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FACULTY OF VETERINARY MEDICINE
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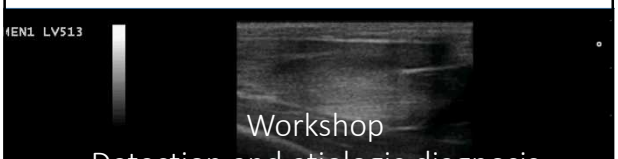

Workshop
Detection and etiologic diagnosis of bronchopneumonia in calves

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Objectives

- Knowing your sensitivity and specificity of lung auscultation
- Introducing lung ultrasonography
  - How to perform?
  - Getting the correct diagnosis with a simple algorithm
- Introducing bronchoalveolar lavage as an alternative sampling method for the LRT

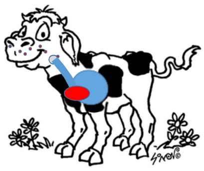
BRD detection and diagnosis

- Diagnosis= art of identifying a disease from its signs and symptoms
  - Sign= can be read by other person
  - Symptom= only described by the person 'feeling them'
- Detection= how good are we in seeing the signs?
- Correct diagnosis is essential for rational (antimicrobial) treatment and relies on optimal detection

Signs of BRD

- Fever: > 39,0°C; > 39,5°C; > 40°C
- Cough: spontaneous or induced (Positive tracheal reflex)
- Aspect of nasal and ocular discharge
- Stridor
- Tachypnea: > 45 bpm
- Dyspnea
- Tachycardia: > 100 bpm
- Depression: sopor, stupor or coma
  - Head position
  - Ear position
  - Lying or standing?
  - Appetite
  - Suckle reflex

Which signs are most predictive for **pneumonia**?

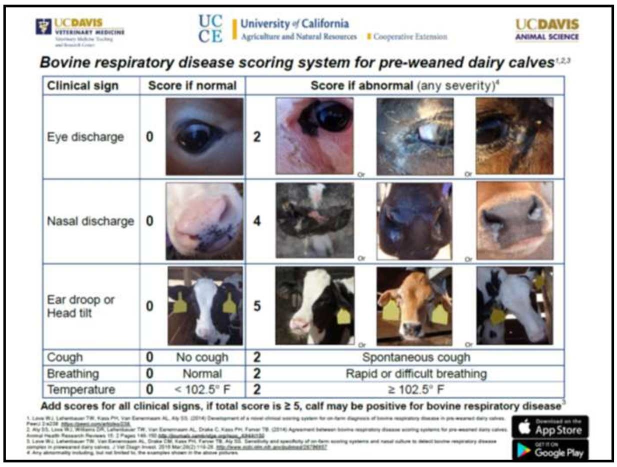


Score cards

Calf Health Scoring Criteria			
0	1	2	3
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop

- Wisconsin score card (S. McGuirck)

= 4→ observe
= 5 treat!



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Bovine respiratory disease scoring system for pre-weaned dairy calves[1,2,3]

Clinical sign	Score if normal		Score if abnormal (any severity)[4]	
Eye discharge	0		2	
Nasal discharge	0		4	
Ear droop or Head tilt	0		5	
Cough	0	No cough	2	Spontaneous cough
Breathing	0	Normal	2	Rapid or difficult breathing
Temperature	0	< 102.5° F	2	≥ 102.5° F

Add scores for all clinical signs, if total score is ≥ 5, calf may be positive for bovine respiratory disease[3]

App Store
Google Play

Sensitivity?

		The Truth		
Test Score:		Has the disease	Does not have the disease	
	Positive	True Positives (TP) a	False Positives (FP) b	PPV = $\frac{TP}{TP + FP}$
	Negative	False Negatives (FN) c	True Negatives (TN) d	NPV = $\frac{TN}{TN + FN}$
		Sensitivity $\frac{TP}{TP + FN}$	**Specificity** $\frac{TN}{TN + FP}$	
	Or,	$\frac{a}{a + c}$	$\frac{d}{d + b}$	

Overview diagnostic accuracy different methods

Method	Sensitivity (%)	Specificity (%)	Reference
Producer based diagnosis	64.5 (58-71)	69.1 (66-72)	White et al., 2016
Pen checkers	63.5 (57.9-68.8)	63,5 (60.5-66.4)	Mang et al., 2015
Wisconsin BRD score card	62.4 (47.9-75.8)	74.1 (64.9-82.8)	Buckzinski et al., 2015
Wisconsin BRD score card	71.1	91.2	Love et al., 2016
Californian BRD score card	72.6	87.4	Love et al., 2016
Lowered head + respiratory rate	36	92.7	Pardon et al., 2016
Thoracic ultrasound	79.4 (66.4-90.9)	93.9 (88.0-97.6)	Buckzinski et al., 2015
Thoracic auscultation (1 observer)	5.9 (0-16.7)	97.3-100	Buckzinski et al., 2015
Thoracic auscultation (1 observer)	72.9 (50.1-96.4)	53.3 (43.3-64.0)	Buckzinski et al., 2016
Whisper stethoscope	92.9 (71-99)	89.6 (64-99)	Mang et al., 2015
REDI (IR-location)	81.3 (55-96)	92.9 (88-97)	White et al., 2016
Flipping a coin	50	50	

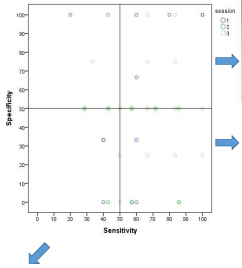
BRD detection: auscultation

	Sensitivity		Specificity		Number of participants
Session	Mean	Min.-Max.	Mean	Min.-Max.	
Session 1	60	20-100	61	0-100	11
Session 2	57	29-86	31	0-100	18
Session 3	70	33-100	51	0-100	20
Total	**63**	20-100	**46**	0-100	49

8.2% was 100% sensitive, 16.3% 100% specific and 4.0% was perfect

BRD detection: auscultation

Minder vals positieven



Minder vals negatieve

Highly specific signs?

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Thoracic auscultation (1 observer)	72.9 (50.1-96.4)	53.3 (43.3-64.0)	Buckzinski et al., 2016
Whisper			Mang et al., 2015
REDI (IR			White et al., 2016
Flipping			

Dewolf et al., 2016

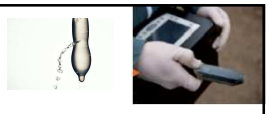
Lung ultrasonography

Lung ultrasonography

- Preparation
  - Shaving + alcohol + gel
  - Shaving + alcohol
  - Alcohol

Device protection

- Echogel + finger condom
- Essential for sectorial probe
- Advised for rectal probe
- Remove condom and rince with water after every use



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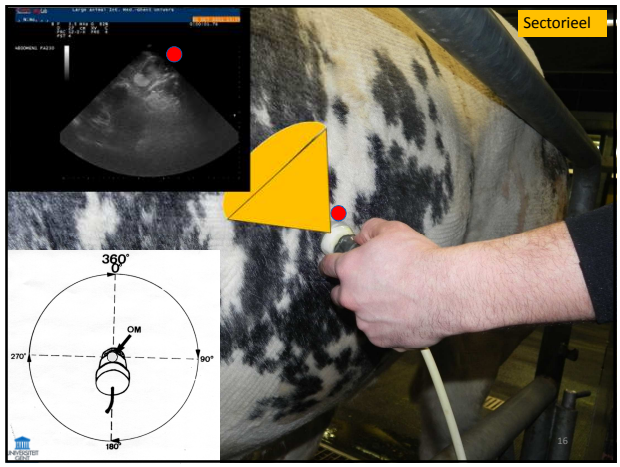

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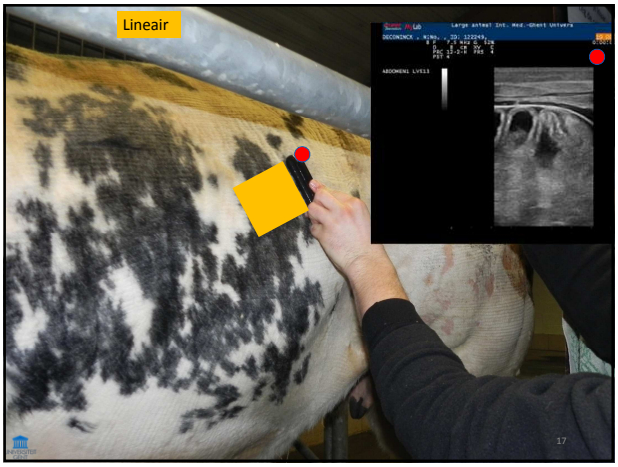
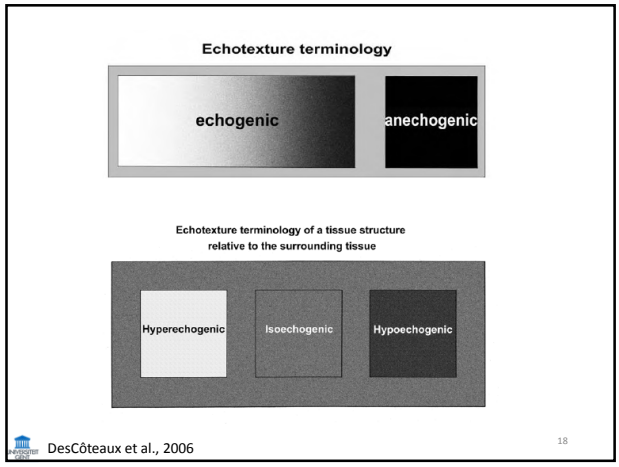
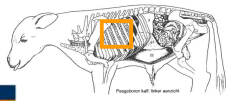




Lung images

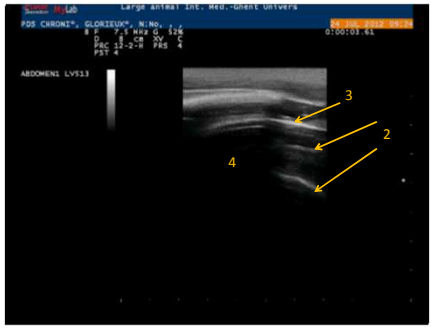
1. Reverberation artefacts (= normal)
2. Comet tail artefacts
3. Consolidation (= pneumonia)
4. Pleural effusion
   - Transsudate
   - Exsudate (pleuritis)

Normal image



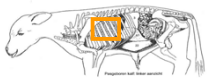
P. Simoens

Reverberations= normal image



1= rib
2= reverberation
3= pleura
4= acoustic schadow

Normal (sector probe)



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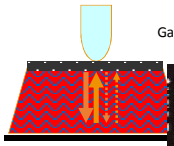
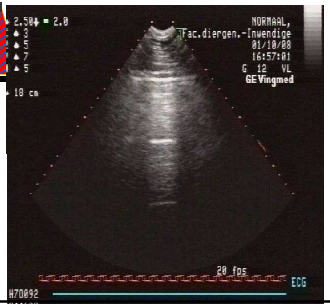
Artefacten : reverberation



Gas containing structure: vb. lung, caecum,…



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Artefact: acoustic shadow

- air = hyperechogenic + reverberation
  (100 % reflection)
- bone = hyperechogenic + shadow
  (partial reflection, partial absorption)

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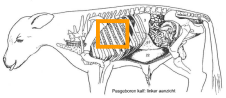
Comet tail artefact



Interpretation limited (< 4 pro intercostal space)=

- Cranial= normal
- Caudal→ check cranial lobes (possibly pneumonia)

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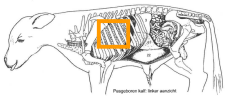
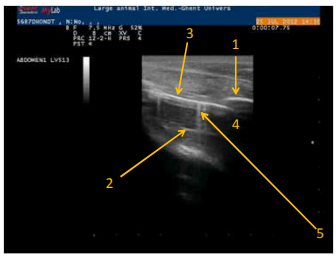
Comet tail artefact





1= rib
2= reverberation
3= pleura
4= acoustic schadow
5= comet tail artefact

Disturbs the reverberation, originates from the pleural line, any direction changing with movement of the pleural line

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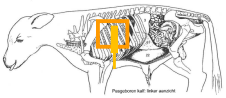
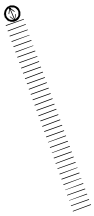
Multiple comets





Multiple comet tail artifacts (diffuse)= interstitial syndrome= lung edema

Multiple comets= always trouble

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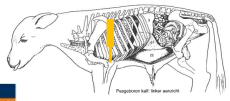
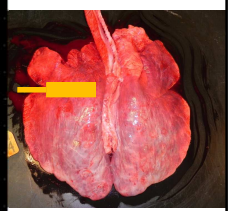
Mirror artefact



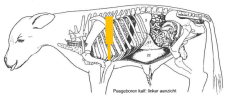


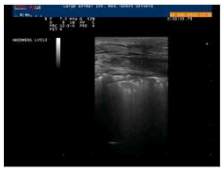
Tricepsvenster

Mirror artefact

- Tissue between probe and pleural line= Mirrored into healty lung

Consolidation





Interpretation= pneumonia

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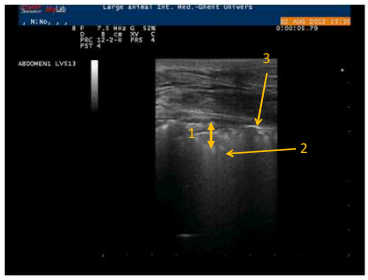
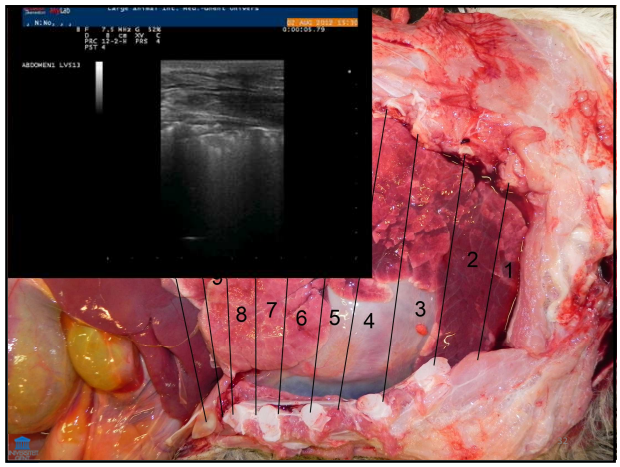
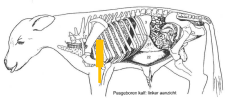
Consolidation



1= consolidation
2= comet tails (from the deep)
3= pleura
4= acoustic schadow
5= comet tail artefact



Consolidation



Interpretation= pneumonia cranial lung lobe

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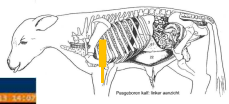
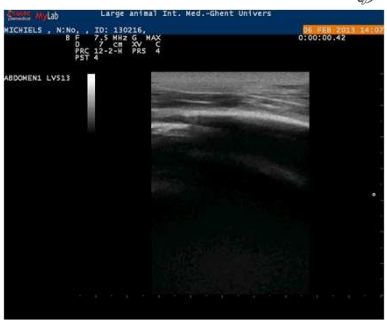
Consolidation





Interpretation= whole lobe affected

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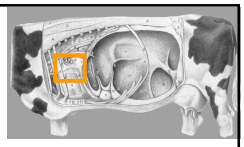
Lung abcess



Interpretatie= abcederende pneumonie

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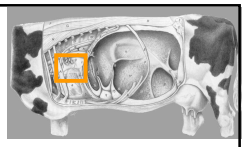
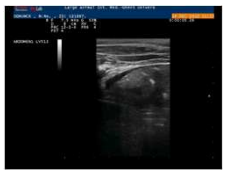
Pleuritis





Interpretation= pleural effusion + consolidated lung

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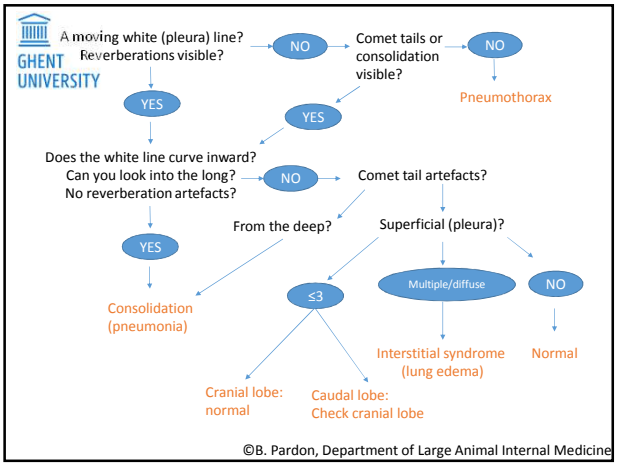
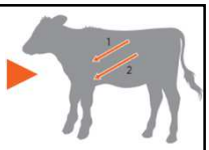
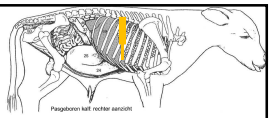


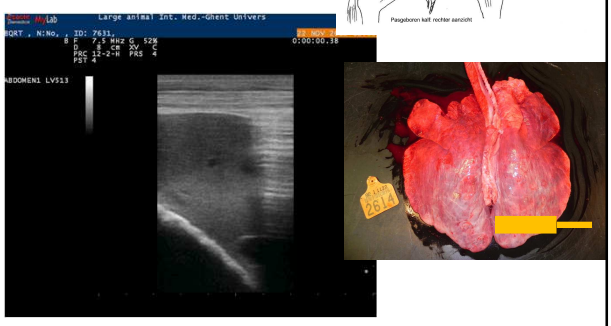
Quick scan method



- 2 min.
- 2 movements: left and right thorax
- Landmarks right
  - Start: lung-liver-image (1/2 liver/ ½ lung)
  - ½ heart/ ½ lung image
  - End: a and v thoracica interna
- Landmarks left
  - Start: lung-spleen-rumen
  - ½ heart/ ½ lung image
  - End: a and v thoracica interna
- Hold probe parallel to ribs (in intercostal space): if comet tail is detected→ stop→ move probe in all directions to explore further

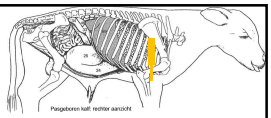
Start landmark right





½ lung/ ½ liver

End point right



a v thoracica interna

End point right

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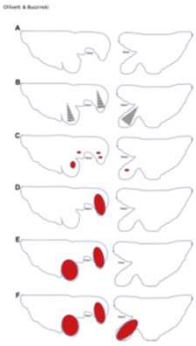
Lung ultrasound scoring systems



- LS0= normal
- LS1= comet tails
- LS2= lobular pneumonia
- LS3= lobar pneumonia
- LS4= lobar multiple lobes
- LS5= 3 or more lobes

Vet Clin Food Anim 32 (2016) 19-35
http://dx.doi.org/10.1016/j.cvfa.2015.09.001
0749-0720/16/$ – see front matter

Lung ultrasound scoring systems

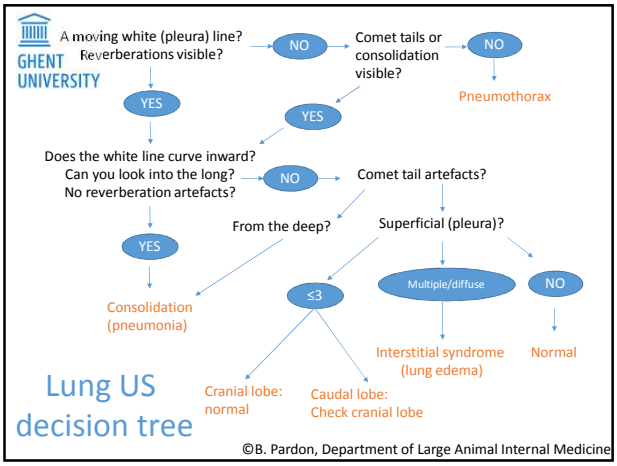
- LS0= normal
- LS1= comet tails
- LS2= <1 cm consolidation
- LS3= 1-3 cm consolidation
- LS4= > 3 cm consolidation

J Vet Intern Med 2015;29:1728–1734

Thoracic Ultrasonography and Bronchoalveolar Lavage Fluid Analysis in Holstein Calves with Subclinical Lung Lesions

T.L. Ollivett, J.L. Caswell, D.V. Nydam, T. Duffield, K.E. Leslie, J. Hewson, and D. Kelton

Lung US decision tree



Etiological diagnosis

Sampling & interpretation of laboratory analysis

Which animals to sample?

- Early state of disease- untreated
- 3 –step selection
- From a distance
  - (1) reluctant to move
  - (1) droopy ears/lowered head
- At clinical examination
  - (2) tracheal reflex positive
  - (3) rectal temperature > 39,0°C

Only significant association with pneumonia of depression and tachypnea (> 52 bpm; few cases)
Pardon et al., 2016 (WBC)

How to sample?

Deep nasopharyngeal swab

Bronchoalveolar lavage

Sample processing?

- Fridge (4-7°C)
- Plate within 24 hours
- Bacteriology:
  - Culture: *Pasteurellaceae* (+ antibiogram) and *Mycoplasma spp.*
  - PCR: Mh, Pm, Hs and Mb
- Virology: (1-2 very acutely ill)
  - (Virus isolation)
  - PCR: combi PCR RSV/PI-3/BVDV/BCV/BHV-1

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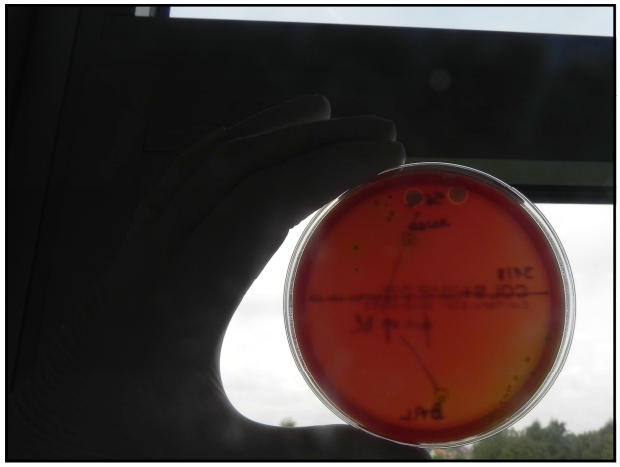
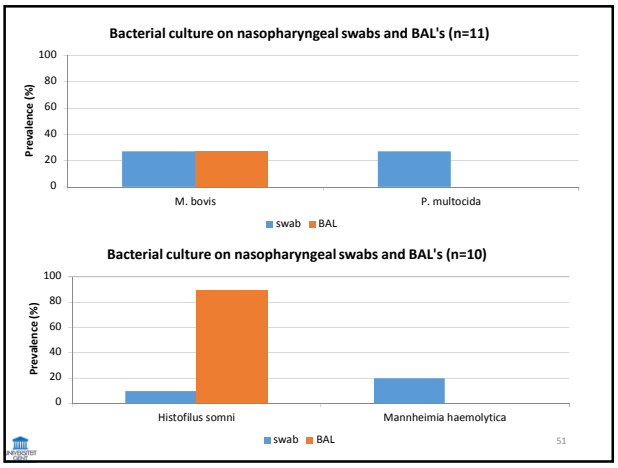
Sample 'quality'

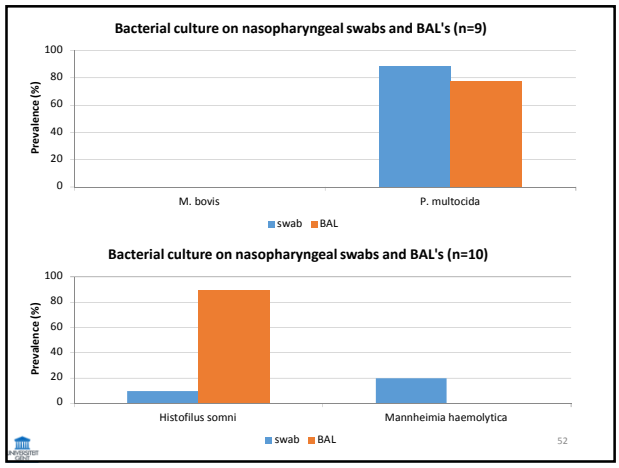
- No difference in number positive culture results between swab and BAL (except: *H. somni*) (53,5% vs. 43,7% (*P*>0,05)
- BAL→ more negatives (40,3% vs. 14,6%) (*P*<0,001)
- BAL→ more pure cultures (29,2% vs. 8.3%) (*P*<0,001)
- BAL→ less polymicrobial results (20,8% vs. 68,8%) (*P*<0,001)

- BAL returns a clinically interpretable result in 79,2% of the samples
- → large 'herd or sampler' effect

Van Driessche et al., JVIM 2017







Interpretation PCR assays on BAL

- Viral
  - Detected= virus present and involved
  - Attention: detection of live vaccine virus (e.g. intranasal- 14 days detectable (Timsit et al., 2009))
- Bacterial
  - *M. bovis*, *H. somni*, *M. haemolytica*: presence on farm aanwezig op bedrijf
  - *H. somni*, *M. haemolytica*: not sure of involvment in disease process
  - *M. bovis*: almost always involved in disease proces
  - *P. multocida*: almost on every farm, not informative?

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