and the types of crops and livestock produced. Heavy farming equipment includes tractors, combines, corn pickers, forage harvesters, flail choppers, mowers, balers, rakes, augers, plows, spreaders and cultivators. Small equipment, such as chain saws, tillers and lifts, is also frequently used.

*Tractors*—The most common cause of farm-related accidents is the tractor, which is the workhorse of the modern farm and the source of power for many commonly used farm implements. The modern tractor is either two- or four-wheel drive and is powered by gas, diesel fuel or, in some instances, liquid petro-

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Figure 1. Note the intact structure of the hand. This, combined with the excellent care provided in the field, made the patient a good candidate for replantation.

Figure 2. Examination of the stump reveals that the forearm muscles retracted toward their points of attachment, exposing the radius and ulna.

Figure 3. The patient's hand is successfully replanted, and he slowly regains considerable function in the extremity.
Objectives

After completing this article, the reader will be able to:
1. Identify hazards common to the rural and agricultural setting.
2. Relate potential injuries to the various types of farm machinery.
3. Identify EMS system complications that are unique to rural settings.
4. List priorities associated with extraction from agricultural equipment.
5. In a given scenario, identify appropriate treatment for a patient injured in a farm accident.

Harvesting equipment—Harvesting equipment is farm machinery that removes the crop from the plant and processes the crop in preparation for being sold at market. This includes corn pickers as well as combines and equipment used to process hay and straw. Corn pickers are typically self-propelled devices that move through a corn field and shear the corn cobs from the stalks. The machine then removes the corn from the cob and transports it to an attached trailer or storage hopper, leaving the corn stalks behind as waste. Most corn-picker injuries are amputations and crush injuries that occur when the operator attempts to unjam the corn picker by manually removing the corn stalks without first turning off the motor. These wounds have a high rate of infection and often require extensive surgical debridement and skin grafting.

Combines are used in grain fields to harvest and thresh grain. The stalks are ejected, and the grain is transported by conveyor belt to a trailer or attached hopper, which is a device used to transport or deliver grain. Combine injuries are often severe, usually involving deep lacerations and partial or complete amputations.

Hay balers are common farm and ranch devices that compact hay into rectangular bundles (bales) or large round rolls. As with corn-picker injuries, injuries associated with hay balers are usually amputations and crush injuries.

Mowers—Agricultural mowers are designed to cut thick grass and brush, often in preparation for baling. Two types of mowers are commonly used: Rotary mowers, which are multiblade devices pulled behind a tractor, function similarly to a household lawn mower. Cutter-bar mowers cut 6- to 7-foot wide swaths by shearing plant stalks between reciprocating blades and stationary guards, similar to the way a large electric hedge trimmer works. Power for the mower blades is provided by the tractor’s PTO.

Mower injuries may occur when the operator attempts to clear an obstruction within the mower. The victim’s fingers or toes are often caught in the blades, causing partial or complete amputation. Another common mower injury occurs when the operator falls from the tractor and is run over by the mower. Equally common are incidents in which the operator inadvertently runs over someone who is standing or working near the tractor; many childhood farm injuries occur in this fashion. Mower accidents in which the victim is run over by the mower are often severely debilitating, if not fatal.

Spreaders—Spreaders are usually pulled behind tractors and are used to evenly distribute fertilizer or a similar substance over a field. Some spreaders are simply long hoppers with adjustable holes at the bottom and an agitator that keeps the material flowing out of the holes. Power for the agitator is provided by the turning of the spreader wheels.

Manure spreaders are also common. This type of spreader is pulled behind a tractor, with the spreading mechanism powered by the tractor’s PTO. Most manure spreaders have a set of conveyor chains that constantly feed the manure to two sets of beaters, which are spikes, paddles or augers mounted one above the other. These beaters break up the manure and spread it evenly over the field. Injuries from spreaders usually result when the operator attempts to unjam the spreading mechanism; fingers and extremities can be quickly pulled into the mechanism, causing crush injuries and amputations.

Farm Structures and Environment

Also unique to farms are the buildings and special structures that support the agricultural operation, including barns, hay-storage buildings, animal pens and work sheds. Grain-storage bins also may be present if grain is a major crop. In addition to such buildings, irrigation equipment, water wells, water-storage tanks and ponds are common. Many
farms and ranches also have storage buildings for agricultural chemicals and solvents, and most have petroleum-storage tanks for gas, diesel and propane. In parts of the West and Midwest, especially Texas and Oklahoma, gas- and oil-field equipment may also be present. These devices extract natural gas and crude oil from the ground and transport it to storage facilities via pipelines. Oil rigs are usually unattended and may start and stop at any time, posing a particular risk to children.

Grain bins and augers—Grain bins, used to store grain following harvest, are used in conjunction with various mechanical devices that load and unload grain. Bins are dangerous for several reasons. Entrapment in moving equipment and grain-dust explosions are possible, but the most common injuries associated with grain bins occur when the victim falls and is drawn into a flowing column of grain, creating the potential for suffocation.

Another common injury associated with grain bins is entrapment in power equipment. Grain augers and conveyors are used to move the grain into and out of the bin. Augers are dangerous devices that rotate rapidly to move the grain from one place to another, making it difficult for a person to free himself if clothing or body parts become entangled in the machine. Entrapment in an auger often results in amputation or entanglement of the victim in the device.

Livestock—Livestock are also a source of injury for agricultural workers. Animals routinely encountered on U.S. farms are cattle, hogs, horses, mules, sheep, goats and chickens. Injuries associated with livestock include falls from horses and being kicked or otherwise attacked by horses and cows. Falls from horses usually result in head and upper extremity injuries, although pelvic fractures and lower extremity injuries are also common. A significant number of these injuries occur in children younger than 16.3 Animal kicks usually cause lower extremity injuries, although head, face and chest injuries are also reported. In addition, charging or uncontrolled animals may inflict chest and abdominal trauma.

Many farms with livestock have other hazards in the form of manure-storage ponds and tanks, or silos, in which manure is stored for use as fertilizer. Most of the injuries associated with manure storage ponds are due to drowning or exposure to toxic fumes.8 Silos may contain dangerous amounts of carbon dioxide, methane and nitrogen dioxide. Although silo gases may have a strong bleacihlike odor, often, the victim will not realize that he has been poisoned, because the gases cause little discomfort. Exposure to silo gas can cause either acute or delayed pulmonary edema, cardiac arrhythmias, hypoxia and death.

Agricultural chemicals—The increased productivity of modern agriculture is due in part to the use of agricultural chemicals, including pesticides, herbicides and fertilizers. Many of the pesticides used belong to the organophosphate class. Organophosphate poisons account for a significant number of agricultural poisonings and pose a serious threat to workers, as they are easily and rapidly ingested and absorbed through the skin and lungs. They affect both the parasympathetic and voluntary components of the nervous system. Early indications of these effects include eye pain, watery nasal discharge, diaphoresis (profuse sweating), bradycardia (slowed heart beat), abdominal cramps and vomiting. Advanced symptoms include involuntary muscle twitching, generalized weakness, paralysis and respiratory depression.10

Anhydrous ammonia, a frequently used agricultural fertilizer, is a nitrogen substance that absorbs water and acts as a strong alkali. Transported in a pressurized tank in liquid form, most incidents involving anhydrous ammonia occur when the fertilizer is transferred between tanks or when valves on the tanks are adjusted. Exposure to this chemical can cause extensive damage to the eyes, skin and lungs. When handling anhydrous ammonia, extensive protective clothing should be worn, including heavy rubber gloves, aprons, boots and non-ventig goggles. Federal law requires that at least five gallons of water be carried on any vehicle transporting the substance.9

Environmental hazards—Farmers and ranchers are constantly exposed to the elements. In the northern and mountainous states, hypothermia and frostbite are potential risks during the fall and winter months. Even during a freeze, farmers

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Glossary of Terms

Amputation—The removal of a part of a body, typically a leg, arm, finger or toe, either surgically or accidentally.

Anger—In farm equipment, a device fashioned like a boring tool that is used to force or move materials, such as grain, through machinery.

Crush injury—A phenomenon in which compressive force over a long enough period of time damages or kills muscle tissue.

Debridement—The removal of dirt and damaged tissue from a wound.

Degloving injury—Removal of most or all of the skin and subcutaneous tissue from a hand or foot that exposes bony structures.

Skin grafting—The transfer of skin from one part of the body to another to restore function or to change appearance.
and ranchers must brave the cold to feed and water their livestock.

In the southern and southwestern states, the most common environmental hazard is heat, with most planting and harvesting occurring during the warmer months. As crops must be removed from the field before they spoil, workers often labor from well before dawn until after dusk to take advantage of all available daylight. The work is strenuous, and rest breaks are rare; if water intake does not keep up with water loss, the worker can become seriously dehydrated. Older workers and children are at increased risk for developing heat cramps, heat exhaustion and heat stroke.

Sudden storms also pose a risk for agricultural workers, with severe storms usually occurring during the crop's growing season, typically spring and summer. High winds, tornados and torrential rains are all potential risks. Lightning injuries can also occur, especially to field workers who find themselves on open land in a sudden storm.

Water is essential to all agricultural operations, as the crops must be irrigated and the livestock watered. The water source varies with the farm or ranch; many have wells that provide the water, while others have ponds or tanks in which to store water. Ponds also serve as a source of recreation allowing for swimming, diving and fishing. Drowning in these water sources is a particular risk for farm children.

In addition to these physical environmental hazards, biological hazards are present, as many farms and ranches are home to wild animals. These wild reptiles and mammals, as well as domestic farm animals, can bite and scratch. As well as causing tissue injury, mammal bites can transmit diseases including rabies and bubonic plague. Also threatening are poisonous reptiles, including rattlesnakes, copperhead snakes, water moccasins, coral snakes and Gila monsters, which can be encountered in virtually all parts of the United States.

The Rural Response
Rural EMS differs from urban EMS in many ways. For example, rural EMS services are often responsible for larger geographic areas than their urban counterparts. However, these services' call volumes may be relatively low, making full-time, paid EMS service cost-prohibitive. Because of this, many rural EMS services are exclusively volunteer operations. Some are limited to BLS care, as their communities do not have the financial resources to purchase and maintain sophisticated ALS equipment.

Access to advanced EMS training can also be a problem in rural areas. While continuing education and in-service training may be provided in the community, EMT and paramedic courses may be unavailable locally, forcing volunteers to drive considerable distances to attend classes. The length of paramedic training, travel time to and from class and clinical rotations, and the associated costs often prohibit rural volunteers from obtaining paramedic certification.1

Response times are often prolonged because of the large geographical area for which rural EMS services are responsible and the long distances between scenes and where ambulances are stationed. In fact, in some rural areas, response times of one hour or longer are not uncommon. Further complicating matters, many rural residences do not have street addresses, so EMS personnel must locate scenes with maps or from directions provided by callers. This is even more difficult after dark, as many rural roads and residences are not clearly marked.

EMS system activation may be further delayed by communications problems. Many rural areas are not yet served by 9-1-1 telephone service, in which case citizens must call the sheriff, police or the local EMS service directly to report an emergency. Worsening the problem, many areas have limited and dependable telephone service.12,13

In rural areas, transport time to the hospital may be even longer than the response time to the scene. Many small rural hospitals closed during the 1980s, forcing emergency patients and ambulances to travel to distant cities for definitive emergency medical care. Of the small rural hospitals that have remained open, many are ill-equipped to handle major trauma and serious medical emergencies, with some lacking 24-hour, in-house physician coverage of the ED. Not infrequently, a rural EMS service will deliver a patient to a small hospital ED only to be called later to transfer the same patient to a larger hospital in a distant city. And, despite the proliferation of air-medical services in the 1980s, many rural areas still do not have access to such services. For all of these reasons, rural EMS responders are often required to provide prolonged patient care.

Finally, the victim may be well-known to the responder, which can add to the stress already being experienced due to the prolonged response and transport times.

Patient Care
Many emergency situations encountered by EMS responders are identical to those seen in the urban setting, with treatment priorities being the same. However, there are also many emergencies that are unique to the rural environment, such as agricultural emergencies and prolonged patient-care situations.

The first priority of any rescue scenario is always the rescuer's personal safety and that of fellow rescuers. First, the dispatcher should try and learn as much about the emergency as is practically possible. Based on that information, a decision about special equipment needs can be made. Incidents involving agricultural equipment may require special, heavy-duty rescue tools in addition to medical equipment. Similarly, poisoning emergencies from pesticides, fertilizers or silo gases dictate that each responder wear protective equipment.

A thorough scene survey should be made on approaching the scene. If a hazardous substance may be involved, the scene should be approached from upwind, and responders should survey the scene with binoculars from a safe distance. Only after scene safety is determined should they approach.

Accidents occurring in pastures and fields may prevent access by many types of
rescue vehicles. Before venturing off the road, responders should exit their vehicles and determine the softness of the soil. If the area is wet or difficult to access, rescue equipment ideally should be transferred to a four-wheel-drive vehicle to access the patient.

Ideally, several groups of rescuers are required in an agricultural rescue. If personnel resources permit, one group should be assigned patient-care duties while others are responsible for rescue and fire suppression. Once the patient is accessed, the primary assessment should be rapidly completed. Any threats to the patient's airway, breathing or circulation should be immediately corrected, and high-flow supplemental oxygen should be administered if no immediate fire hazard exists. Due to the force and energy typically associated with agricultural emergencies, always assume that the patient has suffered a head or neck injury, and treat accordingly.

Following the primary assessment, a secondary assessment should be performed to identify any obvious injuries and areas of entrapment. At this point, it can be determined which rescue tools are needed. While rescue is under way, the medical team should plan for patient removal and transport, and equipment such as backboards, pneumatic anti-shock garments (PASG) and dressings should be prepared. If the rescue will be prolonged and the patient's condition warrants it, use of an air ambulance should be considered if available.

Patient care may need to be modified if the victim is entrapped. For example, it may not be possible to access the injury and apply direct pressure to a bleeding wound. Instead, the pressure point immediately above the injury may need to be compressed. In such a case, obtain a baseline set of vital signs, and check them frequently. Pulse oximetry, if available, is useful; not only does it indicate peripheral oxygen delivery, but it also gives a constant, audible indication of the patient's heart rate and oxygen-saturation status. If a crush injury is present or if there is a possibility of other arterial damage, the pulse oximeter probe can be placed distal to the injury to help determine whether peripheral tissues are being adequately perfused.

If the responding EMS unit has ALS capabilities, an IV of lactated Ringer's should be established with a large-bore (14- to 16-gauge) catheter. If the injury is serious or its extent cannot be quickly determined, a second IV of Ringer's should be established. Continuous EKG monitoring is essential throughout extrication and transport. If shock develops, PASG should be applied if protocols allow, especially if the injury involves the pelvis and lower extremities.

Entrapment in farm machinery will often involve only one extremity. If no other injuries are apparent, medical con-
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trol should be contacted regarding anal-
gesic administration during extrication and transport. Nitronox (50% nitrous oxide/50% oxygen) may be administered if no fire hazard exists. This not only has an anesthetic effect on the patient but also provides supplemental oxygen. Parenteral analgesics, such as morphine sulfate, butorphanol (Stadol) or nalbuphine (Nubain), may be administered intravenously or intramuscularly as ordered by medical control. Watch for any nausea and vomiting that may accompany use of these medications. Once the patient is extricated, emergency care priorities are the same as for other injuries.

If the accident results in an amputation, every attempt should be made to find the amputated part and transport it to the hospital. However, patient transport should never be delayed while searching for an amputated part. Once it is found, the body part should be rinsed with sterile saline or sterile water and wrapped in a moist towel or dressing and then placed in a watertight plastic bag that is marked with the contents. Once sealed, the bag should be placed in a container of water or saline, with a few pieces of ice added. Never pack the amputated part in ice or immerse it in water, as this may cause tissue damage, rendering the part unacceptable for replantation. Always transport the body part, no matter how mangled; if the amputated part cannot be replanted, tissue, bone and blood vessels may be used to repair the stump.14

**Extrication and Rescue**

Entrapment in agricultural equipment poses many challenges to the EMS responder including, at times, the disassembly of the device. Before attempting to remove the patient or dismantling the device, it is advisable to call in fire/rescue personnel trained in extrication procedures. Also, note any hazards while approaching the scene. If the engine is still running, it should be turned off immediately. If the engine is off, the battery cables or distributor wire should be removed to ensure that it cannot restart during the rescue. Regardless of whether there is evidence of a fuel leak, fire suppression equipment should be deployed and ready for use.

Once the scene is reasonably safe and the engine is inoperative, the equipment should be stabilized. If the accident involves a tractor, both the rear and front of the vehicle should be stabilized with chains and hoists if no other equipment, such as inflatable bags, is available. Cribbing, such as blocks of wood, should be placed under all vehicles for support during rescue activity.

If the accident involves a victim trapped under an overturned tractor, the vehicle must be lifted so the patient can be freed. Common rescue tools, such as hydraulic jaws or air bags, are often effective. Some of the larger modern tractors can weigh up to 10 tons, so moving these requires special cranes or large wreckers. Remember to always stabilize the vehicle with blocks and cribbing.
Patient entrapment in PTOs can present special problems for rescuers. First, the tractor should be turned off. Many PTOs “freewheel” (the shaft turns freely) when the power is off, allowing rescuers to rotate the shaft and free the patient. If the PTO shaft is locked, the patient can be freed by unhooking the coupling device and sliding it apart. If it cannot be uncoupled, it can be cut, with care being taken to lock the shaft in place to prevent it from spinning. Other options are available, such as disconnecting the shaft at either end. Again, however, it is best to request specialized assistance before attempting any dismantling of the device.

Entrapment in augers, combines, corn pickers and other farm machinery usually requires disassembly of the equipment, and rescue tools are often ineffective. Disassembly and extraction can either be quite easy or extremely difficult, with familiarity with farm equipment being the key to a rapid extraction. Often, a neighboring farmer who is familiar with the equipment can assist rescuers in disassembly, occasionally freeing the patient more quickly than when rescue tools are used. If the patient is entangled in an unfamiliar piece of equipment, attempts to locate a service technician should be made. These people often live in the area and can arrive at the scene shortly, bringing with them any special tools that may be required.

On very rare occasions, it is impossible to extricate a patient from farm equipment. In such cases, it may be necessary to amputate the entrapped body part at the scene. If it appears that this will be required, plans should be made to locate a surgeon and any necessary equipment. Many air-medical operations have protocols for this and will send a surgeon or surgical resident to the scene. If there is no surgeon or air-medical service available, a local physician should be called to the scene. In any of these cases, it may be necessary for EMS personnel to act as surgical assistants, administer medications and provide fluid therapy.

Extraction from farm equipment poses additional hazards. For example, in grain-bin rescues, the grain itself poses a hazard to the rescuer as does grain dust, which can cause explosions. Before entering a bin, responders should request the presence of specially trained personnel to manage the rescue. They should then don the appropriate protective respiratory equipment, such as a self-contained breathing apparatus, and be secured via life lines. On entering the bin, responders must determine whether the victim is completely or partially submerged in the grain. If only partially submerged, rescue ropes can be lowered to the victim to pull him free, while if the victim is unresponsive, rescuers must themselves be lowered—always under supervision.

If the victim is totally submerged, the rescue becomes much more difficult. In such cases, the gravity doors must never be opened to release the grain, as grain flows from the top through to the bottom, pulling the victim deeper into the grain.

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Instead, 18-inch triangular holes should be cut in the side of the tank as high as possible but still below the level of the grain. These holes, which should be cut opposite each other, should then be opened simultaneously to allow the grain to flow out evenly, preventing collapse of the bin walls. When cutting holes, always be aware that grain dust is flammable and that an explosion is possible. Proper ventilation and fire suppression should therefore be available. (For more information on grain-bin rescues, see Smith M, Hillers P: "Grain-bin rescues." JEMS. 11(3): March 1986.)

Pesticides and other agricultural chemicals are also hazardous in rescue operations. If a hazmat incident is suspected, proper rescue and safety equipment should be used. As many pesticides, especially organophosphates, enter the body through the skin and lungs, all rescuers must wear protective clothing and respiratory equipment. Once the victim is accessed, he should be taken from the area to open air upwind from the accident. All of the patient's clothing should be removed, and he should be copiously irrigated with water.

Standard BLS care, including oxygen administration, should be provided. If the patient exhibits signs and symptoms of organophosphate poisoning, such as muscle twitching, paralysis, respiratory depression and excessive drooling, and ALS care is available, medical control should be contacted regarding the possible administration of antidotes, such as atropine sulfate and pyridoxine (2-PAM) if protocols allow.

**Prolonged Patient Care**

Rural EMS personnel are often called on to provide prolonged patient care. This can be due to prolonged extrication times, wilderness rescue or prolonged transport times to a hospital. EMS agencies that often provide prolonged care should obtain additional training in topics such as fluid and electrolyte therapy; administration of various medications, including pain medications; continuous monitoring; and other skills typically performed in hospitals. Many of the skills needed for prolonged patient care are not allowed.
under basic-EMT certification. Thus, EMTs who may have to provide prolonged care may wish to obtain further training and certification, such as wilderness EMT (W-EMT).

Similarly, paramedics who frequently provide prolonged patient care should become proficient in Foley catheter insertion, nasogastric tube insertion, ventilator management and other advanced skills. Because of the potential need for prolonged care, rural ambulances and rescue vehicles may need to carry larger quantities of drugs and other supplies than would urban vehicles.

Conclusion
Agriculture is the second most dangerous industry in the United States, causing significant death and disability. Although farmers are skilled and resourceful people, many farms are small, family owned and not adequately monitored by federal and state governments in terms of safety. Aging equipment, worker fatigue, inadequate worker training and lack of safety equipment all contribute to agricultural injuries and death.

Rural EMS also presents many challenges not encountered in the urban setting. Much of the sophisticated equipment in today's ambulances is too expensive for many small communities to afford. Response and transport times are often long, and extraction from farm equipment can be difficult and prolonged. In small communities, the patient may be well-known to the rescuers—often family members or close friends.

Additionally, for many years, the unique needs of rural EMS have been inadequately addressed in EMS training, and EMS training has often been difficult to obtain. As EMS further evolves, more attention needs to be devoted to the special needs of rural EMS providers and the patients they serve.

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