

# Phase 1 Scrapie Incentive Program Summary

## Background

Since 1952, Veterinary Services (VS) has worked to control and eradicate scrapie in the United States. The scrapie program goals are to eradicate classical scrapie from the United States and to meet World Organisation for Animal Health (WOAH) criteria for disease freedom. In 2001, VS modernized the National Scrapie Eradication Program, which has reduced scrapie prevalence in the national herd (calculated using data from fiscal year (FY) 2017 through FY 2021) to <0.005 percent in sheep and <0.017 percent in goats. This low prevalence requires additional surveillance efforts to detect the remaining cases, such as increased targeted sampling (sampling subpopulations with a higher prevalence than the general population).

The VS Surveillance Design and Analysis (SDA) unit completed an internal evaluation of the scrapie surveillance system in March 2018. The evaluation included multiple recommendations to meet surveillance metrics. One recommendation was to develop a risk-based system for targeted sampling efforts to support eradication. SDA formally elicited input from a group of seven experts with field scrapie experience to create a points system. SDA worked with the Sheep and Goat Team (SGT), using its knowledge of the United States' current scrapie status and of running a scrapie surveillance program, to develop a system to incentivize submitting samples from higher-risk animals and animals from higher risk farms based on the expert-elicited points system. This paper describes an incentive system that provides risk-based credit based on animal-level risk factors (Phase 1). Credit based on farm-level risk factors will be incorporated in FY 2023 (Phases 2 and 3).

A true points system assigns point value to an animal or farm based on risk factors. Points measure relative risk adjusted for the frequency of occurrence of the risk factor in the general population. When mathematically evaluating the probability of disease detection, points can be used in place of sample size; that is, sampling one two-point animal equals sampling two one-point animals in probability calculations. SDA's expert elicitation resulted in an estimated points system that targeted sampling efforts differentially to animals or to flocks/herds with the greatest likelihood of infection according to expert experience and expectation. The system assigned points to individual animals based on the expert-identified factors predictive of scrapie in sheep and goats and assigned points to farms based on farm-level factors predictive of scrapie in sheep flocks and goat herds. For some factors, practical experience suggested that the incentive or disincentive provided by the expert-elicited points would be inadequate for targeted sampling efforts or inappropriate to support the goal of scrapie eradication. SGT and SDA therefore adjusted the expert-elicited points system in some categories to provide risk-based credit more likely to encourage sampling of animals and farms with the highest surveillance value. The incentive system does not discourage submissions in some categories the way the expert-elicited points system would have.

Implementing Phase I of the incentive system during FY 2022 will provide extra sample credit for samples from animals of specific age categories showing clinical signs (see [Footnote 3](#) for definitions) compatible with scrapie as these animals have the greatest likelihood of infection. This will encourage States and VS field offices to conduct awareness programs with veterinarians and producers to get them to submit clinical animals, particularly those that are 24 to 72 months of age. Phases 2 and 3, which will

be implemented in FY 2023, will provide incentives for sampling animals according to farm-level risk factors.

## Current surveillance system

Currently, every sheep and goat tested for scrapie is counted as one surveillance sample, whether the animal is submitted through live or dead on-farm testing or Regulatory Scrapie Slaughter Surveillance (RSSS), and regardless of its genotype.

*On-farm surveillance:* Includes both regulatory testing of scrapie-exposed and potentially exposed sheep and goats and testing sheep and goats on-farm for routine surveillance. On-farm surveillance consists of samples from animals tested on a premises for one of the following reasons:

- 1) Scrapie Flock Certification Program (SFCP) - to obtain certification or monitored status.
- 2) Post Exposure Monitoring and Management Plan (PEMMP) – samples from a flock previously infected with or exposed to scrapie and currently under a monitoring and management plan.
- 3) Voluntary on-farm surveillance (not part of SFCP) of mature sheep or goats that die from unknown causes or have signs compatible with scrapie, live animal testing of susceptible sheep or goats in flocks with risk factors for scrapie, or from sheep and goats that reside in States that cannot meet their sampling minimums through other methods.
- 4) Disease investigations.

For routine live animal surveillance, sheep are typically genotyped through a blood sample taken prior to or at the same time as the collection of rectal biopsy samples to reduce the costs associated with immunohistochemistry (IHC) testing. Genotyping is performed before IHC testing and any resulting RR or QR<sup>1</sup> sheep result in one surveillance sample counted towards the State's sample minimum requirements without scrapie testing due to their genetic resistance/decreased susceptibility. The laboratory will test IHC scrapie samples for sheep with a QQ-genotype<sup>2</sup> and the State also receives one surveillance sample credit for each QQ sheep that is IHC tested.

*Regulatory Scrapie Slaughter Surveillance (RSSS):* The RSSS samples mature sheep and goats slaughtered or condemned at participating slaughter facilities, as well as dead or disabled animals found at other concentration points, such as markets and cull feedlots. Every sheep or goat sampled through RSSS is worth one surveillance sample. In most cases, genotyping is only performed if a submitted sample tests positive for scrapie. In a 2019 pilot project, RSSS samples collected at several slaughter plants were genotyped prior to scrapie IHC testing of those samples found to be genetically susceptible. Results (May 2021) demonstrated cost savings and RSSS genotyping prior to scrapie testing will be continued indefinitely for heads submitted to the Indiana and Michigan VS collection sites. This is a relatively small number of animals and is not likely to increase because only a few sites could manage the sampling process in a cost-effective manner. For reference, in FY 2019-2021, 8,065 sheep were genotyped and 5,809 (72 percent) of these animals were not genetically susceptible.

## Surveillance system using risk-based credits

The implementation of the scrapie surveillance sample incentive system will occur in three phases. Phase 1, which this paper describes, will partially implement the incentive system by focusing only on assigning risk-based credits according to individual animal risk factors. These credits will be computed with data already being captured in the Data Integration System (DIS) during sample collection and the laboratory test submission and resulting process. These *additional* credits will only be applied if the tests are deemed valid by the laboratories on at least one tissue.

<sup>1</sup> As used in this document QR refers to any genotype that includes one R at codon 171, such as HR or KR.

<sup>2</sup> As used in this document QQ stands for any genotype at codon 171 that does not include R, such as QH, QK, KH, HH or KK.

Phase 2 entails creating and approving farm survey questions and additional fields to capture information needed to assign risk-based credit according to farm-level risk factors. Phase 2 will also ensure data management of newly collected information in DIS and apply rules for receiving credit based on animal-level and farm-level risk factors. Phase 2 is expected to be completed by end of FY 2023.

Phase 3 will fully implement the incentive system using both animal and farm-level risk factors to incentivize collecting high-value surveillance samples. Once implemented, it will incentivize collecting sheep and goats with characteristics making them more likely to be infected by scrapie as well as sampling sheep and goats from farms with characteristics that make the flocks and herds more likely to be scrapie-affected. Phase 3 is expected to begin in FY 2023.

## Phase 1

Starting October 1, 2021, SGT will use data already acquired during the sample collection and laboratory submission process for all on-farm and RSSS scrapie testing to assign risk-based credits for individual animal scrapie tests. The Center for Informatics (CFI) is designing an algorithm to automate this process; VS expects the algorithm to be fully functional by early summer. The incentive system encourages sampling of animals with a higher risk of scrapie, ultimately improving scrapie eradication efforts by focusing surveillance sampling on higher-risk animals and herds while helping States meet their yearly surveillance minimums, especially in those States that struggle to hit that yearly goal. The incentive system will only apply additional credits for animals where at least one tissue submitted has a valid result as determined by the testing laboratory (for example, if there are insufficient follicles in a rectal biopsy sample or the incorrect tissue or location is submitted for both the retropharyngeal lymph node (RLN) and obex, no additional credit will be assigned regardless of the animal-level factors). Zero points will be assigned for samples not received by the lab.

### Risk-based credits for animal-level factors

Credits (see [Table 1 and Table 2](#)) will be assigned for individual animal risk factors: age, clinical signs, and for on-farm testing for sheep with susceptible genotypes (such as QQ) when the owner knows the genotype of the animals before sampling. One risk-based credit in the new system is the equivalent of one surveillance sample in the current system. For example, if an animal were assigned 30 risk-based credits, it would be the equivalent of testing 30 animals in the current system. Sheep and goats will be given the same credit for the same risk factors. This system encourages reporting and testing of clinical suspects in the most likely age groups and discourages (by providing credit less than one) testing animals not in the targeted groups that have a very low likelihood of infection, such as the very young or the very old.

### *Clinical Signs*

Mature animals exhibiting clinical signs compatible with scrapie are more likely to be infected than apparently healthy animals. The expert elicitation determined three categories for clinical signs: [Classic clinical signs](#), [less specific clinical signs](#), and no clinical signs ([Footnote 3](#)). SGT will award risk-based credits for the classic clinical signs category only with approved documentation. A video or detailed description of observed clinical signs must be submitted by the animal health official to the

[scrapie@usda.gov](mailto:scrapie@usda.gov) email address for SGT concurrence. SGT and VS appreciate video submissions and will use them for training presentations. Mature animals exhibiting clinical signs typically qualify for indemnity.

Only on-farm testing will receive additional credits for submissions from age-appropriate animals ([age indicators](#)) exhibiting less specific clinical signs. Samples collected from age-appropriate animals through slaughter channels will continue to receive credit for one surveillance sample per animal with no additional credit for animals exhibiting less specific clinical signs. RSSS animals exhibiting classic clinical signs are eligible for the additional credit if the SGT receives video documentation or detailed descriptions of clinical signs observed by the animal health official or the animal is over 12 months and condemned by FSIS for CNS signs (see [Table 2](#)). Incentive credits for sampling any one sheep or goat will be capped at 30 percent of the State's annual minimum sample requirements.

### *Age*

According to the expert elicitation panel, literature, and historic data provided by the SGT, animal age is strongly associated with presentation of clinical signs for scrapie-infected animals. Using current Sheep and Goat Program policy for age-appropriate animals as the foundation, the DIS algorithm will use seven age categories to calculate the incentive credits: Less than 12 months, 12 to <18 months, 18 to <24 months, 24 to <36 months, 36 to <48 months, 48 to <72 months, and greater than or equal to 72 months.

Very young animals (less than 12 months) that do not have additional tissues collected as part of the lamb protocol are very unlikely to have scrapie detected and should not be sampled for routine surveillance. Animals 12 months to 18 months of age are unlikely to have had time to be clinically affected with scrapie but should be tested if they present clinical signs. Animals between 18 months and 6 years of age are the most likely to have scrapie detected and should be tested regardless of clinical signs. Those presenting classical or less specific clinical signs should be preferentially sampled on-farm over those with no clinical signs. Testing animals presenting classic clinical signs is especially valuable for animals in the 3- to-5-year range as this is the period when clinical signs are most likely to occur. Most animals are infected with scrapie at or near birth. Animals infected at or near birth rarely live more than 72 months, so very old animals are less likely to be infected with scrapie. Animals exposed to scrapie after weaning are less likely to become infected, but it does happen and can result in animals over 72 months of age presenting with clinical scrapie.

### *Genotype*

This section pertains only to sheep. At this time, all goat genotypes are considered genetically susceptible for regulatory purposes; however, there is evidence that goats having a single copy of one of three goat prion gene alleles, D146, S146, or K222, may be less susceptible to scrapie. The majority of RSSS sheep are not genotyped. Positive scrapie cases are genotyped, but there is no opportunity for incentivizing sampling of QQ genotypes in this situation. Genotyping prior to scrapie testing cannot be widely applied across slaughter facilities, so the incentive system does not include risk-based credit for the susceptible genotype animal collected through RSSS.

For States that struggle to meet their scrapie surveillance State minimums, the current practice is for the State to identify a flock for sampling and submit up to 30 samples for scrapie testing along with blood samples for genotyping. The lab makes a "submit/don't submit" decision after running all blood samples; only corresponding samples from QQ sheep are processed for scrapie testing. All sheep determined to have a QR or RR genotype receive one credit. There is no opportunity to incentivize

sampling of QQ genotypes in this process, so these sheep will continue to get one credit once their samples have been submitted for testing.

If the owner knows the genotypes of their sheep and can select the QQs for testing, 4 risk-based credits will be given for each QQ sheep 18 months or older presenting no clinical signs to a maximum of 40 credits per flock. If one or more of these QQ sheep displayed clinical signs they would get the higher of the clinical sign credits or the genotype credits. Risk-based credits for clinical signs would follow [Table 1](#). No risk-based credits would be given for rectal biopsy tissue submitted from live nonclinical sheep known to be QR or RR prior to VS genotyping them; these animals should not be genotyped or biopsied. Dead animals of any genotype will receive the credits listed in [Table 1](#).

### Laboratory Submission

The Veterinary Services Laboratory Submissions (VLS) process for submitting the samples to the laboratory remains the same for RSSS samples, though to receive additional credit for animals exhibiting classic clinical signs, the submitter must submit the animal as a clinical suspect and put the Food Safety and Inspection Service (FSIS) condemnation tag's number in one of the secondary ID fields. There is one small but important change to the VLS process for submitting on-farm samples. Under the "designation" drop-down found in the "Sample Details" section (see the area labeled with a blue triangle in Figure 1), the available options have changed from the five options displayed in Figure 2 to the six options displayed in Figure 3. The first four options, "Positive", "Suspected", "Exposed" and "Missing Ewe", have remained the same and their definitions can be found in [Footnote 4, VLS On-Farm Designations](#), as well as a newly added help menu in VLS. The "No Designation" option has been split into two options, now called "No Designation-Less Specific Signs" and "No Designation-Non-Clinical". Briefly, the "No Designation-Less Specific Signs" should be selected when submitting samples from an animal exhibiting less specific clinical signs (see [Footnote 3](#)) and "No Designation-Non-Clinical" should be selected when an animal does not fit into one of the other categories and is not exhibiting any classic or less specific clinical signs (see [Footnote 4](#)). The "Designation" data field is the algorithm used in DIS to assign the appropriate surveillance credits. If "Suspected" is selected, that animal will be assigned the age-appropriate credit for the "less specific signs" category until video documentation is sent to and approved by the SGT, at which point the SGT manually adjusts the credit received for that animal.

Sample Information:

Sample Details:

Species\*: Goat

Breed\*:

Goat Type\*: ?

Addition Type\*:

Sex\*:

Age\*: 12 to < 18 months

Est: Est ?

Designation\*: [Blue Triangle Icon]

Figure 1. On-farm VLS Sample Details

Designation\*:

- Positive
- Suspected
- Exposed
- Missing Ewe
- No Designation

Figure 2. On-farm VLS Original Designation Options

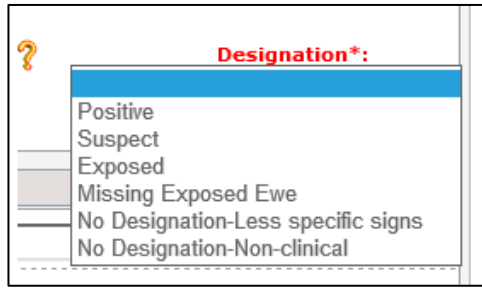


Figure 3. On-farm VLSL Updated Designation Options

Table 1. Risk-based Credits for On-Farm Submissions

	Age <sup>1</sup> (months)	<12 months	12 to <18 months	18 to <24 months	24 to <36 months	36 to <48 months	48 to <72 months	≥72 months
	Age (VLSL drop- down menu options) <sup>2</sup>	NA	12 to <18 months	18 to <24 months	2 years	3 years	4 years  OR  Full mouth – minimal (5 years)	Full mouth- moderate (6-7 Years)  OR  Full mouth- severe (8+ years)
Clinical Signs <sup>3,4</sup>	Classic clinical signs	0 <sup>+</sup>	1	2	15 <sup>+++</sup>	30 <sup>+++</sup>	20 <sup>+++</sup>	2
	Less specific clinical signs	0 <sup>+</sup>	0.5 <sup>+</sup>	1.5	1.5	3	1.5	1
	No clinical signs	0 <sup>+</sup>	0.5 <sup>+</sup>	1 <sup>++</sup>	1 <sup>++</sup>	1 <sup>++</sup>	1 <sup>++</sup>	0.5

Table 2. Risk-based Credits for RSSS Submissions

Age <sup>1</sup> (months)		<12 months	12 to <18 months	18 to <24 months	24 to <36 months	36 to <48 months	48 to <72 months	≥72 months
Age (VLSL drop-down menu options) <sup>2</sup>		N/A	12 to <18 months	18 to <24 months	2 years	3 years	4 years OR Full mouth – minimal to moderate (5-6 years)	Full mouth- severe (≥6 years)
Clinical Signs <sup>3,4</sup>	Classic clinical signs	0 <sup>+</sup>	1	2	15 <sup>+++</sup>	30 <sup>+++</sup>	20 <sup>+++</sup>	2
	No or less specific clinical signs	0 <sup>+</sup>	1	1	1	1	1	0.5

<sup>1</sup> Determined through dentition unless the submitter provides a registration certificate showing birth date. Due to difficulty in making an age determination via dentition in the RSSS system, any animal displaying broken, missing, splayed, or severely worn teeth will be assessed as greater than 72 months.

- <12 months (no permanent incisors)
- 12 to <18 months (initial eruption of first incisor)
- 18 to <24 month (first incisor fully erupted to eruption of second incisor)
- 24 to <36 months (second incisor erupted and third incisor not erupted)
- 36 to <48 months group (third incisor erupted to fourth incisor fully erupted)
- 48 to 72 (fourth incisor fully erupted and no broken, splayed, or missing teeth and/or severe wear)
- ≥72 months (broken, missing, splayed and/or severe wear)

<sup>2</sup> When known, VS recommends entering the age in months into VLSL rather than using the drop-down menu estimates.

<sup>3</sup> Clinical Sign Categories

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*Classic clinical signs* – 1) Central nervous system (CNS) signs including ataxia, incoordination, biting at legs or side, lip smacking, defensiveness, star gazing, change in behavior, ear tremors, general tremors or 2) Intense rubbing and bilateral abrasions with bare areas/wool or hair loss suggestive of rubbing or chewing, thickened and/or hyperpigmented skin with bare areas.

*Less specific clinical signs* - 1) Non-ambulatory prior to slaughter or death, 2) condemned at slaughter other than for CNS signs (and over 12 months of age), 3) signs of wasting (poor body condition) or being unthrifty with good teeth, 4) wool or hair loss without intense rubbing being observed and/or 5) dead of unknown cause. (Note that this category includes fallen stock defined as non-ambulatory prior to slaughter and dead of unknown causes, i.e., dead, down, or disabled.)



<sup>4</sup> VSLs On-Farm Designations The following is how the on-farm designations in VSLs correlate to the clinical signs categories for awarding credit:

*Positive*

A sheep or goat that has been confirmed positive for classical scrapie by the National Veterinary Services Laboratories (NVSL).

*Suspect animal*

A sheep or goat meeting at least one of the following criteria is considered a scrapie suspect:

- A mature sheep or goat as evidenced by eruption of the first incisor that has been condemned by FSIS or a State inspection authority for CNS signs, or that has been determined to be suspicious for scrapie by an accredited veterinarian or a State or USDA representative, based on one or more of the following signs and the severity of the signs: Weakness of any kind including, but not limited to, stumbling, falling down, or having difficulty rising, not including those with visible traumatic injuries and no other signs of scrapie; behavioral abnormalities; significant weight loss despite retention of appetite or in an animal with adequate dentition; increased sensitivity to noise and sudden movement; tremors; star gazing; head pressing; bilateral gait abnormalities such as but not limited to incoordination, ataxia, high stepping gait of forelimbs, bunny-hop movement of rear legs, or swaying of back end, but not including abnormalities involving only one leg or one front and one back leg; repeated intense rubbing with bare areas or damaged wool in similar locations on both sides of the animal's body or, if on the head, both sides of the poll; abraded, rough, thickened, or hyperpigmented areas of skin in areas of wool/hair loss in similar locations on both sides of the animal's body or, if on the head, both sides of the poll; or other signs of CNS disease. An animal will no longer be a suspect animal if it is redesignated in accordance with title 9, *Code of Federal Regulations* (9 CFR) 79.4.
- A sheep or goat that has tested positive for scrapie or for the proteinase resistant protein associated with scrapie on a live-animal screening test or any other test, unless the animal is designated a scrapie-positive animal.
- A sheep or goat that has tested inconclusive or suggestive on an official test for scrapie.

*Exposed animal*

Any animal or embryo that:

- (1) Has been in a flock with a scrapie-positive female animal.
- (2) Has been in an enclosure with a scrapie-positive female animal at any location.
- (3) Resides in a noncompliant flock.
- (4) Has resided on the premises of a flock before or while it was designated by a designated scrapie epidemiologist (DSE) as an infected or source flock and before a flock plan was completed. An animal shall not be designated an exposed animal if it only resided on the premises before the date that infection was most likely introduced to the premises as determined by a Federal or State representative.

*Missing Ewe*

If high-risk female animals that may have lambed in the flock ("may have lambed" refers to any ewe/doe old enough to lamb, unless it can be documented that she did not lamb) are no longer available (sold, died, cannot be positively identified, etc.), this designation is selected when testing their progeny and any birth cohorts of their progeny remaining in the flock, and when appropriate, subsequent lambing cohorts.

*No Designation (Non-Clinical)*

Not displaying any clinical signs associated with scrapie-routine surveillance

*No Designation (Less Specific Signs)*

Any animal that has any of the clinical signs listed for a scrapie suspect animal, that was not condemned for CNS signs and was **not** deemed to be a scrapie suspect by an accredited veterinarian or a State or USDA representative.

<sup>†</sup>Zero or reduced points assigned for sheep or goats less than 18 months of age unless submitted on an approved lamb protocol

<sup>\*\*</sup>If the situation arises where QQ genotype live sheep showing no clinical signs can be pre-selected prior to testing (submit/don't submit decision needs to be made), those animals can receive an additional four risk-credits per sheep. Any samples from live sheep showing no clinical signs with previously identified QR or RR genotypes should not be sampled and if submitted will receive no risk-credits.

<sup>\*\*\*</sup>Incentive credits for sampling any one sheep or goat will be capped at 30 percent of the State's annual minimum sample requirements.



