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Information for an Industry on the Move

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In This Issue...

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ANIMAL AGRICULTURE INITIATIVE

This newsletter is edited by:

Dr. Madonna Benjamin, MSU Extension Swine Veterinarian, 517-614-8875, gemus@cvm.msu.edu
& Emily Schmitt MPPA, Program Director, schmitt@mipork.org

Farm safety hits home for Michigan swine veterinarian

By Emily Schmitt, MPPA Program Director

Michigan swine veterinarian, Dr. Jim Kober, never imagined that he would be the protagonist in a story about a farming accident. But in early September, Dr. Kober lost a majority of his right arm in an accident involving a power take off on a manure spreader.

Dr. Kober is a swine veterinarian in Holland, Michigan and has been practicing for 30 years. He also owns a contract swine finishing barn on the farm where he grew up.

"I was working up at the barn with a tractor and manure spreader," he said. "It's an older spreader that didn't have any guards on the power take-off. I reached over to do something and I was wearing a raincoat with elastic straps on the sleeve. It pulled me in. It was like tug-of-war for a few seconds before I lost my arm."

Kober said his wife, Donna has been a big help in his recovery.

"As my wife put it, you are not going to use this as excuse to sit around and watch TV for the rest of your life," he said. "You move on the best you can. It's going to change my life, but I am

not going to let it stop my life."

Pain is still a hurdle for Kober's recovery, but he trying to remain positive throughout the process.

"The wound healed uneventfully, but the phantom pain is lingering," he said. "That is the most aggravating thing at this point. The phantom pain is a very real thing. I think once I get on top of that, I will be OK. Mentally, I am usually pretty good earlier in the day, but as it wears on, I get crabbier than I used to. I can tell if I don't get enough rest at night. I start feeling sorry for myself later in the day."

Dr. Kober is still getting used to life since the accident, especially getting back to work at his veterinarian practice. While he lost his right arm, Kober is left-handed so he said it could have been worse.

"I am getting back to work two or three days a week," he said. "Everything takes more time than is used to. Getting dressed, getting suited up, and showering in and out at farms takes more time. I am not able to do as much heavy lifting and I need to take assistants with me to do things like snaring pigs. Driving has been a little bit of a challenge, but it's getting better. I still spend a lot of time going to doctors' appointments and physical therapy and things like that."

Support from those around him have played a large part in keeping Kober's practice and his hog farm operating successfully.

"I have a really good employee that takes care of the barn on a day-to-day basis," he said. "I have to have more help from assistants on my vet calls and sometimes I have someone drive me."

Kober is in the process of getting a prosthetic arm to help with everyday activities.

"In the next four to eight weeks, I am looking at getting a prosthetic," he said. "It's an interesting process to get a prosthetic. By the morning after the accident, there was already someone from a prosthetic company in my hospital room talking to me. I learned there is no standard prosthetic. Every single one is custom made and different for every person. They tell you to use the prosthetic as an assistant, not as you would your regular arm. I would be able to use it to help with things like driving or changing the radio station. They have different detachable hands—one holds a tennis racket, one holds a fishing pole. The main one would be a finger and thumb pincher to grab things with."

Farm safety has a whole new meaning for Dr. Kober and he would advise farmers to take caution when working on the farm.

"Be leery of power take-offs and moving machinery in general," he said. "Don't wear baggy clothes. Don't take short cuts. I know farmers take short cuts when they are in a hurry. Just be careful."

Taking the time to think about safe work practices on the farm……is time well spent.

By: Melissa Millerick-May MSc, PhD, Assistant Professor of Medicine, Division of Occupational and Environmental Medicine, Michigan State University

Farming is often considered by the public to be an idyllic occupation based on media portrayal of family working together, farms handed down from generation to generation, and images of awe-inspiring countryside with tractors slowly bumping down a beautiful shady lane. What isn't readily understood is that the agriculture industry can be one of the most intense and dangerous industries in the United States.

The agriculture industry employs approximately 2 to 4 million people nationwide, and includes the highest percentage of 'self-employed' individuals of all

Table 1*. Traumatic Work-Related Fatalities by Industry Sector, Michigan Incidence Rates Compared to US Incidence Rates, 2015

Industry Sector (NAICS Code)	Number of Fatalities	2015 MI Employment-based Rate[ab]	2015 MI Hours-Based Rate	2015 US Hours-Based Rate[f]
Agriculture, Forestry, Fishing and Hunting (11)	21	24.7	35.2[d]	22.8
Construction (23)	28	18.9	9.8[d]	10.1
Manufacturing (31-33)	16	2.7	2.2[d]	2.3
Wholesale Trade (42)	4	2.4	2.4[e]	4.7
Retail Trade (44-45)	9	1.9	2.6[e]	1.8
Transportation & Warehousing (48-49)	18	13.3	5.9[d]	13.8
Financial Activities (52)	1	0.6	3.5[d]	0.9
Real Estate and Rental and Leasing (53)	6	11.7	**	**
Professional & Business Services (54, 56)	12	2.1[c]	**	3.0
Educational & Health Services (61, 62)	1	0.1[c]	**	0.7
Leisure & Hospitality (71, 72)	10	2.4[c]	2.5[d]	2.0
Other Services (except Public Administration) (81)	3	1.8	2.2[e]	3.0
Public Administration (92)	7	3.0	4.0[d]	1.9
Total	**136**	**3.0**	**3.1[d]**	**3.4**

[a] Sources: USDA, National Agricultural Statistics Service. 2012 Census of Agriculture, AC-12-A-22, Released May 2015. Table 23, Summary by Farm Typology Measured by Gross Cash Farm Income, Primary Occupation of Small Family Farm Operators, and Non-Family Farms - Michigan: 2012 Pg 315 http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Typology/typology13_mi.pdf Accessed March 8, 2015, Michigan Department of Technology, Management and Budget (DTMB), Office of Labor Market Information, Industry Employment (Establishments-CES) (IES), Michigan, Year: 2012. Accessed November 25, 2015. www.milmi.org/cgi/dataAnalysis/.

[b] Incidence rates calculated per 100,000 full-time equivalent (FTE) workers (from Table 5)

[c] Employment-based rate calculated as (N+N)/(E+E) x 100,000 FTE workers (from Table 9): N=Number fatalities (NAICS+NAICS), E=Number Employees (NAICS+NAICS).

[d] https://www.bls.gov/iif/oshwc/cfoi/rate2015mi.htm

[e] Rate represents the number of fatal occupational injuries per 100,000 full time equivalent workers and was calculated as: (N/EH) x 200,000,000 where N= Number of fatal injuries; EH = total hours worked by employees in the industry sector during the calendar year (number of hours x 50 weeks per year); 200,000,000 = base for 100,000 equivalent full-time workers (working 40 hours per week, 50 weeks per year) (from Table 5)

[f] U.S. Bureau of Labor Statistics, 2015 Census of Fatal Occupational Injuries (final data): Number and rate of fatal work injuries by industry sector, 2015, Release Date: Final data released December 16, 2016. Accessed Aug 9, 2017. https://www.bls.gov/iif/oshcfoi1.htm#charts

** No data available from respective sources

industries in the U.S[1]. According to the 2015 Bureau of Labor Statistics Census of Fatal Occupational Injuries (BLS CFOI), agriculture had the highest fatality rate of all industries nationwide[2]. In 2016, there were over 54,000 reported non-fatal injuries in the agriculture industry with the highest incidence rate occurring in workers involved in hog and pig farming, which includes 'breeding, farrowing, and the raising of weanling pigs, feeder pigs, or market size hogs' (North American Industry Classification System (NAICS) Code 1122)[3]. It is important to note that these estimates, which are generally based on employer reporting, may be a significant underestimate of non-fatal injuries. The agriculture industry employs many 'seasonal' workers, migrant and undocumented workers, is comprised of a significant number of small and family-run farms not required to report to BLS, and often injuries related to work are not reported to employers due to fear of retribution – all potentially affecting data accuracy[1].

The Division of Occupational and Environmental Medicine at Michigan State University tracks work-related injury, illness, and fatalities in the State of Michigan (www.oem.msu.edu). In Michigan in 2015, there were a reported 21 fatalities and 678 work-related farm injuries[4]. Table 1. shows the incidence of traumatic work-related fatalities in Michigan as compared to the United States by industry sector in 2015.

More than half (n=11) of the 21 fatalities were operators, and four were identified as hired labor[5]. 'Hired labor' may include family members who are paid, office workers, maintenance workers, etc., but excludes contract/migrant workers. There were nine 'machine' related fatalities, with eight of the nine (89%) involving tractors[5]. Four of the eight fatalities involving tractors were the result of a rollover, with none of the tractors possessing rollover protection[5]. The other four individuals were run-over. The final 'machine' related fatality involved a teenage farm worker who became entangled in a hay elevator's chain and sprocket, powered by a tractor[5]. Other causes of death included animal (n=1), fall (n=1), homicide (n=2), motor vehicle (n=3), struck-by (n=2), suicide (n=1), and toxic exposure (n=2)[5].

In 2015 there were 678 work-related farm injuries in the state treated in the emergency department or hospitalized[4]. Farm injuries that were treated in doctors' offices or self-treated are not included in the 678 total.

The majority of injuries were to the upper and lower extremities (39% and 24.8% respectively), followed by injuries to the head (15.4%) and back (10.3%)[4]. Injuries were characterized as contusion/bruise (29.2%) followed by fractures (17.6%) and laceration/cut/ punctures (16.4%) (Figure 1)[6].

In 2004, the MSU Division of Occupational and Environmental Medicine began tracking work-related amputations in Michigan. There were 6,091 amputations statewide in workers across all industries (2006-2016)[7]. The agriculture industry in Michigan had the highest rate of amputations (2006-2015) (Figure 2), with the leading cause(s) of amputation being saws (18%), presses (12%), pinched between objects (12%), struck by an object (9%), and caught in chain/ pulley/gears/belt (9%)[7].

In its Farm Safety Fact Sheet, the Occupational Safety and Health Administration (OSHA) describes the most common health and safety hazards found on the farm, as well as risk factors for injury and illness[8]. While some of

Figure 1. Nature of Injury – Work-Related Farm Injuries, Michigan 2015
*Information on nature of injury available: 677 (99.9%)

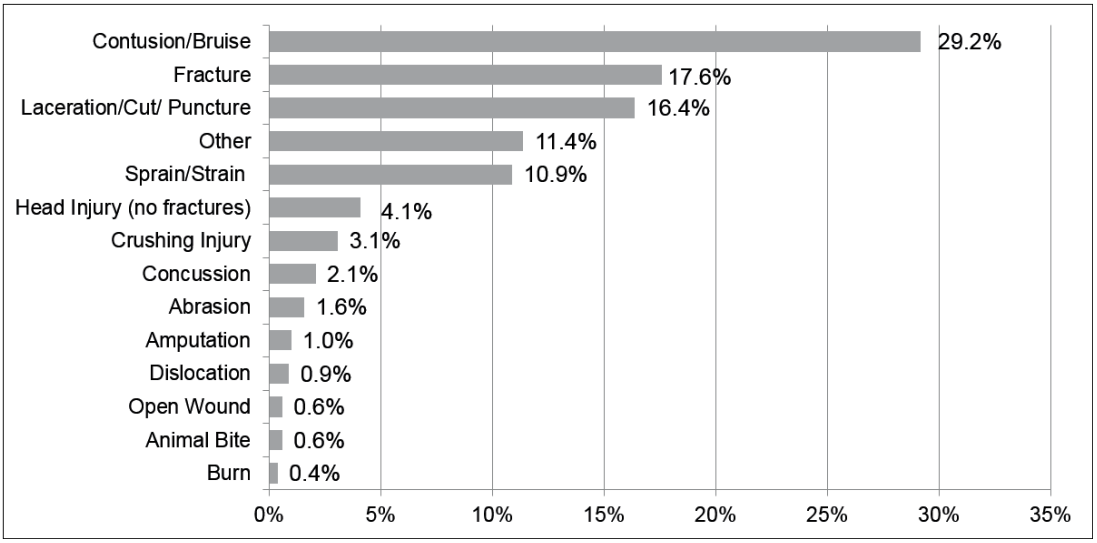
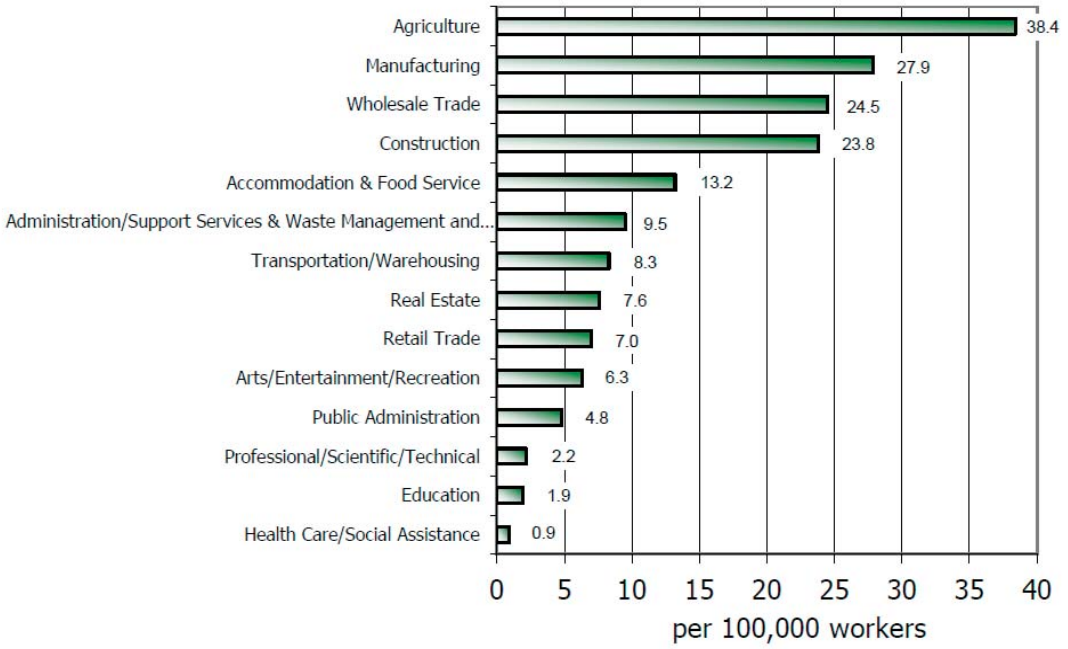


Figure 2. Work-related amputation rates by industry, 2006-2015



these risk factors may be intuitive, others may not be as obvious. Those 'new' to the industry (e.g. small-scale producers and inexperienced growers), those under the age of 15 and adults over the age of 65 (e.g. hearing loss and loss of mobility) have been reported to be at increased risk for injuries and fatalities particularly when working with machines and mechanical equipment[8]. Training, proper machine guarding, and following manufacturer's recommendations for maintenance may reduce machine/equipment related injuries and fatalaties[8]. Incorrect use or the absence of use of protective equipment is also strongly associated with injuries and fatalities. Use of equipment such as seat belts and rollover protection on tractors, and the use of personal protective equipment (i.e protective clothing, gloves, safety glasses, respirators, etc.) can also reduce the risk of illness, injury and death. In addition to making sure equipment is in good repair and employees (and family) have been trained on safety and health hazards on the farm, having an emergency action plan (EAP) in place has the potential to positively impact health and survival outcomes should an adverse event (i.e. fire, explosion, natural disaster, injury, illness, etc.) occur. The MSU Division of Occupational and Environmental Health has recently published two hazard alerts focused on safe animal handling, and preventing farm-related machinery entanglements.

Developing and implementing workplace safety and health programs costs far less than the cost of an injury, or worst case, a fatality. A safe work environment lends itself to fewer employee lost workdays, improved productivity and quality, improved morale, and a reduction in employee turnover – all positively affecting the farms bottom-line.

For assistance with identifying risk factors for employee injury and illness on your farm, as well as for support in developing and implementing safe work practices and health and safety programs, please contact your local MSU Extension Educator or Melissa Millerick-May in the Division of Occupational and Environmental Medicine at MSU (melissa.may@hc.msu.edu).

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Humane Swine Euthanasia and Human Safety - Firearms

By: Madonna Benjamin, DVM, MS[1] and Steven Howard Esq.[2]

As the most common and acceptable methods (AVMA and AASV) of euthanasia used on swine farms for grower pigs and breeding stock are firearms, (rifles and shotguns) the following discussion on firearms is in alignment with this issue of the Pork Quarterly's focus on farm safety. Co-author, Steven Howard, is a third-generation gunsmith and recognized firearms expert in 14 state and federal courts.

Overview: A basic knowledge of firearms and the ammunition is necessary to interpret both euthanasia and human safety. The following discussion will be limited to these methodologies. In the subsequent issues of Pork Quarterly, we will compare use of firearms and captive bolt for humane swine euthanasia.

1) Firearms:

Rifles: Have spiraled grooves (rifling) cut the length of the inside of the barrel. The purpose of rifling is to cause a rotational spin to the bullet on the longitudinal axis stabilizing a bullet's flight. The caliber of a weapon, is determined by the diameter of the gun's bore such as .22 (inches). Rifles are shot from the handler's shoulder and used for longer distances and precision. Projectiles (ammunition) reach speeds of 762 to 1160 m/s[1]. Rifles are the best tool for their low cost, efficiencies and ability to humanely euthanize even a larger pig.

Shotgun: Is a firearm with a smooth or rifled barrel and are fired from the shoulder dispersing shots (pellets, buck shot and slugs) at shorter distances. Velocities range from 366-396 m/s, with pellets a slower velocity than slugs. Slugs are used commonly for deer and bear hunting in highly populated areas as with the intention to reduce long range shooting accidents. Because shotguns throw out either a very large single slug, or many smaller balls they are not a particularly useful or safe tool to use in a farm euthanasia environment. Each projectile has the possibility of ricochet and causing the secondary casualty.

2) Ammunition:

An ammunition cartridge is comprised of a cartridge case, a primer, propellant and bullet (projectile). Rifle bullets consist of either a metal jacket or led. There are full metal jacket bullets, half metal jackets, and partial metal jackets. Full metal jackets are typically used for high velocity firearms, used in the military or while hunting wild game and should not be used in on-farm situations were pigs can be restrained and euthanized individually.

Shotgun cartridge (shells) are composed of a cartridge case of plastic or cardboard, a primer in the base, gunpowder, and the wadding and shot enclosed in the casing. Shell sizes are based on length and gauge. The gauge refers to the caliber size referring to the number of lead balls that can make up a pound.

Firing a firearm:

Pulling the trigger causes the firing pin to be released. The pin strikes the primer, crushing and igniting it. The metal cartridge case expands and isolates the chamber of the weapon against a backward escape of gases when fired. The primer (center fire or rim fire) is ignited and produces an intense flame through a flash hole. The flame flows through the flash hole and ignites the powder in the cartridge producing a large quantity of gas and heat. This heat and pressure expels the projectile (bullet) through the barrel. As the bullet emerges, it is accompanied by a jet of flame and gas.

A General Rule: One gram of propellant produces 1 liter of gas under high temperature and pressure[1].

Ballistics is the science of projectile travel and is expressed in a common formula describing the influences of mass of the bullet and muzzle velocity on the amount of Kinetic Energy (KE) that can be delivered to a target or tissues by a projectile. If mass of the bullet is doubled then KE on the target is doubled. However, if muzzle velocity is doubled, then KE is quadrupled.

Velocity is determined by the type of firearm, distance traveled and type or changes of media in the path[2]

Kinetic energy (foot pound) = ½ Mass * Velocity.

Four Rules of Firearm Safety (taught in all police academies). [8]

1. Always treat every firearm as if it is loaded.
2. Always keep muzzle pointed in a safe direction.
3. Keep your finger outside the trigger guard until you are ready to shoot.
4. Always be sure of your target and what is in front and behind it.

3) How tissue damage occurs:

Tissue damage can occur in three ways: 1. laceration or crushing; 2. cavitation and 3. shock waves. Laceration, affected by the characteristic of the ammunition, forms a wound cavity, where the crush and stretch forces act on the tissues. Thicker tissue such as brain and cortical bone (skull) offer great resistance, increasing the energy transfer or KE from the projectile to the tissue. In addition, cortical bone tends to fracture and fragment ideally causing more disruption of the brain. Secondary fractures of the skull occur due to the gas produced from the weapon which enters the cranial cavity and expands intracranial pressure. Therefore, euthanasia of the pig occurs when the correct amount of energy is used for the size of the animal, the additional fragmentation of bone on the brain and the disruption from the brain stem due to the shock waves.

4) The science of Ricochet:

Jed Clampett hustles the pool hustler at the "billy-ard" table saying "this is just like ricochet shootin".

Although bullets and shotgun pellets lose energy after striking a surface, they retain sufficient energy after ricochet to inflict serious or fatal injuries[3]. A national database for entry of these types of accidents on humans does not exist. There is both anecdotal evidence from other veterinarians or through conversations with farmers and forensic investigation have described individual cases to emphasize a point.

While ricochet is the most common terminology of the continued flight of a rebounded projectile, deflection is the deviation in a projectile's normal path because of an impact with some object. Of interest are the circumstances which ricochet will occur. In general, the more rigid the target the lower the angle of ricochet, compared to the angle of incidence or the source angle. However, the angle of ricochet can be greater when the bullet strikes a yielding surface. Contrary to conventional wisdom, flexible targets bend under the impact and when that surface rebounds it returns some of the energy to the projectile. In general, the trajectory of a ricochet bullet is impossible to predict. Soil for example will crater and can result in a higher ricochet angle than the angle of incidence[4]. The angle of ricochet will generally increase, but lower than the angle of incidence, as the angle of incidence increases. However, if the angle of incidence is very low and strikes a yielding surface, the angle of ricochet can be greater This theory fits with anecdotal stories of ricochet shot inside confinement facilities whereby unintended targets (persons, other pigs) are wounded in the foot or leg.

Also, solid point bullets can begin to penetrate but, depending on energy transfer and bullet quality, part of the bullet shears off and follows a separate trajectory[5]. In other situations, the bullet may fragment on impact causing fragments to spray out in a fan. Further, the surface itself might fragment, sending secondary projectiles injuries.

The shape of the bullet determines whether it will ricochet. Round nose bullets are more likely to ricochet than flat-nosed bullets and full metal jacket bullets are as likely as lead or lead alloy bullets. At short distances, hollow point or low-velocity bullets (ie shotgun) are less likely to ricochet, when compared to flat-nosed, lead or high-velocity bullets[3]. In addition, the soft-point ammunition deforms or mushrooms when entering the skull and destroys brain tissue more effectively. However, if a hollow-point bullet ricochets, it might fail to expand and penetrate more deeply than the direct shots. If animals are required to be shot from a distance, a high-velocity bullet should be used[1].

Interestingly, projectiles at low velocity are also more likely to ricochet than high velocity projectiles.

As mentioned earlier (KE = 1/2 * velocity) the kinetic energy determines the penetration of the bullet to the target. Research[4] has demonstrated a "billiard ball" effect when the leading pellets in the shot decelerate at the point of impact, as the pellets in the rear overtake the lead pellets and collide with them causing the shot string to scatter. When shotgun pellets ricochet, the pellets will spread out horizontally. For shotguns, the steeper the angle of incidence, the wider the spread of shot. Consider when the average height person aims the muzzle down toward the skull of a pig, the angle of incidence is near 45-60 degrees. With many barns having open curtain siding, this information further confirms that small children, pets and people should not be in the barn area within at least 60 yards when a rifle or shotgun is fired.

Firearms Safety: No one can call a shot back.

Source: National Shooting Sports Foundation

Once a gun fires, you have given up all control over where the shot will go or what it will strike. Don't shoot unless you know exactly what your shot is going to strike.

Clear the bore with a rod before Shooting: Bits of mud, dirt, rodents, snow, or grease in the bore can dangerously increase pressures and cause the barrel to bulge or burst on firing and injure the shooter and bystanders.

Firearms are designed, manufactured and proof tested based on standards of factory loaded ammunition. Use the correct ammunition for your firearm. Read and heed all warnings, including those that appear in the gun's instruction manual and on the ammunition boxes.
Handloaded ammunition pressure is different from pressures generated by factory loads. *The money you save is not worth the risk of possible injury*.

Examine every cartridge you put into your gun. Never use damaged, wet, lubricated or substandard ammunition or smaller gauge/caliber into a gun (ex 20-gauge shell in a 12-gauge shotgun).

A cartridge in the chamber = loaded firearm- even if it did not fire.
Occasionally, a cartridge may not fire when the trigger is pulled. If this occurs, keep the muzzle pointed in a safe direction. Keep your face away from the breech. Then, carefully open the action, unload the firearm and dispose of the cartridge in a safe way.

When shooting, wear protective shooting glasses and hearing protection. **Shooting glasses** guard against a shattered bullet, ruptured case or firearm malfunction.

Don't Alter or Modify Your Gun, And Have Guns Serviced Regularly
Your gun is a mechanical device that is subject to wear and requires periodic inspection, adjustment and service. Check with the manufacturer of your firearm for recommended servicing.

Learn the Mechanical and Handling Characteristics Of The Firearm You Are Using
Never handle any firearm without first having thoroughly familiarized yourself with the firearm you are using. Safe gun handling rules for loading, unloading, carrying and handling that firearm.

Wounds: When bullets ricochet, they may tumble and strike an unintended target in an unstable condition. This effect can cause larger and more irregular wound shape and tend to penetrate rather than perforate[6].

Advantages of firearms:

- Experienced operators can achieve a humane pig euthanasia, safely.
- Firearms and ammunition are readily available.
- High velocity ammunition of a small caliber is humanely effective.[7]

Disadvantages of firearms:

- Potentially the most dangerous of humane euthanasia of swine.
- The potential for ricochet.

5) Humane Swine Euthanasia using Firearms:

Humanely swine euthanasia can be completed from close range using a .22 caliber rifle with long-rifle mushroom shells such as a hollow point or a soft-shell lead.

The procedure should be performed outdoors whenever possible and in a location away from public access. The trajectory of a ricochet bullet is impossible to predict. People, other than the shooter, should be cleared from the area. Assistants should stand behind the shooter.

To improve euthanasia - the distance from the muzzle to the skull target should be 2-6 inches.

The barrel of the firearm should never be placed directly against the animal's skull.

As a properly euthanized animal will undergoes tonic/clonic actions, improve shooter safety by restraining the pig using a rope snare secured to a solid object.

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All comments and suggestions should be directed to the:

MSU Pork Team

Dale Rozeboom: Extension Specialist
(517) 355-8398, *rozeboom@msu.edu*

Madonna Benjamin:
Extension Swine Vet
(517) 614-8875, *gemus@cvm.msu.edu*

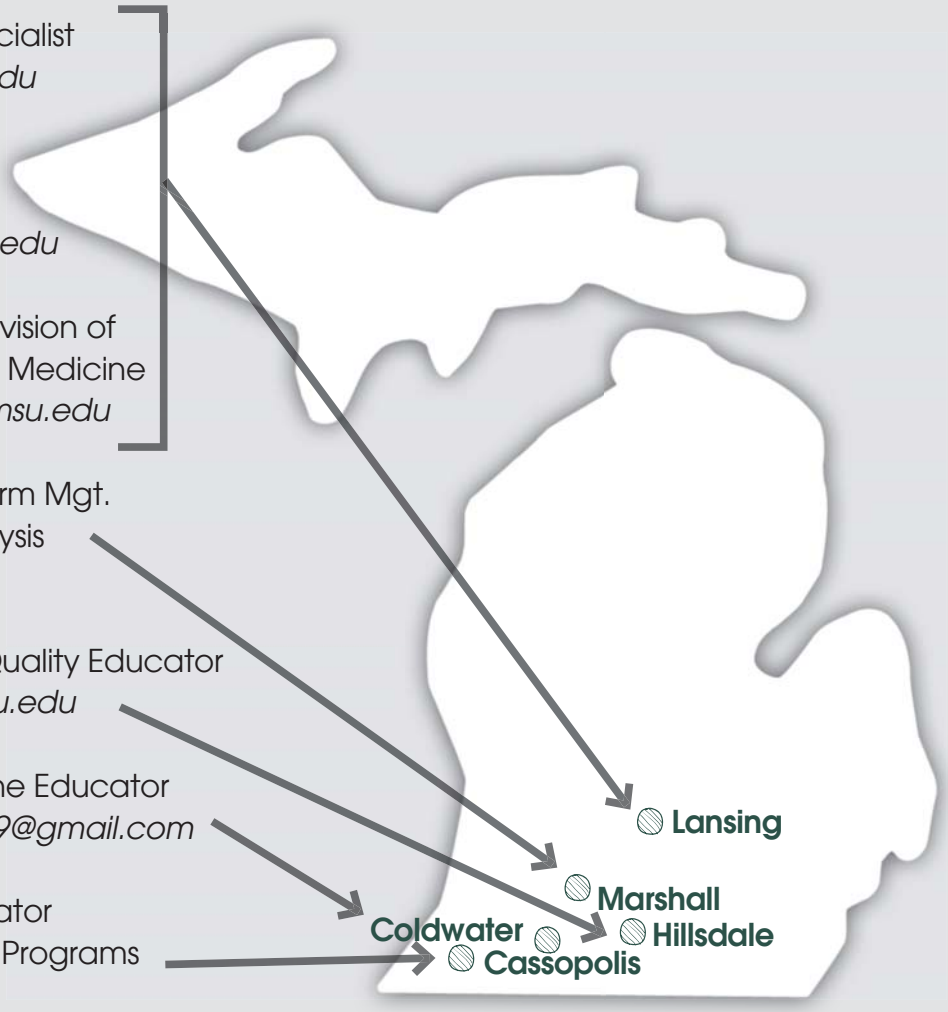
Melissa Millerick-May: MSU, Division of Occupational and Environmental Medicine
(517) 432-0707, *melissa.may@hc.msu.edu*

Roger Betz: Southwest District Farm Mgt.
Finance, Cash Flow, Business Analysis
(269) 781-0784, *betz@msu.edu*

Shelby Burlew: Environmental Quality Educator
(517) 439-9301, *bollwah1@anr.msu.edu*

Dave Thompson: Extension Swine Educator
(269) 832-8403, davethompson729@gmail.com

Beth Ferry: Southwest Pork Educator
Management, Quality Assurance Programs
(269) 445-4438, *franzeli@msu.edu*



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