

Lung Scoring Methodology

The logo features the word 'ceva' in a white, lowercase, sans-serif font inside a dark blue vertical rectangle. To its right, the words 'LUNG' and 'PROGRAM' are stacked in a large, bold, blue, uppercase, sans-serif font. The letter 'O' in 'PROGRAM' is replaced by a white silhouette of a pig's head. The entire logo is centered on a white, wavy banner that is part of a larger, colorful, abstract graphic design consisting of overlapping, wavy bands in shades of red, green, and purple against a blue background.

ceva LUNG
PROGRAM



Istituto Zooprofilattico
della Lombardia e
dell'Emilia Romagna



The Ceva Lung Program

offers the **methodology** and **guidelines** on how to correctly evaluate the presence, incidence, circulation patterns and impact of *Mycoplasma hyopneumoniae*, *Actinobacillus pleuropneumoniae* and *Aujeszky's disease virus* infections using serological investigation and adapted lung scoring of slaughter pigs.

It is used to determine the appropriate vaccination protocol and monitor the results of vaccination. This brochure will bring insight into slaughter house lung check in pigs.



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1

Mycoplasma hyopneumoniae

Mycoplasma hyopneumoniae (*M. hyo*) is the primary pathogen causing Enzootic Pneumonia (EP), one of the most prevalent respiratory diseases in pigs resulting in high morbidity but low mortality. It is also one of the main pathogens involved in the porcine respiratory disease complex (PRDC), however other bacteria and viruses are also often contributing factors.

Acute inflammation, due to *M. hyo* infection, leads to a catarrhal or even purulent exudate in the airways. The accumulation of neutrophils and mono-nuclear cells around the bronchi and bronchioles results in airway collapse and consolidation of the lungs.

Lung tissue infected with *M. hyo* develops consolidation and catarrhal broncho-pneumonia with purple to grey regions of meaty appearance. The consolidation can be observed from 3 - 12 weeks post infection. The lesions are mainly localized in the apical and cardiac lobes, in the anterior part of the diaphragmatic lobes, as well as in the intermediate lobe. Lesions resolve after 12 to 14 weeks with formation of interlobular fissures, also referred to as scarring.

M. hyo and related viral and bacterial pathogens are also responsible for

the development of pleuritis, which is typically localized in the cranio-ventral part of the lungs, most often between the apical and cardiac lobes.

► Consolidation of the apical and cardiac lung lobes indicating the acute to sub-acute bronchopneumonia is suggestive of *M. hyopneumoniae* induced EP. Pleuritis at the junction of the cardiac and dia-phragmatic lobes can still be assigned to the cranio-ventral area. Pleurisy in this area are most likely due to *M. hyo* and associated bacterial or viral infections.

> Fig 1: Pig lungs. Lesions of bronchopneumonia and cranial pleurisy*



*Courtesy of IZSLER Inst. Reggio Emilia, Italy

2

Actinobacillus pleuropneumoniae

The forms of pleurisy located in the dorso-caudal region are primarily caused by *Actinobacillus pleuropneumoniae* (*A.p.*) and to a lesser extent by other pathogens.

A.p. is responsible for serious acute clinical disease characterized from a pathoanatomical standpoint by cases of fibrino-necrotic-haemorrhagic pleuropneumonia, with variable mortality in animals afflicted according to the virulence of the serotype involved.

The chronic form of the infection is characterized by the development of chronic lung lesions appearing as fibrous pleurisy of variable gravity at the dorso-caudal side of lungs that can seriously impair the animal's productive career. This is because the dorsal pleural lesions, even more than the apical lesions, impose a mechanical limitation and a level of pain during the animals' respiratory movements that result in

reduced daily weight gain and an increased number of days necessary for reaching slaughter weight.

► The chronic pleural lesions, still present at the time of slaughter, can be easily observed in this context and provide key information regarding the health conditions of the farm, the timeliness of undertaking control measures or for assessing the results obtained by implementing them.

> **Fig 2:** Pig lungs. Cases of fibrous dorso-caudal pleurisy, likely associated with *A.p.*



3

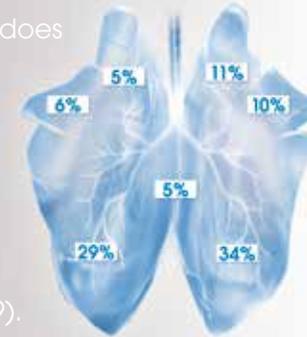
Evaluation of pneumonia and pleurisy

Pneumonia and pleurisy can be evaluated in a qualitative and quantitative manner. In the Ceva Lung Program, pneumonia is scored based on Madec method, which has been modified considering the contribution of each lobe to the overall capacity of the lungs. Quantification of Scarring is included. Pleurisy is scored using the Slaughterhouse Pleurisy Evaluation System (SPES) method, although here in the Ceva Lung Program all cranial pleurisy is recorded as Cranial Pleurisy Scoring. Then the APPI is calculated for the A.p. induced dorso-caudal pleurisy.

► Modified Madec Scoring

For the modified Madec score, the enzootic pneumonia-like lung lesions of each lobe are quantified according to the following:

Since each lobe does not represent an equal proportion of the lung, the following weights were assigned according to Christensen (1999).

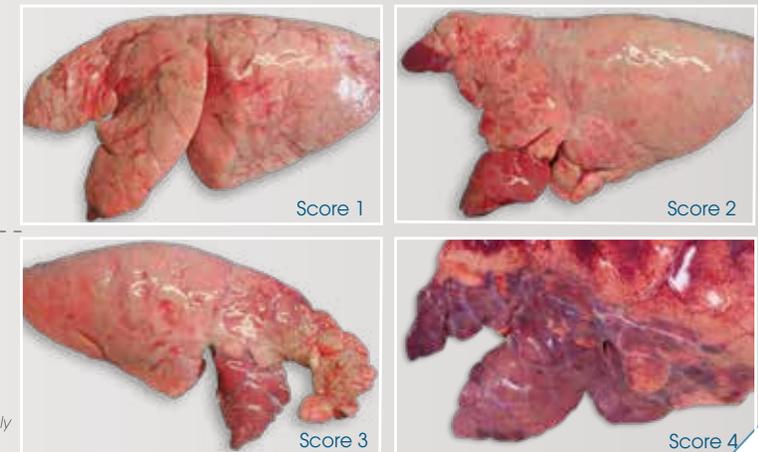


Surface of the lobe affected

Score 0	No lesions
Score 1	1-25 %
Score 2	26-50 %
Score 3	51-75 %
Score 4	76-100 %

< Fig 3: Percentage of total lung capacity represented by each lobe (Christensen 1999)

> Fig 4: Scoring of bronchopneumonia lesions typical for EP on the cardiac lobe*



*Courtesy of IZSLER Inst. Reggio Emilia, Italy

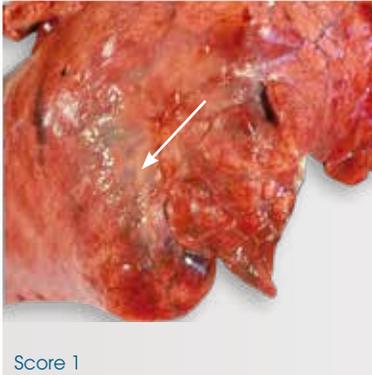
► Quantification of Scarring

The prevalence of fissures, or scarring, is evaluated based on their presence or absence. The incidence of fissures indicates the old infections likely due to *M. hyopneumoniae*.



- Score 0 : Absence of fissures (scarring)
- Score 1 : Presence of fissures (scarring)

> Fig 5 : Prevalence of fissures in pig lungs



**Courtesy of Pig Research Centre, Denmark

► Cranial Pleurisy Scoring

Cranial pleurisy can be attributed to pathological processes in this area which are likely related to *M. hyo* and other respiratory pathogens such as SIV, *Pasteurella multocida* and other bacteria. This cranial pleurisy should be recorded separately from the

dorso-caudal pleurisy to allow the appropriate differential diagnosis. These lesions include pleurisy on the surface of the lung lobes or between lobes as interlobar pleurisy. Pleurisy in the apical and cardiac lung lobes are scored as follows:

- Score 0 : No pleurisy in apical and cardiac lung lobes
- Score 1 : Pleurisy in apical and cardiac lung lobes

> Fig. 6 : Scoring of pleurisy in the apical and cardiac lung lobes



► Dorsocaudal pleurisy based on SPES

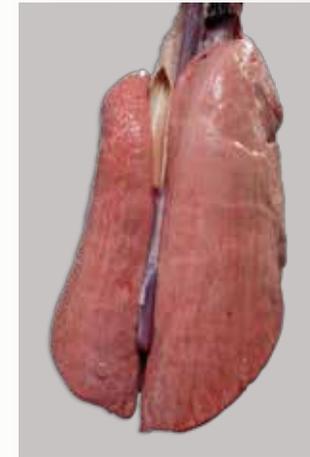
The SPES method facilitates the assessment of pleural lesions according to their location, appearance and extension. The SPES method is based on a point system from 0 to 4 based on the

presence, the extension and position of pleurisy observed on both lungs of each animal directly on the slaughter line (>table 1).

> **Table 1:** Modified SPES grid for chronic pleuritis score

Score	Lesion characterisation
0	Absence of chronic pleurisy lesions
2	Dorso-caudal monolateral focal lesion
3	Bilateral lesion of type 2 or extended monolateral lesion (at least 1/3 of one diaphragmatic lobe)
4	Severely extended bilateral lesion (at least 1/3 of both diaphragmatic lobes)

Note: Cranio-ventral lesions previously associated with SPES score 1 is now recorded as Cranial pleurisy



Score 0



Score 2



Score 3



Score 4

< **Fig 7:** Pig lungs on the slaughter line. Score 2, 3 and 4 lesions -----

Note the characteristic “stripping” in score 4 due to the tenacious adhesions between the parietal and visceral pleura with resulting laceration of the pulmonary tissue during the slaughter operations.

► Processing the Scores

Through statistical processing of recorded data, the Ceva Lung Program enables not only measurement of the incidence of the injury, but also identification of the distribution by classes within the sample and restoration of the data in easily legible graphic displays.

The Ceva Lung Program is capable of providing information about the frequency, severity, and suspected origin of pathological changes most likely due to *M. hyo* and *A.p.*

This information includes:

► Enzootic pneumonia like lesions

1 > Average percent of affected surface out of all lungs:

Using the Madec score assigned to each lobe, after taking into account the weight of that lung lobe in comparison to the entire lung, we are able to determine the percentage of the total lung surface affected for each animal. These values are then summed and divided by the total number of lungs

scored to determine the average percent of affected surface out of all lungs evaluated. This gives the actual value of the lungs that are damaged by Enzootic pneumonia on average in the group of evaluated animals.

► Average percent of affected surface out of all lungs =
 $\text{Sum of individual \% of affected lung surface} / \text{N}^\circ \text{ of all scored lungs}$

2 > Average percent of affected surface out of pneumonic lungs:

This gives us the information about the extent of the lesions and thus severity of the infection in the sick animals. It is possible that a severe infection in a small number of animals can be diluted due to a large number of healthy animals within the group. This situation will be revealed with this calculation.

► Average percent of affected surface out of lungs with active pneumonia = $\text{Sum of individual \% of affected lung surface} / \text{N}^\circ \text{ of sick lungs}$

► Cranial pleurisy

Cranial pleurisy is scored based on its presence or absence. The percent of cranial pleurisy in the evaluated group indicates the probability of the previous infection of pathogens affecting the cranial part of the lungs, especially *M. hyo*.

3 > Average percent of scarring in pneumonic lungs:

This parameter reveals the percentage of resolved lesions attributed to Enzootic pneumonia. This indicates old infections likely due to *M. Hyo* in the herd.

► Average percent of scarring out of all lungs =
 $\text{N}^\circ \text{ of lungs with scars} / \text{N}^\circ \text{ of all scored lungs} * 100$

This value completes the evaluation of the lung, as we are able to quantify the presence of pathogens that did not result in long term parenchymal lesions.

► Percent of cranial pleurisy =
 $\text{N}^\circ \text{ of lungs with cranial pleurisy} / \text{N}^\circ \text{ of all scored lungs} * 100$

► Actinobacillus Pleuropneumoniae Index (APPI)

The Actinobacillus pleuropneumoniae Index (APPI) provides information regarding the prevalence and seriousness of the dorso-caudal pleurisy, highly indicative of prior pleuropneumonia due to *A.p.*

> APPI =

Frequency of the lesions attributable to *A.p.* (number of lungs with scores 2, 3, and 4/total number of lungs examined)* average score (considering score 2,3,4) attributable to *A.p.*

For example:

in the case where 10 lungs were evaluated with the following scores: 0,0,0,0,2,2,2,3,3,4, the frequency of the lesions attributable to *A.p.* is thus obtained by applying the previous formula $(6/10)*((2+2+2+3+3+4)/6) = 1.6$

► According to the original SPES method, a high level of correlation was found between the *A.p.* seropositivity of herds and the SPES value. This confirms the specificity of recording of the dorso-caudal pleurisy for previous *A.p.* infections.

Conclusion

The Ceva Lung Program Scoring Methodology

is designed to assist in identifying the correct diagnosis of respiratory disease through the evaluation of lungs at slaughter. It enables the discovery of even subclinical infections that were not noted during the growing period.

The calculated values allow the estimation of both the incidence and the severity of enzootic pneumonia and pleuropneumonia. It can also be used to evaluate the efficacy of the control measures against *M. hyo* and *A.p.* when used both prior to and after their implementation. Finally, when used routinely, the Ceva Lung Program can aid in the recognition of the dynamics of those infections in a defined period or seasonal differences.



Partnership leading to answers

• Diagnosis • Monitoring • Prevention



Made by Ceva in cooperation with IZSLER

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