

Swine Trichinae - Trichinellosis

USDA APHIS VS Career Services Program
Program Diseases Training Module

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This course is designed to provide updated information on the major domestic diseases for which Veterinary Services (VS) has program responsibility. It will provide information on surveillance, disease control and eradication for these diseases. It will also give an overview of the duties of a field Veterinary Medical Officer (VMO) as a support worker of VS animal disease programs and how they interact with other units in APHIS.

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1. DISEASE INFORMATION

a. Agent

Trichinellosis (trichinosis, trichinae) results from infection by parasitic nematodes in the genus *Trichinella*. *Trichinella* larvae localize most often in the voluntary muscles of their host.¹⁻³ The larvae are transmitted to a new host when the larvae infected meat is eaten. For this reason, infections are typically found in carnivores and omnivores such as pigs, rodents, and bears; however, most domestic, wild, and marine mammals are susceptible if they ingest larvae.¹⁻⁵ Horses can become infected if their feed contains infected dead rodents.³ Birds, including raptors, passeriform birds, and chickens are susceptible to *T. pseudospiralis*.^{4,6,7}

There are seven known species and several unnamed isolates of *Trichinella*.³ *Trichinella spiralis* (also known as T-1), is the most common species in domestic animals and is highly infective for pigs, rats, and mice.^{1,3,6,7} *T. spiralis* is also found in many other warm-blooded carnivores and omnivores worldwide.^{1,6,7} Other species found in North America include *Trichinella nativa* (T-2), *T. pseudospiralis* (T-4), *T. murrelli* (T-5), and *Trichinella* T-6.⁷ The latter four species and types are seen mainly in wildlife and have only limited infectivity for pigs.^{3,7} *T. murrelli* occurs in bears and other wildlife in the eastern U.S., while T-6 is seen in the northwestern U.S.⁷ *T. nativa* is adapted to the cold and is found in Arctic bears, walrus, and canids.^{6,7} *T. pseudospiralis* is seen in birds (including raptors, passeriform birds, and chickens) and mammals (wild carnivores, rats, marsupials, and occasionally pigs).^{4,6,7} Species and isolates that do not normally occur in North America include *T. nelsoni* (T-7) and *Trichinella* T-8 in Africa, *T. britovi* (T-3) in Europe and Asia, *Trichinella* T-9 in Japan, and *T. papuae* (T-10), which has been found only in Papua New Guinea.^{3,6}

Trichinella larvae can remain infectious for long periods of time inside meat, unless it is treated.⁵ *Trichinella spiralis* can be killed by heat or by freezing temperatures. In pork meat, it is inactivated within 47 minutes at 52° C (125.6° F), six minutes at 55° C (131° F), and less than one minute at 60° C (140° F).⁷ It is also killed by exposure to -20° C (-4° F) for eight minutes, -15° C (5° F) for 64 minutes, or -10° C (14° F) for four days, and is killed instantaneously at -23.3° C (-10° F).⁷ The cooking and freezing times actually recommended for meat are longer and take into account the potential for uneven freezing or heating.⁷

Other species of *Trichinella* are more resistant to environmental conditions. *T. nativa* and *Trichinella* T-6 are resistant to freezing.^{1-3,7} *T. britovi* also has some resistance to freezing, while *T. nelsoni* is more resistant to high temperatures than other species.³

b. Transmission

Trichinella parasites complete all stages of their development in a single host. *Trichinella* larvae most often localize in the voluntary muscles.¹⁻³ An animal becomes infected when it eats meat containing the encysted larvae. The larval cyst wall is digested in the stomach and the larvae enter the small intestinal mucosa where, over the next few days, they develop into tiny threadlike adults and then eventually mate.^{1,2,6,7} The females begin discharging larvae five to seven days after infection and can produce up to 1,500 larvae over four to 16 weeks.^{1,2}

The newborn larvae migrate through the lymph and blood to the striated muscles, where they encyst in muscle cells and mature.^{1-3,7} The larvae are attracted to muscles that are constantly active; they are often found in the diaphragm and tongue in pigs, and the tongue and masseter

muscles in horses.^{2,3} Larvae can be seen in many other tissues during their migration, including the myocardium, brain, cerebrospinal fluid, and body cavities.² In pigs, development to the infectious stage requires 17 to 21 days.⁷ In humans, encystment is completed in four to five weeks.⁶ Larvae can remain viable for years in the encysted form, but their development remains arrested unless they are ingested by a new host.^{1,2,6} *T. pseudospiralis* and *T. papuae* do not encyst and are found free inside muscle cells.^{3,6}

After a few weeks the adults are expelled or digested.^{1,7} Any immature larvae expelled in the feces are infective to other animals.^{1,2} Larvae can also be transmitted through the placenta in mice and humans, but not in pigs.⁴

c. Clinical signs

If an animal is infected by large numbers of *T. spiralis*, it may develop diarrhea, anorexia, fever, weakness, or myositis accompanied by a reluctance to move.⁴ Most infections in domestic animals are asymptomatic or undiagnosed.^{1,4} The pathogenicity of all species of *Trichinella* has not been studied.

d. Epidemiology

Most infections are seen in carnivores and omnivores, which become infected with *Trichinella* when they feed on infected rodents or other hosts.⁶ Infected animals develop strong and persistent immunity and are at least partially resistant to reinfection.⁷

In the U.S., the most important risk factor for domestic pigs is exposure to rodents and wildlife.⁷ Rodents, particularly rats, act as both reservoir and maintenance hosts for trichinae.⁷ Rats are omnivores and they become infected when they consume infected carrion. Pigs, in turn, will eat both live and dead rats. Pigs allowed to browse outdoors may also eat the infected carcasses of other wildlife; among small mammals, *Trichinella* is particularly common in raccoons, skunks, and opossums.⁷ Other risk factors for domestic pigs are the feeding of contaminated animal products, particularly undercooked meat scraps, and cannibalism within an infected herd.⁷ Transmission methods such as tail biting or coprophagy are not important in maintaining infections among pigs.⁷

e. Diagnosis

Trichinellosis can be diagnosed by microscopic detection of larvae in the muscles and by serology.³ Although muscle biopsies can be taken from the tongue or other muscles, serology is generally preferred in live animals.^{1,3} Testing by both serology and direct inspection of the muscles can be used at slaughter.³

Larvae can be found in the muscles of infected pigs or horses as soon as 17 days after exposure.^{3,7} In pigs, the diaphragm and tongue usually contain the most larvae, followed by the masseter and abdominal muscles.³ During meat inspection, muscle samples are usually taken from the pillars of the diaphragm or from the tongue in pigs.³ Samples for trichinoscopy are usually taken from the pillars of the diaphragm (crus).

Two techniques, compression and digestion, are used to concentrate the larvae. In trichinoscopy, compressed pieces of muscle tissue are inspected for larvae with a specialized microscope, the trichinoscope. Trichinoscopy can detect as few as three to five larvae/gram of tissue but is time-consuming, as multiple samples should be inspected from each carcass.³ It is

much more efficient in detecting encysted than free larvae and may miss *T. pseudospiralis*.³ In the digestion technique, individual or pooled muscle tissue samples are digested then selectively screened, filtered, or sedimented and examined microscopically for larvae. The digestion methods can detect approximately three larvae/gram of tissue, when 1 gram of tissue is sampled.³ If the animal is infected with fewer than three larvae/gram of tissue, conventional direct methods are not reliable.³ The absence of larvae does not rule out trichinellosis.¹

Only one serologic test, the enzyme-linked immunosorbent assay (ELISA), is commonly used.³ Although this test uses *T. spiralis* antigens, these antigens are conserved in all species and types of *Trichinella*.³ The ELISA is used for both pre-and post-slaughter testing and is very useful for detecting and monitoring infected herds.⁷ It can detect as few as one larva/100 g of tissue and the false positive rate is low.³ False negatives may be seen in recently infected pigs with low parasite burdens.^{1,3} Serology may be of limited use in horses, as their titers may decline within a few months as the number of larvae in the muscles diminishes.³ In pigs, titers do not decline for at least 6 months after infection.³ The efficacy of serology for game species is not known.³

f. Prevention and control

Trichinellosis can be controlled by eating (or feeding) only meat products known to be safe, or by destroying the larvae before ingestion. Human trichinellosis is prevented by meat inspection, processing of pork products to destroy the larvae, and/or prevention of exposure in domestic animals used for meat.^{3,7} Treatment is usually impractical in animals and vaccines are not available.^{1,3,4}

In the U.S., humans are generally exposed when they eat infected game species or pigs.⁸ Pigs usually become infected when they eat rodent carcasses, infected wildlife, or meat scraps in undercooked food waste, and when they cannibalize infected swine carcasses.^{7,9} Pigs should not be fed uncooked or undercooked waste products, table scraps or animal carcasses, particularly from wildlife.^{7,9} Care must be taken to maintain a clean production environment that does not attract wildlife or rodents.⁹ There should be barriers to separate the pigs from skunks, raccoons and other small mammals, and an effective rodent control program should be in place.⁷ Good hygiene should include the removal of dead pigs as soon as they are found, secure storage of feed, and the prevention of clutter in barns.⁷

Documentation of trichinae-safe management practices can be a viable alternative to meat inspection.¹⁰ The VS Trichinae Certification Program is a voluntary program to certify herds with management practices that minimize the risk of infection with *T. spiralis*. Trained veterinarians periodically audit participating farms to document the absence of risk factors for *Trichinella*. To verify the absence of *Trichinella*, a statistical sample of the national certified herd is tested regularly at slaughter.

Human infections can also be controlled by meat inspection or meat processing.^{3,7,10} Although many countries require pigs to be tested for *Trichinella* at slaughter, the U.S. has relied on commercial processing of pork products and warnings to consumers to cook fresh pork.⁷ *T. spiralis* can be destroyed by cooking, freezing, or irradiation, as well as curing under some conditions.^{3,7,10} Smoking, salting, or drying of meat is not usually effective.² The U.S. Code of Federal Regulations requires processed pork products to be cooked for two hours at 52.2° C (126° F), 15 minutes at 55.6° C (132° F), or one minute at 60° C (140° F).⁷ Pork intended for

use in processed products must be frozen for 106 hours at -17.8° C (0° F), 82 hours at -20.6° C (-5° F), 63 hours at -23.3° C (-10° F), 48 hours at -26.1° C (-15° F), 35 hours at -28.9° C (-20° F), 22 hours at -31.7° C (-25° F), eight hours at -34.5° C (-30° F), or 30 minutes at -37.2° C (-35° F).⁷ The U.S. Department of Agriculture also recommends that fresh pork be cooked by the consumer to an internal temperature of 71° C or 160° F.⁷ These recommendations allow for cooking methods which may not result in evenly heated meat but it should be noted that, in microwaves, heating to 77° C (171° F) or 82° C (180° F) does not completely destroy trichinae.⁷ Game should be tested or cooked completely to kill *Trichinella* species.³ Freezing does not reliably kill some of the species found in game, including *T. nativa* and *Trichinella T-6*.^{2,3}

According to the World Organization for Animal Health (OIE), a country can be considered free from trichinae in domestic pigs when trichinellosis has not been reported for five years and has been shown to be absent from wildlife by surveillance.⁷ Human and animal trichinellosis must be notifiable and a disease reporting system must be in place. In addition, a statistically significant sample of domestic pigs must have been tested regularly. Although the U.S. has an extremely low incidence of trichinellosis in pigs, this disease is reportable only in humans in most states, and there is no regular testing program to detect *Trichinella* in pigs.⁷

g. Public health consequences

Humans are accidental hosts for *Trichinella*, and are usually infected when they eat improperly processed meat from infected animals.⁶ All species of *Trichinella* can cause human disease.^{2,3} The symptoms depend on the dose and range from inapparent infections to severe or fatal disease.⁵ The initial invasion of the intestines may cause diarrhea, abdominal pain or cramps, malaise, and occasionally vomiting, 1-2 days after ingestion of the parasite.^{2,4,6} The larval migration to the muscles can cause systemic symptoms, including periorbital and facial edema, conjunctivitis, ocular pain, photophobia, fever, headaches, myalgia, splinter hemorrhages, pruritus, or rashes; systemic symptoms usually develop 2-4 weeks after infection and can last for 2 months.²⁻⁶ Occasionally, serious sequelae, including myocarditis, neurologic signs, and pneumonitis may occur. Encystment may be accompanied by myalgia and weakness, and is usually followed by recovery; serious sequelae can still be seen during this period.^{2,6} Death can occur in severe cases, usually as the result of the myocarditis or anaphylactic shock.^{3,4} In light infections, there may be no clinical signs.⁶ Several effective drugs are available and treatment should begin as soon as possible.⁶

Human infections from pork can be prevented by animal rearing under good production practices, meat inspection, processing of pork products, and consumer education.¹⁰ The risk of infection from domestic pork is low, as the parasite is found at very low levels in commercial U.S. swine.^{7,10,11} In the U.S., the number of human cases of trichinellosis reported to the Centers for Disease Control and Prevention (CDC) fell from approximately 500 per year in the 1940s to fewer than 50 per year in the 1990s.^{7,12} Currently, fewer than 25 cases are reported each year and many of these cases are traced to non-commercial pork or game meats such as bear.^{7-9,11,12}

h. Economic impact

Although the public perceives trichinae as a problem, the parasite is found at very low levels in U.S. swine.⁷ Therefore, there is currently little direct cost to the producer due to the parasite

and the main economic impact is in a reduced world market for pork. U.S. pork may also be subject to international trade barriers.⁷ The pork industry is likely to benefit from a program to document the absence of *Trichinella* in pigs.⁷ Canadian pigs are *Trichinella*-free, except in part of Nova Scotia. According to Canadian animal health personnel, this freedom from infection has been instrumental in the \$1 billion annual export market and 28 kg (61.6 lbs) per capita annual consumption of pork.⁷ U.S. efforts to certify pork as trichinae-free could increase international exports, and is likely to increase the perceived safety of pork in domestic markets.^{7,11}

An estimated 90-95% of U.S. pork production sites could meet the certification requirements of the VS Trichinae Certification Program with minimal facility changes.¹¹ The average cost is expected to be approximately \$500 over a five year period.¹¹ The least prepared sites would be expected to meet the requirements with an input cost of \$2500 over 5 years. One alternative to an on-farm certification program, a slaughter inspection program, would be more costly. In 1997, the European Union spent \$572 million on inspection for *Trichinella*.⁷

2. HISTORY OF THE DISEASE AND CONTROL PROGRAMS

Trichinella spiralis was first seen in the muscles of autopsied human patients in the 1820s and 1830s.² In 1846, Joseph Leidy reported that he had discovered very similar larvae in pigs. Transmission studies demonstrating the parasite's life cycle were followed, in the late 19th century and early 20th century, by the realization of the public health dangers of pork.² Although estimates vary, at least 2.5% of the swine in the United States were infected with *Trichinella* at the beginning of the 20th century.⁷ A 1943 National Institutes of Health study reported that 1 out of every 6 people in the U.S. had also been infected.⁷ Fear of this parasite led to a strict federal code for ready-to-eat pork products in the U.S. and meat inspection requirements in Europe.⁷

During the last 50 years, management changes in the pork industry have led to a dramatic decline in the number of infected pigs.^{7,11} Garbage cooking laws passed to control vesicular exanthema in 1953-1954 and hog cholera in 1962 concurrently suppressed the transmission of *Trichinella*.⁷ Increased biosecurity and hygiene in pig raising were also important in reducing pigs' exposure.⁷ In the 1990s, regional studies found *T. spiralis* in 0-0.5% of U.S. pigs.^{7,12} The 1995 USDA National Animal Health Monitoring System (NAHMS) national swine survey disclosed an overall infection rate of 0.013%, down from the 0.16% prevalence reported in 1990.^{7,9} The same USDA national survey in 2000, demonstrated that the infection rate in U.S. swine had fallen to 0.007% (Eric Bush – Personal Communication). The prevalence of this parasite has also dropped internationally. Some countries with long-standing meat inspection programs, such as Denmark and the Netherlands, are essentially *Trichinella*-free.⁷

However, consumers still question the safety of commercial pork.⁷ Many consumers overcook pork due to fears over *Trichinella* while some undercook it, leading to a potential risk of infection.¹¹ The absence of a *Trichinella* control program in the U.S. also creates difficulties in marketing fresh pork internationally.⁷ In 1994, in response to these concerns, the U.S. began the National Trichinae Research Project (NTRP).^{7,10} This project was a collaboration between the National Pork Producers Council (NPPC), industry groups, and USDA's Agricultural Research Service (ARS), Animal and Plant Health Inspection Service (APHIS) and Food Safety and Inspection Service (FSIS). The project generated a model for herd certification based on good

production practices (GPPs) and systematic monitoring of pigs.⁷ GPPs are management practices which prevent pigs from becoming infected with *Trichinella* or reduce their risk of exposure. In the certification model, trained veterinarians document GPPs during periodic farm audits and certified herds are monitored periodically by tests at slaughter.

A pilot trichinae herd certification study was executed in Iowa, Minnesota, and South Dakota.¹⁰ USDA accredited veterinarians audited 198 producers, using 55 questions to determine the risk of exposure to *Trichinella*. All pigs from these sites were tested for *Trichinella* at slaughter. No *Trichinella*-positive pigs were found by either serology or diaphragm digestion, in more than 220,000 samples collected over a six month period. Although few producers met all of the criteria for risk-free management, particularly a regular rodent control program, more than 85% would be expected to meet these standards with minor changes in management.¹⁰ An improved, more succinct audit was developed, based on the results of this study. The new audit was used in large-scale pilots in packing plants receiving pigs from Iowa, Minnesota, Nebraska, and South Dakota.¹⁰ This large-scale pilot program is expected to lead to a voluntary national trichinae program.

3. CURRENT CONTROL PROGRAM

The Trichinae Certification Program is a voluntary pre-harvest pork safety program. It is designed to certify herds which, due to their management practices, have little risk of being infected with *T. spiralis*. Veterinarians trained in good production practices for trichinae conduct periodic audits on participating farms to evaluate the risk factors for infection. A statistical sample of the national certified herd is tested regularly at slaughter to verify the absence of *Trichinella*. USDA veterinarians also conduct random "spot audits" of certified herds to ensure compliance with program regulations.

a. Audits

A pre-audit package with information on the certification program is available from qualified accredited veterinarians, state and federal animal health offices, the National Pork Board, and APHIS.¹³ Once a producer feels that the program standards have been met, he/she can contact a qualified accredited veterinarian (QAV) and request an official stage I audit.¹³ If a qualified accredited veterinarian is unavailable, the producer can request an audit through APHIS; in this case, a qualified veterinary medical officer (QVMO) will do the audit. In either case, the producer is responsible for the audit fee.¹³ The producer or a representative is expected to accompany the auditor during the audit.

Sites will be audited continually on a regular schedule to document that the standards have been implemented and maintained to ensure that the swine on site have been raised under the Good Production Practices of the program. To guide the certification process and to establish the auditing schedule, three stages (I, II, and III) have been established within the program.

b. Good production practices for trichinae

1. All non-breeding swine entering the site have either originated from certified pork production sites or, in the case of swine less than five weeks old, have originated from either a certified or non-certified pork production site. The

source herd Trichinae Identification Number (TIN) must be documented in an animal movement record.

2. Sources of feed or feed ingredients meet Good Manufacturing Practices, as defined in this program or quality assurance standards recognized by the feed industry and documentation to this effect is maintained at the site.
3. Swine feed supplies at the site must be prepared, maintained and handled in a manner such that the feed is protected from possible exposure to or contamination by rodents or wildlife. Rodent control procedures must be in place and maintained in the interiors and around the exterior of the swine feed preparation and storage facilities. An up-to-date rodent control logbook documenting these practices is maintained at the site.
4. Exclusion and control of rodents and wildlife at the site are to a level such that fresh signs of activity of these animals are not observed in the swine production or feed preparation and storage areas. Rodent control procedures must be in place and maintained in the interior and around the exterior of the swine housing and feeding facilities. The producer maintains at the site an up-to-date rodent control logbook with a site diagram, or maintains comparable records from a Pest Control Operator. All records are updated on at least a monthly basis. In addition, domesticated animals including pets such as dogs and cats, must be excluded from the swine housing and feeding areas and feed preparation and storage areas at the site.
5. Wildlife carcasses are not intentionally fed to swine. Swine shall not have access to wildlife harborage or dead or live wildlife at the site. This harborage limitation includes wood lots and other natural wildlife access areas.
6. If meat-containing waste is fed to swine, the pork production site must hold a State license to feed such waste. Cooking times and temperatures must be consistent with State and Federal regulations and up-to-date records of waste feeding and cooking practices must be maintained at the site. Cooked waste products that are stored prior to feeding must not be contaminated with uncooked material. Uncooked household waste must not be fed to swine.
7. Procedures are in place and are carried out that call for the prompt removal and proper disposal of swine carcasses found in pens in order to eliminate the opportunity for cannibalism, as well as to prevent attraction of rodents or wildlife. These procedures must be documented in an animal disposal plan.
8. General hygiene and sanitation of the production site is maintained at all times such that rodents and wildlife are not attracted.

- Solid waste (facility refuse) must be contained in covered receptacles and regularly removed from the site to prevent rodent and wildlife access and attraction.
 - Spilled feed must be regularly removed and properly disposed of.
9. Animal arrivals and departures from the site must be documented in an animal movement record and take place in a manner that ensures that swine can be traced to/from that particular certified production site.
 10. All records required under the Trichinae Certification Program must be up-to-date and must be readily available for inspection at the enrolled or certified pork production facility.

Once the audit is complete, both the auditor and the producer sign the form and the auditor submits it to the APHIS Area Office for review.^{9,13} If the site meets all GPPs, the producer can expect to receive herd certification within 30 days.¹³ The producer must continue to meet the program standards and good production practices between audits.

c. Program stages

Sites with an initial audit approved by APHIS are given Stage I (enrolled) status.^{9,13} Stage I status indicates that the premises maintain the trichinae Good Production Practices and is officially enrolled in the trichinae program. Pigs from stage I sites cannot be sold as trichinae certified.^{9,13}

Stage I sites must have a second audit between 5 and 7 months after entering stage I.^{9,13} The audit is reviewed by APHIS and, if it is approved, the site is given stage II (certified) status. Swine from stage II sites can be sold as trichinae certified.^{9,13}

Stage II sites must have a third audit between 8 and 10 months after entering stage II.^{9,13} Once the audit has been approved by APHIS, the site is issued stage III (certified) status. Swine from stage III sites can also be sold as trichinae certified.^{9,13} Stage III status is renewed at 14-16 month intervals with another audit.^{9,13} If a producer does not request and submit a new audit, the site loses its certification. If a stage II or III premises or swine are sold, the site must be re-audited within 60-days of the transfer.¹³ Premises and herds that lose their certification must start over again.

d. Spot audits

Certified production sites are randomly spot audited to ensure that GPPs are being maintained between audits, confirm the results of regular audits, and verify that audits are conducted consistently across the program.^{9,13} A qualified veterinary medical officer (QVMO) conducts the audit, at no charge to the producer, and submits the completed audit form to APHIS. If the audit is approved, the site receives a continuation of its certified status.

e. Pigs sold as trichinae certified pork

The certified production site identification must be maintained for pigs from stage II and III herds that are sold to other producers, buying stations, or slaughterhouses.^{9,13} This information is documented in a generic animal movement record.¹³ Pigs sold as certified pork, as well as their pork products, must be segregated from animals and products from non-certified sites.^{9,13}

Slaughter facilities are responsible for testing for *T. spiralis* and for verifying that the producer's certification is current.^{9,13} Testing is done on blood, serum, meat juice, or muscle samples collected during slaughter. The official tests include both serology and the direct detection of larvae by the digestion method. Testing can be done on site or the samples can be sent to a USDA approved laboratory. Packers must keep records on pigs from certified production sites, including their Trichinae Identification Numbers and test results.

If *Trichinella* is found in a slaughtered animal by digestion methods, the certified site is removed from the program.^{9,13} If seropositive animals are retested by digestion methods and larvae are found, the site is also decertified.^{9,13} If the ELISA alone is positive, APHIS personnel investigate the site and test additional animals.^{9,13} If any more positive animals are found either by serology or digestion testing, or if the management practices do not meet the program standards, the site is decertified.

f. Training for qualified accredited veterinarians

Accredited veterinarians can become auditors in the Trichinae Herd Certification program after training by APHIS or its designee(s).¹³ Qualified accredited veterinarian (QAV) status must be renewed every 2 years. Only qualified accredited veterinarians or qualified VMOs can conduct audits.

4. CONTROL PROGRAM STATUS

The current pilot program is expected to lead to a nationwide trichinae program.

5. ROLES AND RESPONSIBILITIES OF THE FEDERAL GOVERNMENT, STATES, INDUSTRY AND PUBLIC HEALTH OFFICIALS

The National Trichinae Certification Program was developed by the National Pork Board, the pork processing industry, and various USDA programs including APHIS, Agricultural Research Service, Cooperative States Research, Education and Extension Service (CSREES), and Food Safety and Inspection Service (FSIS).¹³

USDA distributes information about the program, trains accredited veterinarians to become QAVs, reviews and approves audits, and keeps records on certified production sites, QAVs, and the test results on slaughtered swine.^{9,13} Qualified VMOs conduct random spot audits, as well as routine audits if a QAV is not available.

Producers are responsible for requesting audits, maintaining Good Production Practices between audits, and informing processing plants of any change in status.¹³ Producers must keep records of any information needed for an audit, such as a Feed Production Log, Feed Manufacturer's

Quality Assurance Verification, Rodent Control Log or Pest Management Professional's Log, Disposal Plan, Animal Movement Record, and Waste Feeding Log.⁹

Trichinella testing is the responsibility of slaughter plant personnel and is overseen by FSIS.¹³ Slaughter facilities must test a designated number of swine from certified production sites each year, based on the yearly processing capacity of the plant and the percentage of swine originating from certified sites.¹³ Testing can be done on site or the samples may be submitted to a USDA approved laboratory.¹³ The APHIS Administrator can request that pigs from specific site be tested.¹³

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