
TO: Director, National Institute for Occupational Safety and Health

FROM: Iowa FACE Case no. 2008 IA 081 Report date: 10 October 2012

SUBJECT: Farmer crushed by corn head when disengaging it from combine

SUMMARY

A 33-year-old male farmer died when separating a corn head from the feeder on a disabled combine. A first attempt to disengage the head using a tractor and chains failed when the latches under the feeder would not disconnect. The victim crawled under the raised corn head to examine its connection with the feeder, and while still underneath, used a hammer to force one of the locking latches to release. As the latch released, the corn head separated from the feeder and pinned him to the ground. It took first responders ten to fifteen minutes to lift the corn head off the victim, who was then transported to a Level I trauma care facility via helicopter. Efforts to resuscitate the victim were unsuccessful.

RECOMMENDATIONS

1. *Do not work under elevated equipment without blocking equipment to prevent its falling.*
2. *Confirm that all required steps are completed, in order, when working with heavy machinery.*
3. *Prior to using equipment, inspect machinery and ensure that safety warnings are visible.*
4. *Contact distributors to identify new safety features that may be available on existing equipment.*

INTRODUCTION

A 33-year-old farmer died from traumatic asphyxia in the fall of 2008 after being crushed by a corn head that he was attempting to remove from the feeder of a combine. The Iowa FACE team was first alerted to this fatality by a television news report. Information about this case was also obtained from newspaper clippings, the County Sheriff, Medical Examiner's office, and an on-site interview with family members of the deceased.

INVESTIGATION

The fatality occurred on a family-owned farm (in operation for two generations) that typically employed two to five people. The mixed-farming enterprise consisted of about 2500 acres of crop (corn and soybean) and feeder cattle and cow-calf production. The victim had limited farming

experience, having returned to the farm he grew up on about three years before the incident and initiated an organic farming operation. During this period, he had been involved in harvest activities, including driving tractors with grain wagons and managing the grain drier. The family members shared machinery and equipment for various work activities on the farm, and two non-family employees also worked on this farm.

At the time of the incident, the combine was two years old, in good condition, with 520 hours of use. The eight-row corn head, with 30-inch (76 cm) row width weighed 5700 pounds (2600 kg), was new, and had been delivered earlier that fall, when harvest was nearly over. An after-market corn reel had also been installed, adding more weight to the corn head.

Prior to the fatal incident, the fall harvest was nearly complete. This was a wet season, and some fields had been difficult to harvest. Approximately 10 days prior to the incident, one family member had been operating the combine in the last corn field to be harvested when the transmission of the combine failed. The combine had been left in the field while the transmission was removed for repair at the dealership. During removal, the mechanics had trouble with jacks sinking into the ground. On the day of the incident, they requested that the corn head be removed from the combine's feeder to make the unit lighter and prevent the jacks from sinking into the ground when they re-installed the repaired transmission.

At about 4:30 p.m. on the day of the incident, the victim was called by a family member to help remove the corn head from the combine. The workers reported that this task was routine, performed approximately 50 times in a given season, and they had experienced no previous difficulties in separating these units. Interviews indicated that the victim had been involved with this task about 20 times prior to this incident. At the site, cribbing remained near the combine from the transmission removal process. Corn stalks still covered the feeder unit from the previous harvesting activities, covering warning labels on the feeder.

To complete the corn head removal, the victim arrived at the site with a pickup truck and log chain. The victim released the locking latches under the corn head and, with two other persons, attempted to pull the disabled combine backwards with a tractor. The victim and another worker were in the combine cab to raise and lower the feeder and corn head so they could be separated, and another worker operated the tractor with a log chain attached to the rear of the combine to pull it backward. The initial attempt did not separate the corn head from the feeder, so the area was inspected and the timbers/cribbing were removed before a second attempt, which also proved unsuccessful.

After the second attempt, the feeder and corn head were raised and workers discussed the possibility that both latches may not have been released. The victim went under the raised corn head, inspected the latches, and emerged from under the equipment to retrieve a hammer from his pickup truck. He returned to the equipment and went under the corn head from the center front. The combine operator returned to the cab, where he heard a tap of the hammer, at which point the corn head separated from the feeder, slid away from the combine cab, then rocked back onto the victim. The Sheriff's report indicated that the latch to the left of the victim was in the up and secured position (with pin and securing latch in place), while the latch to the right of the victim was hanging down, without the pin fully secured (confirmed in photos). One of the workers hypothesized that the corn head had moved from its rest on the upper lip of the feeder as soon as the victim hit the unit with the hammer.

The victim was pinned in a kneeling position facing the combine with the corn head resting on his mid-back. The cab operator heard the victim yell and got off the combine, which could not be

moved due to the removed transmission. The cab operator went to the victim and called 911 at 4:50 p.m. The cab operator then requested the tractor operator to remain with the victim while he went to retrieve a forklift to attempt a rescue. The victim was conscious and able to communicate for about four minutes afterwards. The first responders arrived at the scene within five minutes. The Rescue Unit arrived at 5:02 p.m., when high pressure bags were positioned under the right side of the corn head and inflated to elevate the head. Within 15 minutes, the victim was extracted. The first responders' resuscitative efforts were unsuccessful. The victim was then transported to a Level I trauma facility by helicopter, where resuscitation continued but was unsuccessful. He was pronounced dead at 6:00 p.m.

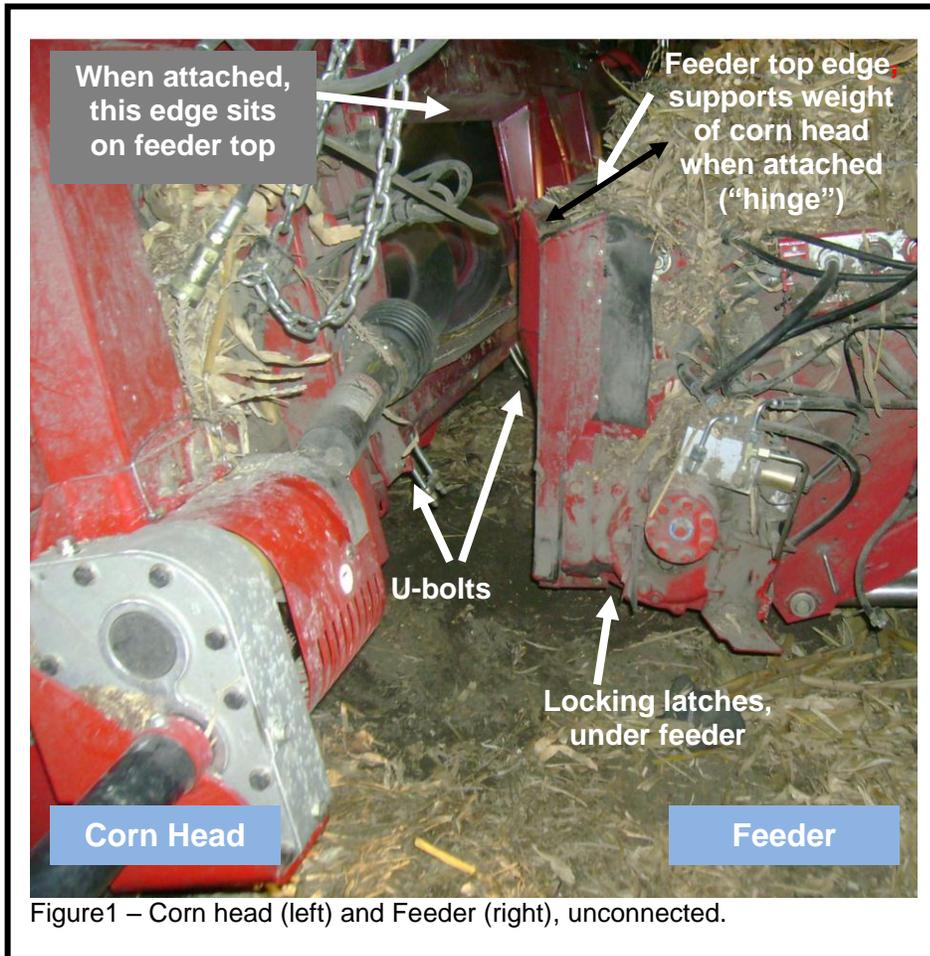


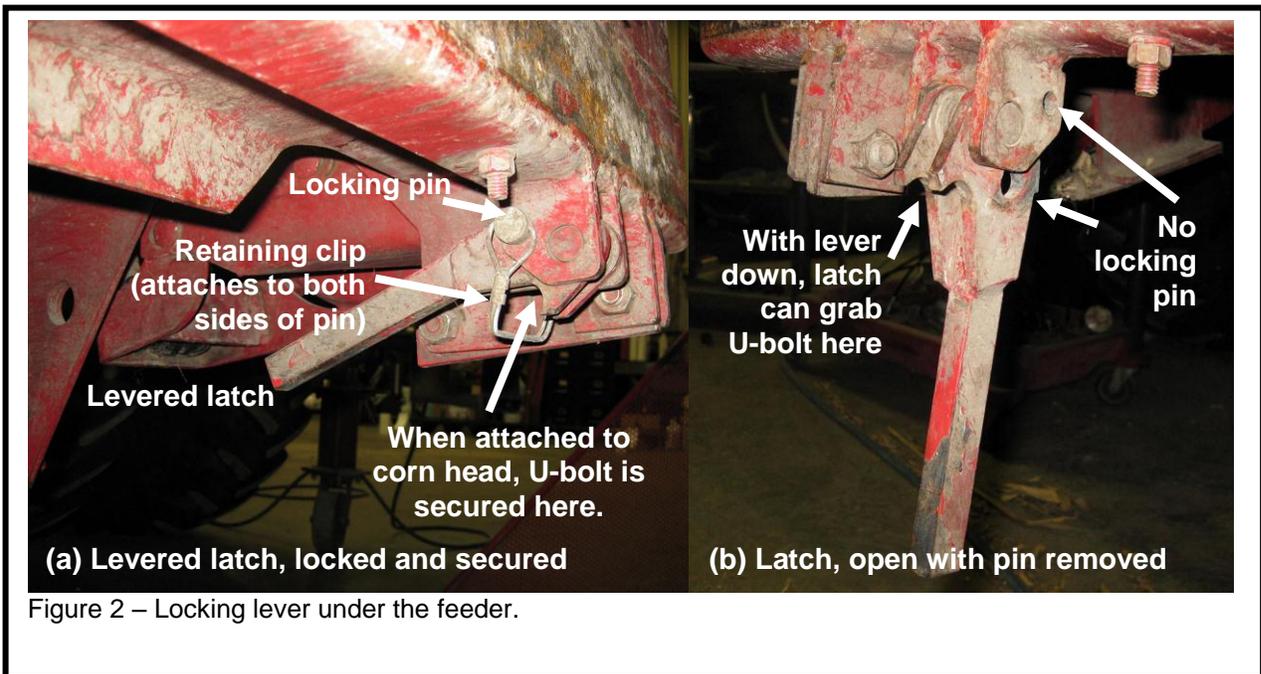
Figure1 – Corn head (left) and Feeder (right), unconnected.

This 2008 model corn head is attached to the feeder by inserting the feeder into the opening of the corn head (Figure 1). Next, the feeder must be raised so that the corn head frame rests on the four-inch lip at the top of the feeder inlet, like a saddle. When the feeder rises, this point of connection acts as a hinge so that the corn head butts against the face of the feeder housing and sits securely. In this process of raising the feeder, the corn head is lifted and tilted toward the combine, and the weight of the corn head is fully supported by the feeder. Once in this position, two lever latches on the bottom of the feeder are opened manually, and each latch is hooked

around a U-bolt on the corn head. With both latches closed and locked, the corn head and feeder are connected at the bottom and the weight of the corn head is fully supported on the top of the feeder. To detach the corn head, the feeder and attached head are first raised and tilted backward. Once the levers of each latch are opened, the U-bolt removed, and the latches closed, the worker moves away and the feeder is lowered until the weight of the corn head is transferred to the ground while the combine moves backwards. The downward tipping and reverse motion separate the two machine components.

Figure 2(a) provides details of the latching mechanism, fully secured but not attached to another piece of equipment. The latching process, for each of the two latches, requires the following steps: remove the pin's retaining clip, remove the locking pin, pull the lever down (Figure 2(b)), catch the

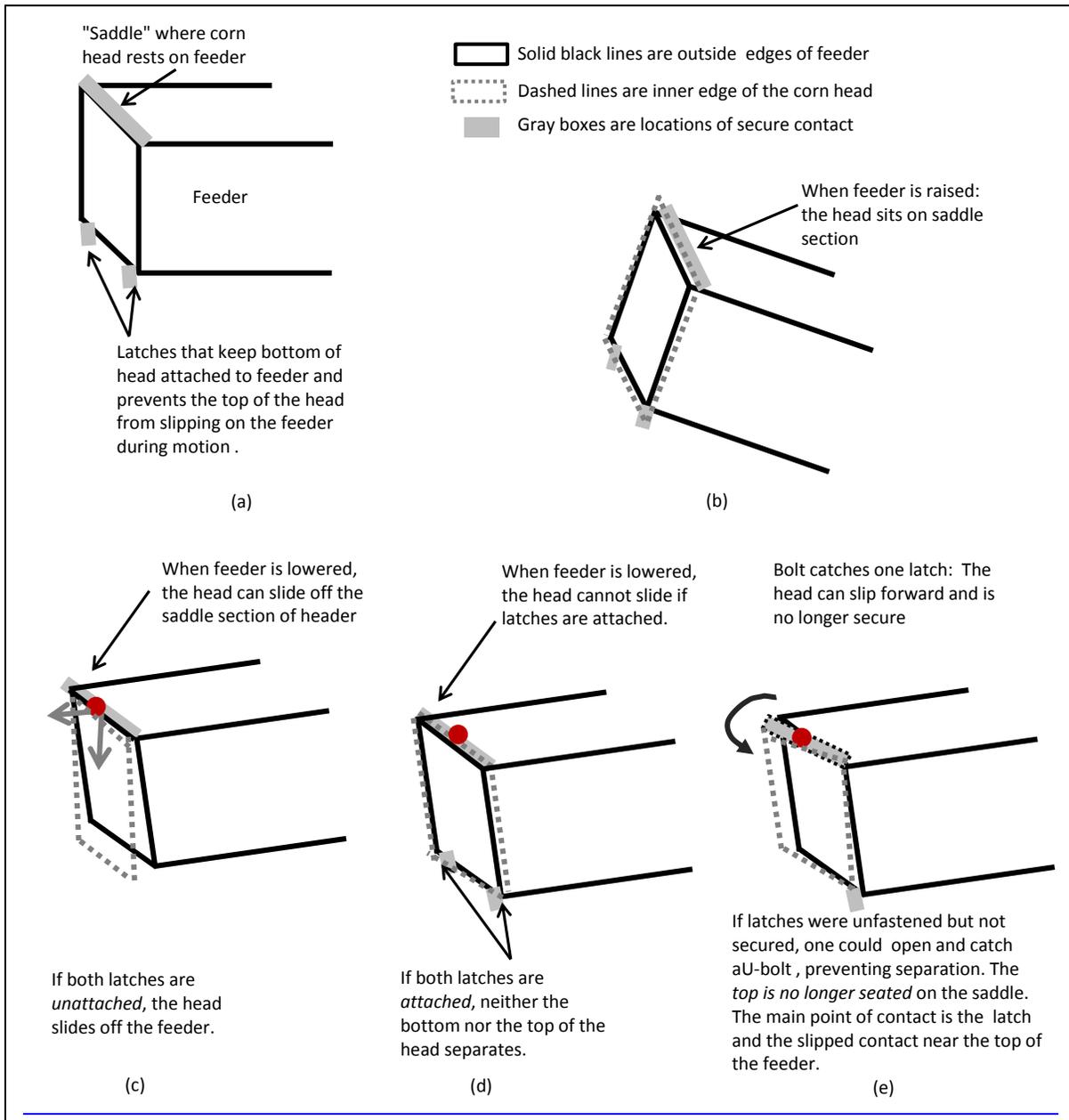
corn head's U-bolt in the latch's hook, then push the lever back up, drawing the connection tight. At this point, the U-bolt on the corn head is held to the feeder under tension to prevent the two units from separating. To complete the process, the locking pin is reinserted into the closed latch, and a retaining clip is inserted to prevent the pin from coming loose as the equipment vibrates during operation. To separate the units, a similar process is used, but when the latch is lowered, the U-bolt is removed from the hook, and the lever is locked and secured. Figure 2(a) illustrates the required configuration for the corn head and feeder to separate without any chance that the latch can re-connect with the U-bolts on the corn head.



To perform these latching tasks, a person accesses these levers from the right and left side of the corn feeder and reaches under the unit to secure the lever. It is not uncommon to work lying on the ground, facing up, under the raised equipment to secure the levers. Warning signs are displayed on the feeder to remind workers to lock out the hydraulic cylinders prior to working under the feeder to prevent a combine operator from moving the unit while someone is under it. When latching and unlatching these bottom levers, the weight of the corn head is typically fully supported by the feeder.

Figure 2(b) illustrates an example of the latch unsecured, with pin removed. The lever arm of the latch now hangs below the feeder. If prior to moving the corn head and feeder units, the latch is not returned to the closed position (Figure 2(a)), with pin and retaining clip securing the latch closed, the latch mechanism could grab the U-bolt (where indicated on the figure) when the units are lowered during the separation process. This partial connection could keep the corn head and feeder from separating. If this occurs, the connection at the top of the feeder would *not* be secure after attempts to separate the two units. The Sheriff's report indicated that the latch to the left of the victim was in the up and secured position (with pin and securing latch in place), while the latch to the right of the victim was hanging down, without the pin fully secured (confirmed in photos). One of the workers hypothesized that the corn head had moved from its rest on the upper lip of the feeder as soon as the victim hit the unit with the hammer.

Figure 3 illustrates how the feeder and the bottom latches are designed to hold the feeder and head together. In level position, the head sits on top of the feeder, with the two bottom latches holding the units together (3a). In the raised position, the head is gravity held against the feeder (3b). In the lowered position, unattached latches allow the head to separate from the feeder (3c), while attached latches keep the units together (3d). However, if one latch is unattached, the raising and lowering of the feeder allows slipping on the saddle point and the only secure connection is at the bottom, latched junction (3e).



Post-Investigation: After the incident, the combine was taken to the dealer and a new locking mechanism (Centralized Header Latch Kit) was installed to replace the underside lever latches which had been the standard on these combines since the 1970's. The new mechanism has a

central lever at the left side of the feeder, allowing locking and unlocking of the corn head by standing to the side of the unit rather than requiring a worker to work under the raised equipment. This mechanism is connected to push-pull cables that operate heavy metal pins locking into the openings in the corn head on both sides. This mechanism replaced the standard latch mechanism in 2010, and was available as a field-installed option for combines produced in 2007. The new attachment is welded onto the frame.

CAUSE OF DEATH

Cause of death was traumatic asphyxia, a form of mechanical asphyxia in which a heavy weight presses down on an individual's chest or abdomen.

RECOMMENDATIONS AND DISCUSSION

Recommendation 1: Do not work under elevated equipment without blocking equipment to prevent its falling.

Discussion: Raised equipment is not at a zero energy state, as the influence of gravitational forces would result in the unit falling to the ground should it become unsupported. The assumption that the weight of the corn head was fully supported at the top of the feeder was no longer reasonable once the locking latches were removed and attempts had begun to disengage the two units. Ideally, operators should approach the latches from the feeder (which does not drop) and/or secure the raised equipment (corn head) with jacks or other supports prior to engaging in activities that will release the raised equipment.

Although it is typical practice when seating and unseating a corn head from a feeder to go under the equipment to latch and unlatch the locking device, a device that has been "unlatched" and shifted cannot be assured to be firmly seated. Leaving the corn head and feeder in the raised position allowed easier access to inspect the locking latches, but it also increased the hazardous energy of the system. Consult OSHA's lockout training materials for additional details on working with hazardous energy, including gravity-based system hazards.

Recommendation 2: Confirm that all required steps are completed, in order, when working with heavy machinery.

Discussion: Injury from heavy machinery is the third leading cause of occupational deaths. For the process associated with this fatality, the steps to lock the corn head to the feeder require the locking pin's retaining clip to be removed, the pin to be removed, the latch to be opened and connected to the U-bolts then closed, with the final step requiring the pin and its retaining clip reinserted. Unlatching requires a similar process. As evidenced in the Sherriff's report, a locking latch was hanging down, which indicates that the lever was not secured in its locked position. Because the process of separating these two units requires raising and lowering the corn head and feeder, movement of an unsecured latch without the locking pin in place could cause the latch to initially release from the U-bolt on the corn head but then catch the U-bolt with the lever in a *different position* during attempts to separate the feeder and corn head by raising and lowering them. For the unsecured latch to re-connect with the U-bolt, the corn head would have shifted at the top of the feeder from its secure position. At that point, the two devices were attached but the weight of the corn head was no longer fully supported at the top of the feeder, and the hammering was sufficient

energy to release the corn head from the feeder. Therefore, insertion of the locking pins and retaining clip is a critical step to separating these units.

Confirm that all steps are properly completed before moving to the next step when working with machinery. When discovering that a previous step has not been performed adequately, full consideration of the energy states of the equipment and environment is required (recommendation #1).

Recommendation 3: Prior to using equipment, inspect machinery and ensure that safety warnings are visible.

Discussion: This unit had been in the field for over a week, and corn stalks covered the top of the feeder. Danger warnings (including the recommendation to rest the corn head on the ground before going under the unit) were obscured by the corn stalks. While housekeeping is not the root cause of this fatality, the time spent cleaning off equipment could have revealed the warning label to remind the worker about the hazardous energy in the system. While a modest recommendation, cleaning off the unit and visual inspection provide the operators time to consider hazards of the task they are about to perform.

Recommendation 4: Contact distributors to identify new safety features that may be available on existing equipment.

Discussion: Upgrades to agricultural equipment are often available to improve its safe operation. In many instances, farmers are using decades-old tools that may have redesigns that reduce the risk of injury. It is critical that equipment owners work with distributors to identify safety features developed over the life of their equipment. Although the equipment in this incident was relatively new, safety upgrades to the latching mechanism were already available: an alternative to the standard latch system had been developed to eliminate the need to work under the equipment during normal operations. Without the newer mechanism, routine tasks such as connecting and disconnecting the corn head require working under it, with hydraulic cylinders locked out to prevent movement of the combine. However, this habitual behavior during normal operations increases the probability that workers will position themselves under equipment during troubleshooting, when safety conditions are likely to have changed.

Safety retrofits have been developed on many types of agricultural equipment, but many farmers are not aware of these improvements. Farmers, distributors, and manufacturers must all make efforts to educate the exposed workers on the latest safety devices for heavy machinery available on the market.

Keywords: farmer, combine, corn head, compressed by equipment

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Fatality Assessment and Control Evaluation FACE

Fatality Assessment and Control Evaluation (FACE) is a program of the National Institute for Occupational Safety and Health (NIOSH), which is part of the Centers for Disease Control and Prevention of the US Department of Health and Human Services. Nationally, the FACE program identifies traumatic work-related deaths, conducts in-depth studies of select cases, makes recommendations for prevention, and publishes reports and alerts. The goal is to prevent occupational fatalities across the nation.

The NIOSH head office in Morgantown, West Virginia, carries out an intramural FACE case surveillance and evaluation program and also funds state-based programs in several cooperating states. The Iowa FACE program is conducted by the Injury Prevention Research Center at the University of Iowa working in conjunction with the Iowa Department of Public Health and its Office of the State Medical Examiner.

NIOSH combines its and the state programs' information for wide dissemination, in a variety of forms, among the industries involved. NIOSH publications are available on the web at <http://www.cdc.gov/NIOSH/FACE/> and from the NIOSH Distribution Center (1-800-35NIOSH).

Iowa FACE also publishes its case studies, issues precautionary messages, and prepares articles for trade and professional publications. In addition to postings on the national NIOSH website, the information is posted on the Iowa FACE website (www.public-health.uiowa.edu/FACE/).

The Iowa FACE team at the University of Iowa includes Marizen Ramirez, Director; Corinne Peek-Asa, Co-Investigator; John Lundell, Co-Investigator; T. Renée Anthony, Co-Investigator; and Murray Madsen and Stephanie Leonard, Field Investigators. Additional expertise is provided from the Iowa Department of Public Health, including Rita Gergely, Principal Investigator; Kathy Leinenkugel, Surveillance Specialist; and John Kraemer, Director, Forensic Operations at Iowa Office of the State Medical Examiner.

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