Remote monitoring of dairy cattle: Opportunities for improved welfare across all species

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Fraser (2005) (FAO)

- Are larger and/or corporately owned units worse for animal welfare?
Time bucket and quality of that time

Business management  5-10%
Reproduction & Health 5-15%
Feeding 10-20%
Milk harvesting 50-60%
The University of Sydney

Cows per farm

10,000,000,000 calculations/second

1 calculation/second

1970 1990 2010 2030 2050
The bleeding edge of dairy farming

Data collection

Food
Animal/environment welfare & health
Wastage

Data analysis

Action(human/machine)
Feed, water type + amount
Labour
Diagnosis/Treatment
Genetic selection
‘The speed of technological advancement has outpaced (by a long way) our ability to turn data into better actions on farm’

(C. Clark, EAAP 2016)
<table>
<thead>
<tr>
<th>Technology</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic cup removers (ACRs)</td>
<td>90</td>
</tr>
<tr>
<td>Herd management software; Computer at dairy</td>
<td>80</td>
</tr>
<tr>
<td>Automatic in parlour feeding (in the shed)</td>
<td>70</td>
</tr>
<tr>
<td>Automatic milk plant wash system</td>
<td>60</td>
</tr>
<tr>
<td>Electronic cow ID</td>
<td>50</td>
</tr>
<tr>
<td>Automatic drafting</td>
<td>40</td>
</tr>
<tr>
<td>Inline milk meters</td>
<td>30</td>
</tr>
<tr>
<td>Automatic post milking disinfection; teat spray</td>
<td>20</td>
</tr>
<tr>
<td>Automatic calf feeders</td>
<td>10</td>
</tr>
<tr>
<td>Automatic oestrus detection systems</td>
<td>5</td>
</tr>
<tr>
<td>Pasture measuring device</td>
<td>10</td>
</tr>
<tr>
<td>Automatic cow weighing scales</td>
<td>5</td>
</tr>
</tbody>
</table>

Lyons et al. (2016)
Data from new technology: Health phenotypes

Obtaining real-time 24 h behaviour of dairy cattle at a ‘minute’ level is available to research (and for commercial farms) now.
Data from new technology: Health phenotypes

**Grazing**

- Equation: $y = 0.9997x - 0.7939$
- $R^2 = 0.9942$

**Rumination**

- Equation: $y = 0.786x + 3.3286$
- $R^2 = 0.6474$

**Low Activity**

- Equation: $y = 0.9292x - 1.5735$
- $R^2 = 0.9365$
Data from new technology: Health phenotypes

Sensor behaviour

Alert for Management
Vet (rural prof.)
Farmer

Database for herd improvement
Genetic selection (farm and industry)

‘Reduced health phenotype’
- ‘Luxury’ behaviours

Auto draft of animal
‘Health phenotypes’

– Behaviour phenotype
‘Oestrus phenotype’
‘Oestrus phenotype’

Evaluation of infrared thermography body temperature and collar-mounted accelerometer and acoustic technology for predicting time of ovulation of cows in a pasture-based system

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aOePro Science Group, Faculty of Veterinary Science, The University of Sydney, Camden, New South Wales, Australia
bMars-One Animal Insurance Group, Faculty of Veterinary Science, The University of Sydney, Camden, New South Wales, Australia
‘Oestrus phenotype’

- Standing to be mounted
- Interval
- Duration
- Intensity
- Expression of behaviours…?
- Interaction herd mates
‘Calving phenotype’
Rumination and activity levels as predictors of calving for dairy cows

C. E. F. Clark¹, N. A. Lyons², L. Millapan³, S. Talukder¹, G. M. Cronin¹, K. L. Kerrisk¹ and S. C. Garcia¹

¹Dairy Science Group, University of Sydney, Camden 2570, NSW, Australia; ²Squirrel and intensive Livestock Industries, NSW Department of Primary Industries, Elizabethtown Agricultural Institute, Murrang NSW 2560, Australia; ³Department of Animal Production, Faculty of Agronomy, University of Buenos Aires, Buenos Aires 1417, Argentina

'Calving phenotype'

Day relative to calving
‘Transition cow phenotype’
‘Lameness phenotype’

School of Engineering and Faculty of Veterinary Science collaboration

PhD: “Advanced Perception in Precision Livestock Robotics: Lameness”
Rumination patterns, locomotion activity and milk yield for a dairy cow diagnosed with a left displaced abomasum

S Talukder, KL Kerrisk, CEF Clark, SC Garcia & P Celi
3 day sickness: Bovine Ephemeral Fever

- Viral disease
- Fever, muscle stiffness, lameness
- Tolfedine (antiinflam)
- Heat stress and rumination time (Moallem et al., 2010)
- Sensitivity heat of the day

Samson et al unpub data
Opportunities/current work: Dairy; Beef Cattle; Poultry

Production animal time allocated to core or luxury behaviours

Welfare state:
- Defined reduction in luxury or low resilience animal behaviours
- Dairy cattle and mice (Mandel et al., 2013; Littin et al., 2008)
- Reduce the costs of transitions between activities
- Longer bout lengths and other detectable changes in behavioural structure (Sherwin and Nicol, 1996; Asher et al., 2009)
Group vision: Forward to the past
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<table>
<thead>
<tr>
<th></th>
<th>Non lame</th>
<th>Lame</th>
<th>Lameness</th>
<th>Parity</th>
<th>DIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield (L/day)</td>
<td>21</td>
<td>15</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rumination (min/day)</td>
<td>445</td>
<td>457</td>
<td>0.163</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Activity (units/ day)</td>
<td>478</td>
<td>441</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>