Evaluation of a computer assisted-electronic stethoscope (Whisper®) for diagnosis of bovine respiratory disease in feedlot cattle

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Background and Rationale

- Accurate diagnosis of bovine respiratory disease (BRD) is crucial for effective BRD treatment and prevention strategies.

- Unfortunately, current diagnostic methods based on clinical inspection are not always accurate (sensitivity [Se] = 62% and specificity [Sp] = 63%; White and Renter, 2009).

- A computer assisted-electronic stethoscope (Whisper®, Geissler Corporation, MN, USA) has recently been developed to improve BRD diagnosis in cattle. Its performance needs to be evaluated before it can be used in commercial feedlots.

Objectives

- To evaluate, in a case-control study, the performance (Se, Sp and likelihood ratios) of Whisper® stethoscope to diagnose BRD in feedlot cattle using veterinary clinical examination and lung auscultation as gold standard.

- To illustrate how the use of this technology can influence the accuracy of BRD diagnosis in feedlot cattle.

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**Materials and Methods**

- 561 Angus-cross steers (initial BW = 246 +/- kg) were observed during the first 50 DOF at a commercial feedlot in Western Canada.

- Steers with visual BRD signs were removed from the pen and clinically examined by an experienced veterinarian. For each steer pulled for BRD, 1 or 2 apparently healthy steers were selected as controls and similarly examined.

- Examination included complete lung auscultation using a conventional stethoscope (3M Littmann®, London, ON, Canada) to detect abnormal lung sounds (e.g. increased bronchial sounds, crackles and wheezes) and focused lung auscultation using Whisper® which automatically gave a lung score from 1 to 5 (1= normal, 2= mild acute, 3= moderate acute, 4= severe acute and 5= chronic) (Fig.1)

- Case definition:
  - True BRD positive (**TP**) = steers with visual BRD signs, a rectal temp > 104°F and abnormal lung sounds at veterinary auscultation.
  - True negatives (**TN**) = steers with no BRD signs, a rectal temp <104°F and no abnormal lung sounds at veterinary auscultation.

- **Se** = # of TP steers with Whisper® score > 2/total # of TP. **Sp** = # of TN steers with a Whisper® score = 1/total # of TN. Positive likelihood ratio (**LR+**) = (1-Se/(1-Sp). Negative likelihood ratio (**LR-**) = (1-Se)/Sp)

- Fagan’s nomogram (Fagan, 1975) was used to illustrate how the use of Whisper® can influence the accuracy of BRD diagnosis in feedlot cattle for 2 scenarios: scenario (A) where cattle have a low pre-test probability of BRD after being pulled (40%) and scenario (B) where cattle have a high pre-test probability of BRD (80%) after being pulled.

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**Fig.1:** Whisper® auscultation consisted in holding the diaphragm of the stethoscope over the 5th intercostal space of the right thoracic wall, approximately 10 cm above the elbow and in recording lung sounds for 8 seconds. Recorded lung sounds were then automatically sent wirelessly to a computer and analyzed by a program provided by the manufacturer.
Results

- 33 and 37 steers were considered TP and TN after clinical examination.
- Of the 33 TP; 6, 15, 10, 1 and 1 steers had a Whisper® score of, respectively, 1, 2, 3, 4 and 5 (Fig.2).
- Of the 37 TN; 35 had a Whisper® score of 1 and 2 had a score of 2.

![Bar chart showing number of steers by Whisper® score](image)

Fig.2: Repartition of lung score obtained after Whisper® auscultation.

Table 1. 2X2 table comparing BRD diagnosis by Whisper® with BRD diagnosis by veterinary clinical examination including lung auscultation (defined as gold standard).

<table>
<thead>
<tr>
<th>Whisper® Score</th>
<th>Present</th>
<th>Absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ (≥2)</td>
<td>27</td>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>- (=1)</td>
<td>6</td>
<td>35</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>37</td>
<td>70</td>
</tr>
</tbody>
</table>

Using a Whisper® score ≥ 2 as a cut-off (Table 1):

- Se = 81.8% (95% CI = 65.5% - 93.0%)
- Sp = 94.6% (95% CI = 81.8% - 99.3%)
- LR+ = 15.1 (95% CI = 3.9 - 58.8)
- LR- = 0.2 (95% CI = 0.1 – 0.4)
Fig. 3. Fagan’s nomogram illustrating how the use of Whisper® can influence the accuracy of BRD diagnosis in 2 scenarios (A = low pre-test probability [e.g. cattle with non-specific BRD signs] and B = high pre-test probability [e.g. cattle with obvious BRD signs]) using the LR+ (15.1) and LR- (0.2) obtained in the present study. Post-test probabilities of positive (red line) and negative (blue dotted line) Whisper® auscultation can be read directly from the nomogram.

- For cattle identified by pen checkers having a low or a high pre-test probability of BRD, a positive Whisper® examination (score ≥ 2) largely increased the probability of being truly affected by this disease (Fig 3).

- On the contrary, a negative Whisper® auscultation (score = 1) did only moderately reduce the post-test probability of BRD, especially in the scenario B with up to 43% of animals remaining potentially BRD affected after a negative test.
**Conclusions**

- The Whisper® stethoscope was moderately sensitive (SE = 82%) and highly specific (SP = 95%) to diagnose BRD in feedlot cattle when compared to veterinary clinical examination and lung auscultation.

- Using Fagan’s nomogram, we showed that the use of Whisper® could significantly increase the proportion of cattle accurately diagnosed with BRD (i.e. reduction of false positive diagnoses). Because of its moderately high LR-, a negative Whisper® auscultation (score = 1) should be interpreted with caution, especially if the pre-test probability of BRD is high (e.g. cattle with specific visual BRD signs pulled by an experienced pen checker).