Animal welfare: definition, measurement and use in the context of dairy herd improvement

Elsa Vasseur and Marie Haskell

1Department of Animal Science, McGill University, Sainte-Anne-de-Bellevue, QC, Canada, H9X 3V9
2SRUC, West Mains Road, Edinburgh EH9 3JG

ICAR 2019, June 18-21 2019, Prague, Czech Republic
Standards to dairy farms around the world
Standards to dairy farms around the world

• Whole Food Market: 5-Step® Animal Welfare Rating Standards
  en coll./

• BC SPCA
Standards to dairy farms around the world

- WTO mandated the OIE to develop animal welfare recommendations for international commercial trade
Assessing dairy welfare is common place

- Improving welfare, and overall dairy farming sustainability by enhancing profitability and reducing environmental impact
  - Industry or stakeholder-led initiatives
Assessing dairy welfare is common place

• Improving welfare, and overall dairy farming sustainability by enhancing profitability and reducing environmental impact
  – Industry or stakeholder-led initiatives

  – Earning public trust i.e. consumer assurance programs
    • ‘Doing the right thing’
      – Metrics to support
    • Verification system
      – Reaching targets
      – Progress overtime
    • Communication
What is Animal Welfare?

- Basic health and functioning
- Affective state
- Natural living

Fraser et al., 1997 AW 6:187; Fraser, 2008 Acta Veterinaria Scandinavica 2008, 50(Suppl 1):S1
Type of animal welfare indicators

• Risk factors

• Outcome measures
Type of animal welfare indicators

- Risk factors
  - Housing-based
    - E.g. density, stall size, etc.
  - Management-based
    - E.g. hoof trimming routine, pasture access, etc.
Type of animal welfare indicators

- Risk factors
  - Housing-based
    - E.g. density, stall size, etc.
  - Management-based
    - E.g. hoof trimming routine, pasture access, etc.

- Outcome measures
  - ‘true’ measure of welfare i.e. how housing/management affect welfare status
Typical outcome measures

• Visual evaluation
  – Lameness
  – Injuries
  – Hygiene
  – Body condition
No Swelling. No hair is missing, some hair loss or broken hair.

No Swelling or minor swelling (< 1 cm). Bald area on hock

Medium swelling (1-2.5 cm) and/or lesion on bald area.

Major swelling (> 2.5 cm). May have bald area/lesion.

Gibbons et al. 2012 AW 21:379
Numerical scoring charts

• How to make sure we are measuring what we are intending to?
  – Reliable indicator = valid and repeatable
Numerical scoring charts

• How to make sure we are measuring what we are intending to?
  – Reliable indicator = valid and repeatable

#1 Validation of scoring system

#2 Development of training program

#3 Ensuring high repeatability of assessors
Numerical scoring charts

- **Validation of a method** to assess lameness in tie-stall herds
  - Lameness prevalence at the stall highly correlated with ‘gold standard’ gait scoring ($r=0.88$)

Gibbons et al. 2014 JDS 97:350
Numerical scoring chart

- Development and implementation of a **training program to ensure high repeatability**

<table>
<thead>
<tr>
<th></th>
<th>d1 - d4</th>
<th>d5</th>
<th>d6</th>
<th>d7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>am</strong></td>
<td>Classroom</td>
<td>Barn</td>
<td>Classroom</td>
<td>On Farm</td>
</tr>
<tr>
<td></td>
<td>- SOPS</td>
<td>Live Scoring n=20</td>
<td>- Data Input</td>
<td>Live Scoring n=20</td>
</tr>
<tr>
<td></td>
<td>- CD ROM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Photos</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- All trainees achieved target repeatability $K_w > 0.6$

Numerical scoring charts

- Ensuring high repeatability of assessors
  - Require continuous checking
About the importance of training

Higginson Cutler et al. 2017 JDS 100: 9871
Sampling strategy

- Truly representative of the herd status i.e. reliable estimates of herd prevalence
  - How many days, how many cows, etc.
  - Correcting for effect of season, milk production, DIM, etc.
Time and time again

• Visual evaluation require
  – Long period of data collection on farm
    • Days (if the farm is big), multiple visits
  – Training and follow-up checks of assessors to maintain repeatability
  – Time = $$$ = animal care assessment very costly to implement

– Choices need to be made… but be careful that it is not in detriment to quality of the assurance program
  • Auto-evaluation every 2\textsuperscript{nd} year e.g. proAction\textsuperscript{®} initiative (Canada)
Future avenues?
Future avenues?

- Automation
App for clinical scores

- Body Condition Scoring
  - Elanco Animal Health BCS guidelines
    - based on Wildman (1982)
App for clinical scores

- Body Condition Scoring
  - Elanco Animal Health BCS guidelines
    - based on Wildman (1982)
  - App for BCS
App for clinical scores

Please select:

- Sacral ligament is barely visible and tailhead ligament is not visible
  - = 3.50

Please select:

- Sacral ligament is visible and tailhead ligament is barely visible
  - = 3.75
Automatic classification of skin injury

- Machine learning techniques using 2,364 2D-images

<table>
<thead>
<tr>
<th>Condition</th>
<th>Classification accuracy</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open wounds</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Red and wet scabs</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>White or dry scabs</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>Complete hair loss</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Broken hair</td>
<td>80%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Presented at ADSA 2018 and ISPA 2018; Manuscript from Piché et al. *in prep*
Activity monitor

- More and more common on commercial dairies
  - Used for heat detection, feeding activity, rumination, etc.
Activity monitors to **predict** welfare status?

- A large amount of data generated from those various technologies
  - Used for **early detection** of health/welfare issues at the cow level
    - Frequency of visits at the AMS or feeders\(^1\)

\(^1\)Deming et al. 2013 CJAS 93:427
Activity monitors to predict welfare status?

- A large amount of data generated from those various technologies
  - Used for early detection of health/welfare issues at the cow level
    - Frequency of visits at the AMS or feeders

- Great potential to be used to predict welfare status at the herd level
  - However, technologies do no ‘talk to each other’ i.e. different companies, different software
  - Data are stored for a limited period and stayed at the farm
    - Future research should focus on valuation system of those data
Future avenues?

• Automation
• Early indicator/predictor of welfare status
  – Remote indicators
Relying on health and performance records

A remote assessment tool for farm animal welfare through dairy herd improvement data

D. Warner¹,², E. Vasseur², R. Lacroix¹, S. Adam¹, M. Villetaz Robichaud³, D. Pellerin³, D.M. Lefebvre¹

ICAR, 17-21 June 2019, Prague, Czech Republic
Remote predictors of welfare status?

- Remote-based reporting could help to ‘flag’ herds, prior to do a costly on-farm visit animal welfare assessment
  - Sensitivity + specificity to be improved
Remote predictors of welfare status?

- Remote-based reporting could help to ‘flag’ herds, prior to do a costly on-farm visit animal welfare assessment
  - Sensitivity + specificity to be improved

- Discriminating between good vs. poor welfare status
  - Links between **protective practices** (in management, genetics, etc.) and cow longevity and herd profit
    - At all stage of animal life (including rearing period)
    - Herd vs. cow level
    - Conditions of use
      - Which data require? How to calculate predictors? How do they evolve in time?
Future avenues?

• Automation
• Early outcome measure of welfare
  – Remote indicators
    • Performance and health data (DHI database)
    • Predicting cow welfare status in milk using biomarkers
Biomarkers in milk

• To date, no research in the world led to the development of biomarker to detect cow welfare status easily detectable in a milk sample.
Biomarkers in milk

• **Rationale of current research project:**
  – Animal welfare research led to reliable behavioral indicators
    • from clinical signs to activity data
Biomarkers in milk

• **Rationale of current research project:**
  - Animal welfare research led to reliable behavioral indicators
    • from clinical signs to activity data
  - Metabolic indicators in blood, e.g. NEFA, BHBA
    • sensitive and specific to cow health issues but not overall welfare status
    • invasive, technically demanding and expensive
Biomarkers in milk

- **Rationale of current research project:**
  - Animal welfare research led to reliable behavioral indicators
    - from clinical signs to activity data
  - Metabolic indicators in blood, e.g. NEFA, BHBA
    - sensitive and specific to cow health issues but not overall welfare status
    - invasive, technically demanding and expensive
  - BHBA in milk correlated positively with that in circulation
    - Denis-Robichaud et al. 2014 JDS 97:3314
    - Milk could be used to measure biomarkers of cow health

Vasseur, Duggavathi, Zhao, Ismail, Santschi, Lefebvre
Biomarkers in milk

- **Objectives of current research project:**
  - Develop precision markers that could be routinely recorded (e.g. milk samples collected by milk recording system DHI) to detect herds and cows within a herd experiencing lower level of welfare and health.

Vasseur, Duggavathi, Zhao, Ismail, Santschi, Lefebvre
Summary

- Emphasis on AW is increasing and AW assessment in place in most part of the world – either industry or stakeholder led
  - Farmers required to achieve high level of AW and health
  - In this context, the development of reliable indicators for assessing and monitoring AW status is of high importance
Summary

- Currently available indicators to assess cow welfare status are either qualitative and/or require
  - On-farm assessment and monitoring (e.g. BCS)
  - Technology not available in most farms (e.g. measuring resting time using electronic data loggers)
Summary

• Future avenues regarding outcome measures of welfare are
  – Automation
    • behavioral + performance data (e.g. frequency to access feeders and AMS)
      – could be used as early indicators of health/AW issues
      – more work to be done on how to use this huge amount of data (the ‘big data’)
        » Technologies that do not talk to each other
        » Sorting/data mining
Summary

• Future avenues regarding outcome measures of welfare are
  – Automation
  – Remote indicators, especially DHI and health data, ‘flagging’ herds with issues
    • Identify best predictors,
      – at each stage of animal’s life
      – at herd and individual level
Summary

• Future avenues regarding outcome measures of welfare are
  – Automation
  – Remote indicators, especially DHI and health data, ‘flagging’ herds with issues
  – *It would make sense to be able to assess dairy cow welfare status in a simple milk sample... but we’re not there yet!*
Thank you! Questions?

elsa.vasseur@mcgill.ca

www.cowlifemcgill.com

@CowLifeMcGill