Relationship between Keto-test results and health and reproduction variables: A retrospective study using data from herd health visits in private practice

V. Caldwell, DMV, M.Sc.¹
R. Martineau, DMV, Ph.D.²

¹Clinique Vétérinaire de Coaticook
²Agriculture and Agri-Food Canada
Keto-tests, my practice, the study

- Why I started using Keto-tests (KTST) in 2003
  - New, convenient way to quantify NEB
  - Data easily retrievable, cross-matched in cow lists and files...« teachable moment »

- Why do a study
  - « Motivation » #1 asset of practitioner!
  - All repro. + health events recorded: value
  - Database with KTST + repro. + health
Study population

- 22 herds, 95% Holstein
  - Average herd size: 70 lactating cows
  - Range: 35 – 225 lactating cows
- Mature equivalent milk production: 9731 kg /305 d
- All herds on computerized herd health (DSA)
  - Monthly (n=18) or every other week (n=4)
- 10 herds are on some form of systematized repro. synchronization
- First breeding: all A.I.
Data collection

- During regular herd health visits (3-year period)
  - Keto-test on all cows (4 – 21 DIM)
- Production data were downloaded from DHI
- Repro., demographic and health events were entered in DSA
  - At the farm (on paper or in the computer)
  - At the clinic (by staff)
  - Or by automatic transfer from vet billing system
Some variables recorded

- HERD: identification of the herd (categorized)
- CS: calving season (categorized)
- LN: lactation number (categorized)
- DIMAI: days in milk at 1\textsuperscript{st} AI (categorized)
- BS: season at 1\textsuperscript{st} AI
- PREG: pregnancy result at 1\textsuperscript{st} AI
- MF: milk fever
- RP: retained placenta
- ME: metritis
- CY: ovarian cyst
- MA: mastitis
- LA: lameness
- DA: displaced abomasum
Descriptive stats

- Cows tested:
  - n=1428

- Cows with Keto-test (+) (cut-off: 100 μM):
  - n=394 (27.6 %)

- Cows bred (1st A.I.):
  - n=1217 (85.2 %)

- Cows pregnant at 1st A.I.:
  - n=387 (conception rate: 31.8 %)
Binary logistic regression

- Complete model included:
  - KTST
  - Potentially confounders (Chi-square $P < 0.25$ between confounder and outcome)
  - Interactions KTST $\times$ confounders ($P < 0.25$)

- Reduced model included:
  - KTST
  - But only the confounders and the interactions that modify the odds ratio

- Odds ratio were converted to %
Characterization of cows diagnosed pregnant or non-pregnant after first breeding

<table>
<thead>
<tr>
<th>Condition</th>
<th>Pregnant</th>
<th>Non-pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cows</td>
<td>387</td>
<td>830</td>
</tr>
<tr>
<td>KTST (+)$^1$</td>
<td>101 (26.1)$^2$</td>
<td>224 (27.0)</td>
</tr>
<tr>
<td>Milk fever*</td>
<td>9 (2.3)</td>
<td>35 (4.2)</td>
</tr>
<tr>
<td>Retained placenta</td>
<td>28 (7.2)</td>
<td>81 (9.8)</td>
</tr>
<tr>
<td>Metritis**</td>
<td>31 (8.0)</td>
<td>113 (13.6)</td>
</tr>
<tr>
<td>Ovarian cyst**</td>
<td>14 (3.6)</td>
<td>87 (10.5)</td>
</tr>
<tr>
<td>Mastitis</td>
<td>75 (19.4)</td>
<td>164 (19.8)</td>
</tr>
<tr>
<td>Lameness</td>
<td>32 (8.3)</td>
<td>63 (7.6)</td>
</tr>
<tr>
<td>Displ. abomasum**</td>
<td>10 (2.6)</td>
<td>41 (4.9)</td>
</tr>
</tbody>
</table>

$^1$KTST (+) if BHB ≥ 100 µM; $^2$n (%)
*Chi-square $P < 0.10$
**Chi-square $P < 0.05$
### Categorization of herds according to 1\(^{st}\) A.I conception rate

<table>
<thead>
<tr>
<th>HERD (conception rate)**</th>
<th>n</th>
<th>Conception rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25%</td>
<td>147</td>
<td>21.1</td>
</tr>
<tr>
<td>25 – 30 %</td>
<td>585</td>
<td>29.1</td>
</tr>
<tr>
<td>30 – 35 %</td>
<td>249</td>
<td>34.1</td>
</tr>
<tr>
<td>&gt; 35 %</td>
<td>236</td>
<td>42.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lactation number**</th>
<th>n</th>
<th>Conception rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>392</td>
<td>36.7</td>
</tr>
<tr>
<td>2 – 3</td>
<td>530</td>
<td>32.3</td>
</tr>
<tr>
<td>&gt; 3</td>
<td>295</td>
<td>25.1</td>
</tr>
</tbody>
</table>

**Chi-square \( P < 0.05 \)**
## Effect of breeding season and days in milk at 1\textsuperscript{st} A.I. on 1\textsuperscript{st} A.I. conception rate

<table>
<thead>
<tr>
<th>Breeding season</th>
<th>n</th>
<th>Conception rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>winter</td>
<td>322</td>
<td>33.5</td>
</tr>
<tr>
<td>spring</td>
<td>276</td>
<td>29.0</td>
</tr>
<tr>
<td>summer</td>
<td>276</td>
<td>33.0</td>
</tr>
<tr>
<td>fall</td>
<td>343</td>
<td>31.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIM at A.I.</th>
<th>n</th>
<th>Conception rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 70</td>
<td>280</td>
<td>28.9</td>
</tr>
<tr>
<td>70 – 100</td>
<td>630</td>
<td>32.7</td>
</tr>
<tr>
<td>&gt; 100</td>
<td>307</td>
<td>32.6</td>
</tr>
</tbody>
</table>

Non significant Chi-square $P > 0.50$
Results, Conception rate

- Complete binary logistic moded included:
  - KTST
  - HERD, LN, MF, RP, ME, CY, DA
- Reduced model included KTST only
- Conception rate at 1st A.I. is not associated ($P = 0.74; n=1217$) with KTST result:
  - 32.1% when KTST is (-)
  - 31.1% when KTST is (+)
### Results, Health events

<table>
<thead>
<tr>
<th></th>
<th>KTST (+)</th>
<th>KTST (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cows</td>
<td>394</td>
<td>1034</td>
</tr>
<tr>
<td>Displ. abomasum**</td>
<td>31 (7.9)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>36 (3.5)</td>
</tr>
<tr>
<td>Metritis</td>
<td>40 (10.2)</td>
<td>124 (12.0)</td>
</tr>
<tr>
<td>Ovarian cyst</td>
<td>23 (5.8)</td>
<td>79 (7.6)</td>
</tr>
<tr>
<td>Retained placenta</td>
<td>32 (8.1)</td>
<td>105 (10.2)</td>
</tr>
<tr>
<td>Milk Fever</td>
<td>18 (4.6)</td>
<td>39 (3.8)</td>
</tr>
<tr>
<td>Mastitis**</td>
<td>98 (24.9)</td>
<td>182 (17.6)</td>
</tr>
<tr>
<td>Lameness</td>
<td>27 (6.9)</td>
<td>86 (8.3)</td>
</tr>
</tbody>
</table>

**Chi-square \((P < 0.01)\); otherwise \(P > 0.20\)

<sup>1</sup>n (%)

<sup>n</sup>
Results, Mastitis

- Final model included KTST only
- Mastitis is associated with KTST result:
  - OR: 1.55 ($P = 0.002$)
  - 17.6% (182/1034) when KTST is (-)
  - 24.9% (98/394) when KTST is (+)
Results, Displ. abomasum

- Final model included KTST, HERD, KTST × HERD
  - HERD was categorized according to incidence of displ. abomasum: < 5%, 5 – 10%, > 10%
- Displ. abomasum is associated with KTST result but depends on herd incidence of displ. Abomasum
  - OR: 3.81 ($P = 0.001$)
# Results, Displ. abomasum

<table>
<thead>
<tr>
<th>Herd incidence of displ. abomasum</th>
<th>Low &lt; 5%</th>
<th>Medium 5 – 10%</th>
<th>High &gt; 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>n cases</td>
<td>20</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>KTST (-)</td>
<td>2.3%</td>
<td>5.9%</td>
<td>12.5%</td>
</tr>
<tr>
<td>KTST (+)</td>
<td>3.4%</td>
<td>8.3%</td>
<td>35.2%</td>
</tr>
</tbody>
</table>
Discussion (reproduction)

- No effect on 1st A.I. conception rate ???
  - Observational retrospective study
  - Test on milk, not serum (sensitivity…)
  - One measure between 4 – 21 DIM (false negatives ?)
  - 1st A.I. conception rate is not the only important repro. variable
Discussion (diseases)

- Strong association between KTST and displ. abomasum
  - In herds with a high incidence of displ. abomasum
  - Cause or consequence

- Strong association between KTST and mastitis
  - Leukocyte function? Immune failure?
  - Duration of effect?

- Underlines the importance of monitoring the transition period and NEB
Discussion (practice)

- Use of Keto-test in practice
  - Easy
  - Creates « teachable moment »
    - Transition / fresh cow nutrition
- Data analysis in private practice
  - Good way to « stay motivated »
  - Emphasizes the value of herd health data
Questions...