



# Developing and implementing technological wellbeing evaluation in dairy animals: COST DairyCare



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UNIVERSITY OF COPENHAGEN



Faculty of Health

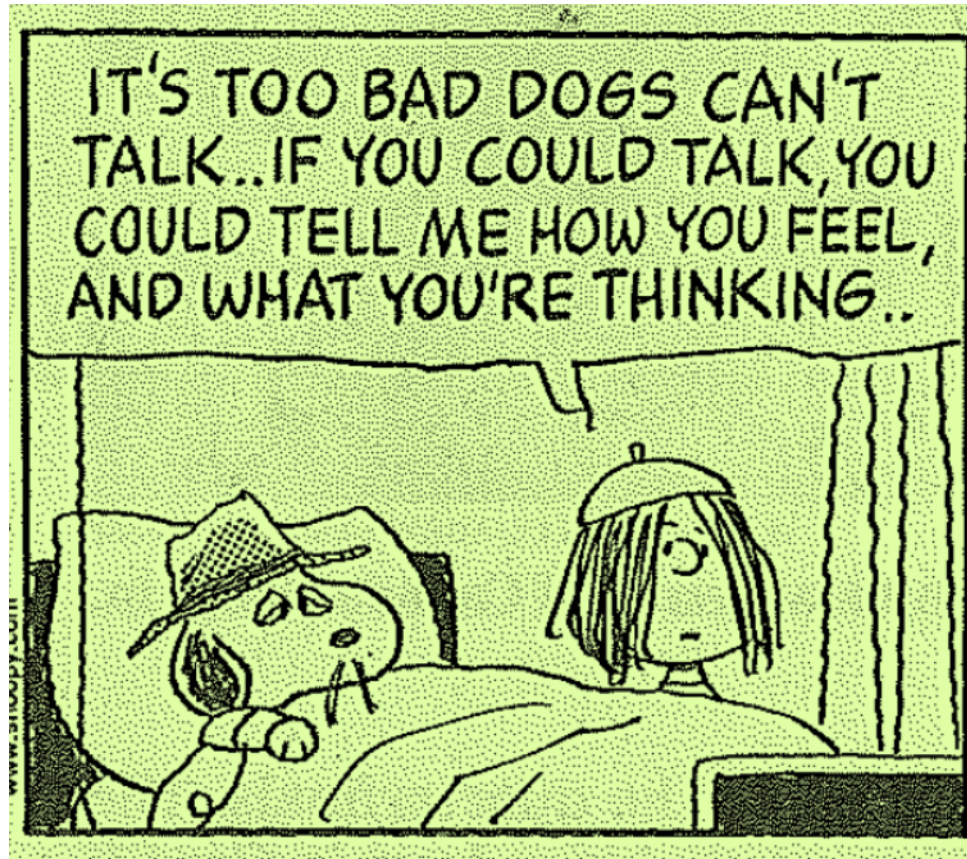


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# Introduction



# Health and Welfare

## Wellbeing

- Contested across disciplines
- Different meanings and associations for
- What is it?
- How can we (should we?) measure it?

Question:  
Is good husbandry  
more than absence  
of disease?

Oxford Institute  
of Social Policy

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# How important is the individual?



Do we care about individuals?

Do we always have that opportunity?

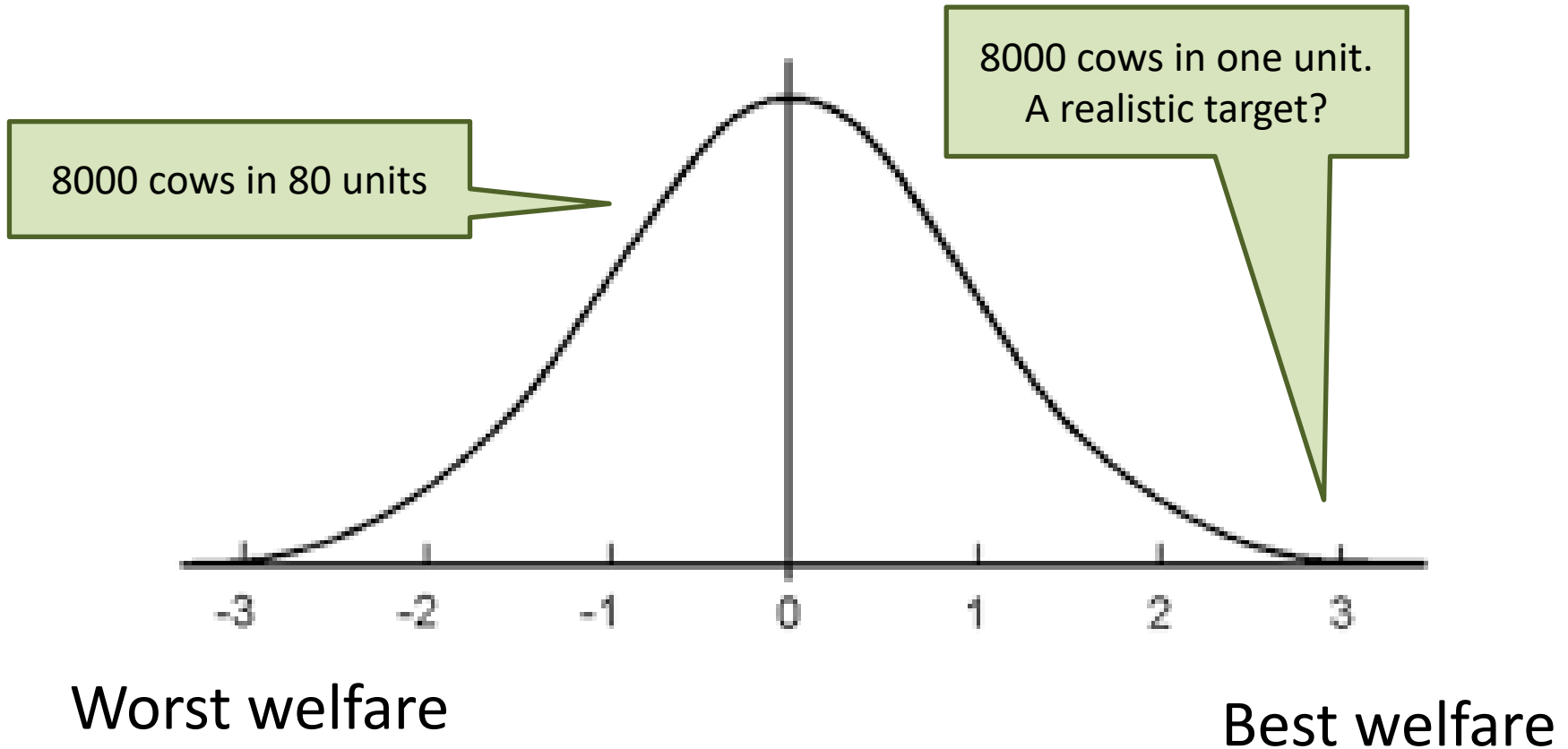
# Dairy Animal Welfare

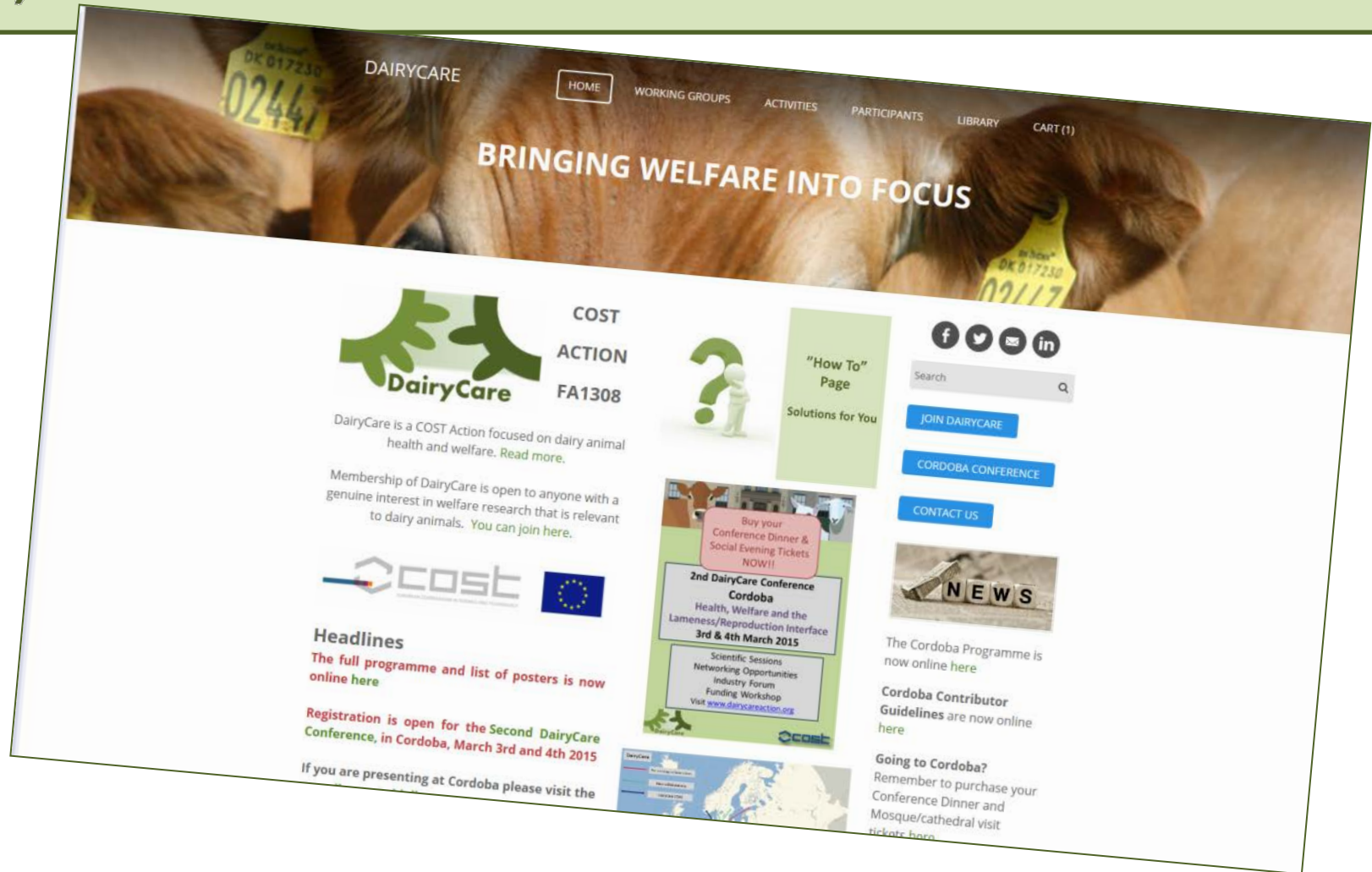


From The Sunday Times  
February 28, 2010  
**'Battery' dairy of 8,000 cows sparks protests**

- EU dairying: the "bigger is better" problem
- How do we achieve good management in large units?
- How do we spot problems?
- Can the cow remain an individual?

# Before you criticise big...






DAIRYCARE



HOME WORKING GROUPS ACTIVITIES PARTICIPANTS LIBRARY CART (1)

## BRINGING WELFARE INTO FOCUS

 **COST ACTION FA1308**

DairyCare is a COST Action focused on dairy animal health and welfare. [Read more.](#)

Membership of DairyCare is open to anyone with a genuine interest in welfare research that is relevant to dairy animals. You can join here.

**Headlines**  
 The full programme and list of posters is now online [here](#)

Registration is open for the **Second DairyCare Conference, in Cordoba, March 3rd and 4th 2015**

If you are presenting at Cordoba please visit the [Cordoba website](#)

**"How To" Page**  
Solutions for You

Buy your Conference Dinner & Social Evening Tickets NOW!!

**2nd DairyCare Conference Cordoba**  
 Health, Welfare and the Lameness/Reproduction Interface  
**3rd & 4th March 2015**

Scientific Sessions  
 Networking Opportunities  
 Industry Forum  
 Funding Workshop  
 Visit [www.dairyreaction.org](http://www.dairyreaction.org)

**NEWS**

The Cordoba Programme is now online here

**Cordoba Contributor Guidelines** are now online here

**Going to Cordoba?**  
 Remember to purchase your Conference Dinner and Mosque/cathedral visit tickets [here](#)

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# What is DairyCare?

- A researcher network focused on dairy animal health and welfare
- Funded by COST: 141K € this year
- More than 650 members, 30+ countries
- Multidisciplinary
  - Biologists, ethologists, engineers, computer scientists, etc etc
- Organising and funding scientific conferences, researcher exchanges and other activities



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# DairyCare Key Objectives

- To improve the wellbeing of dairy animals through two mechanisms:
  - Accelerated development and application of relevant biotechnologies that will assist and promote good husbandry
  - Wider dissemination of best-practices
- Note: COST does not fund actual research

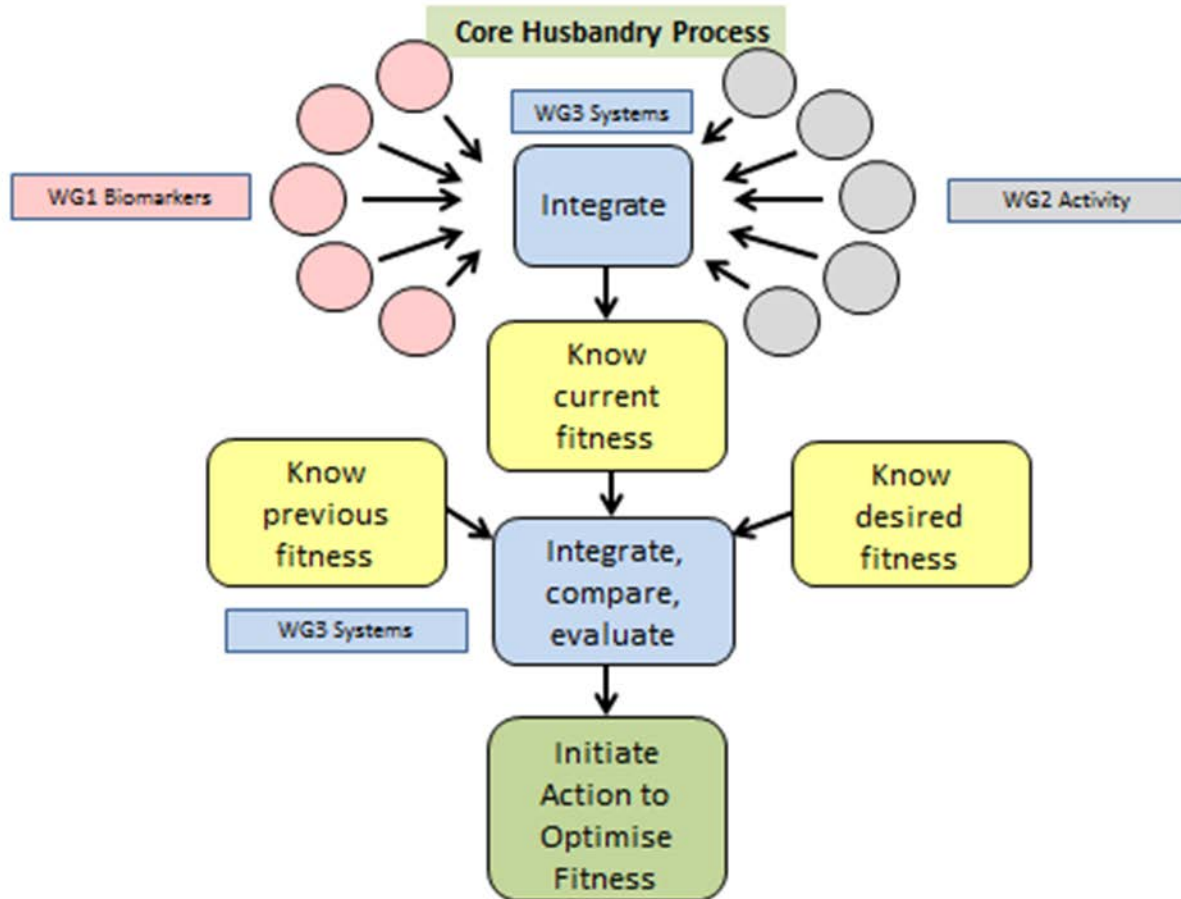


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# DairyCare Core Scientific Focus: Knowing the Animal



- WG1 Biomarkers
- WG2 Activity
- WG3 Systems



# DairyCare Deliverables (examples)

- Novel biotechnologies for:
  - Automated monitoring of dairy cow wellbeing
  - Automated detection of sub-clinical problems (eg SARA)
  - Automated monitoring of feeding behaviour
  - Automated detection of lameness
- Tailored "smart" husbandry support systems for automated herd management
- DairyCare "Blueprint for Action"

**Knowledge translated into effective decision making**



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# First DairyCare Conference

- Copenhagen, August 2014
- Health and Welfare of Dairy Animals
  - What data do we need?
  - What data can we get?
  - How can we use that data?
- WG sessions:
  - WG1 focus on 'omics technologies
  - WG2 focus on automated activity measures state of the art
  - WG3 focus on data acquisition and management



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# DairyCare Copenhagen papers



## What Data Can We Get? The Potential for Omics in DairyCare

**Professor David Eckersall**  
**Veterinary Gene & Protein Group**  
**Institute of Biodiversity, Animal Health & Comparative  
Medicine**  
**University of Glasgow**



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# DairyCare Copenhagen papers

## State of the art of automated activity measuring technologies, and how to accelerate technology development

Matti Pastell  
MTT Agrifood Research Finland



# DairyCare Copenhagen papers

**AUTOMATED ACTIVITY MEASURING  
ADOPTION AND ECONOMIC CONCERNS**



Jeffrey Bewley, Amanda Sterrett, Randi Black  
Barbara Wadsworth, Di Liang  
Matthew Borchers, Lauren  
Maegan Weatherly, Melissa  
Smith, Megan Hardy, a

## Precision Dairy Technologies: A Producer Assessment

Matthew R. Borchers and Jeffrey M. Bewley  
University of Kentucky  
Department of Animal and Food Sciences



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# Second DairyCare Conference

- Cordoba, March 2015
- Health, Welfare and the Lameness/Reproduction Interface
- Scientific Sessions
- Industry Platforms
- Funding Workshop



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# Third DairyCare Conference

- Zadar (Croatia), October 2015
- Feeding Behaviour as an Indicator of Health and Welfare
- Scientific Sessions
- Internationalisation Session
- Publishing Workshop



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# DairyCare Focused Workshops

- WG1 Meeting: **HPA Axis, Cortisol and other Stress Biomarkers.** Bern, September 2015
- WG3 Meeting: **Sub-acute ruminal acidosis.** Glasgow, April 2016
- WG2 Meeting: **Activity measurement in Ruminant Research and Beyond.** Leeuwarden, June 2016 (Joint with Precision Dairy Farming Conference)

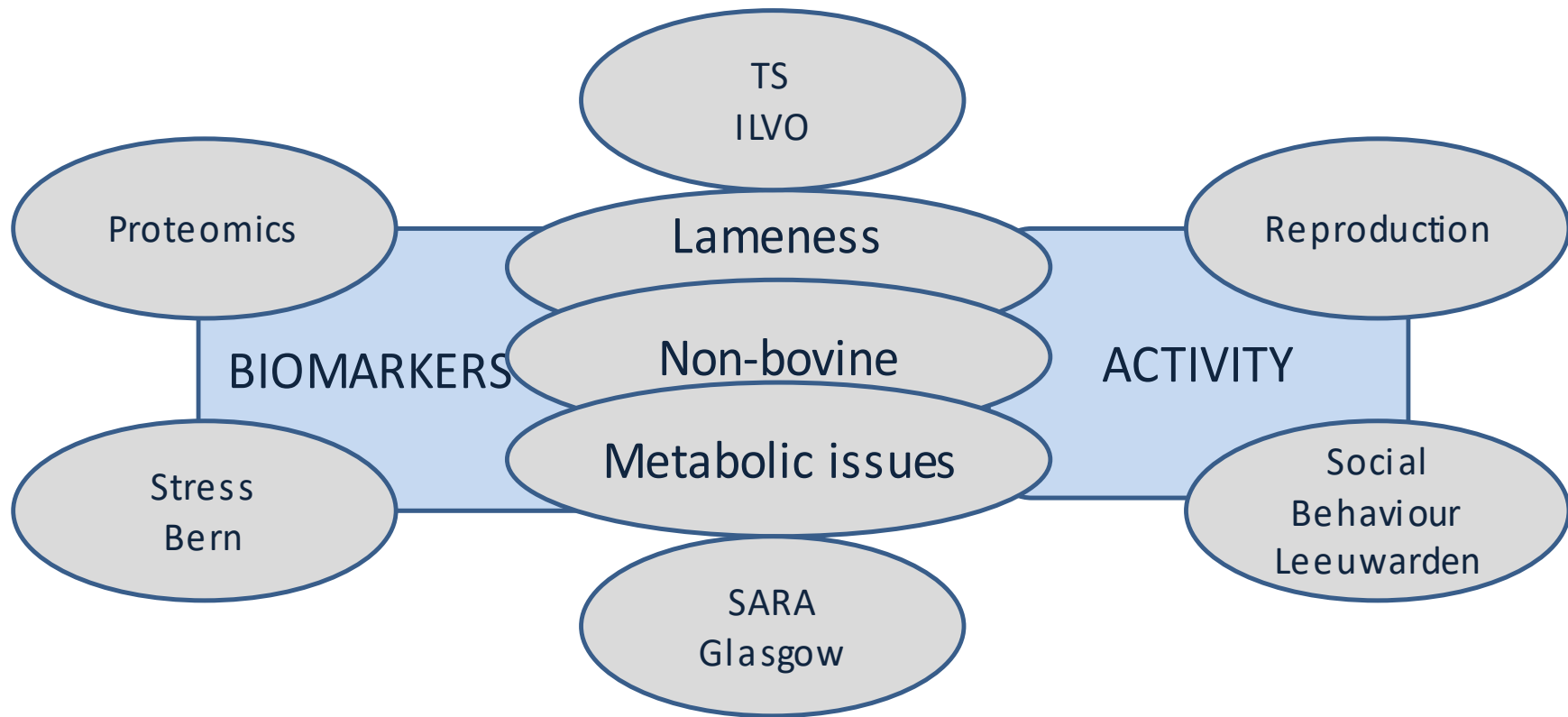


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# Overview of Previous Topics





# Fourth DairyCare Conference

- Scheduled for October 13th/14th 2016 in Lisbon
- Lifelong Health and Welfare Sensing
- Big Data and the Internet of Things



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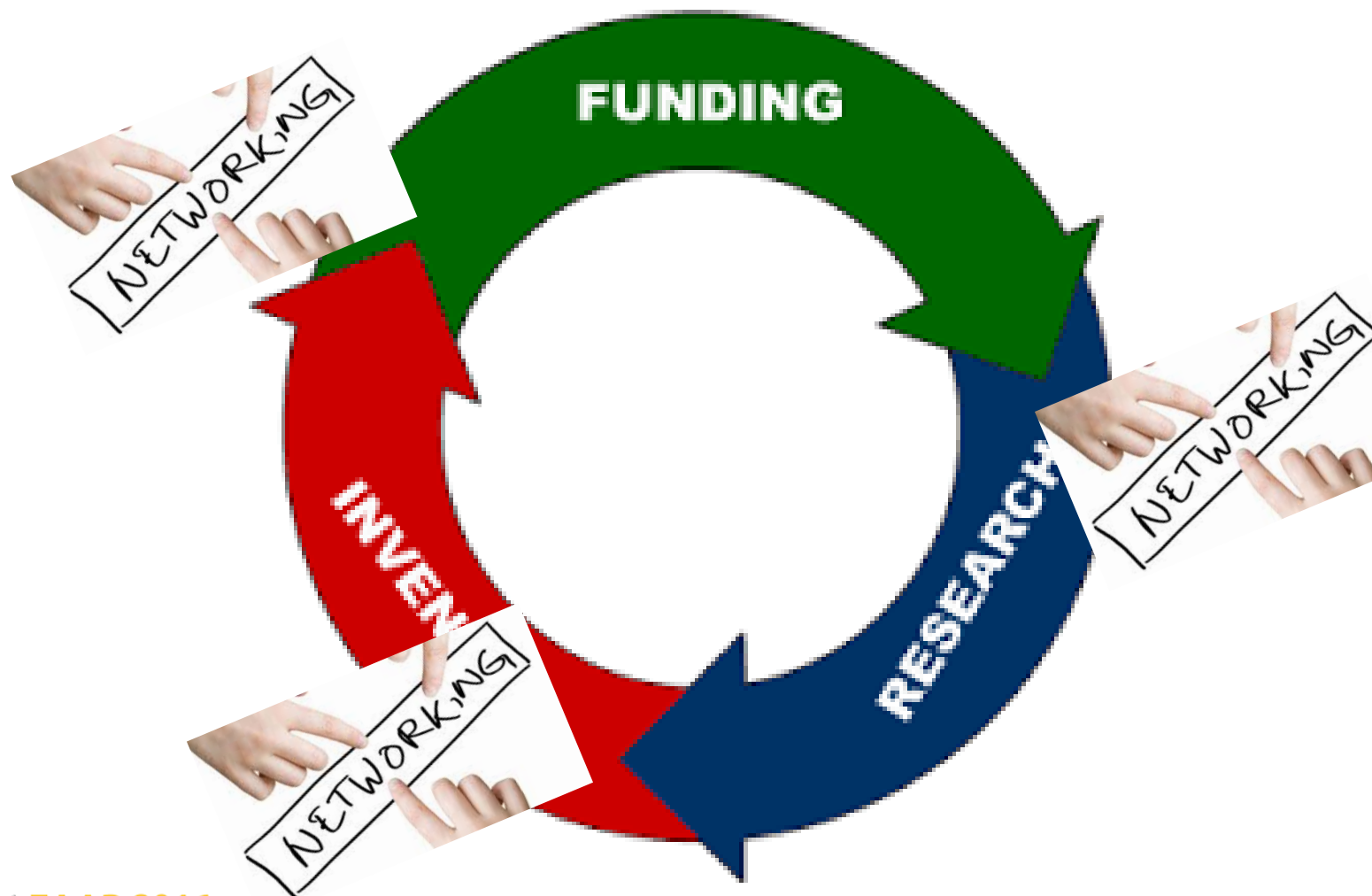
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# COST does NOT fund research!



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**Smart Farming for Europe**  
Value creation through **Precision Livestock Farming**

**EU - PLF**

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You are here: [Home](#) > [EU-PLF final conference](#)

## EU-PLF final conference



**atf** animal task force  
A European Public-Private Platform

**EU - PLF**

**NEWS**

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## SFS-05-2017: Robotics Advances for Precision Farming

Specific Challenge: The specific challenge here is to help attain high levels of precision in modern farming through the smart use of robotics. The technological challenge is to develop and demonstrate new robotics technologies in real-world scenarios involving such as automated mobility around irregular farmland areas, accurate sensing of crop and livestock conditions, and dextrous manipulation of farmed produce. Farming is facing many economic

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<sup>15</sup> See definition of the 'multi-actor approach' in the introduction of this Work Programme part.

## Dairy ICT

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RESEARCH

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**Hello cow, how are you today?** A simple question, but understanding the answer is not easy!

**DairyICT** is a consortium of researchers from 6 European countries whose goal is to find ways of answering the question, using modern and advanced technologies of data sensing, data computation and advice formulation.

**The outcomes** from our research will be better wellbeing for dairy cows and improved profitability for dairy farmers.



# DairyICT: Building on Existing Technology




Herd Navigator:  
Progesterone  
LDH  
BHB

Add  
SARA

Add  
lameness



 **Silent Herdsman™**  
Estrus detection

Add  
feeding  
activity



## ***Silent Herdsman; Automatic Classification of Eating and Ruminating in Cattle using a Collar Mounted Accelerometer***

**Jakub Konka<sup>1</sup>, Craig Michie<sup>1,2</sup>, Ivan Andonovic<sup>1,2</sup>**

<sup>1</sup> Department of Electronic and Electrical Engineering  
University of Strathclyde,  
Glasgow, Scotland



<sup>2</sup> Silent Herdsman Ltd  
Glasgow, Scotland

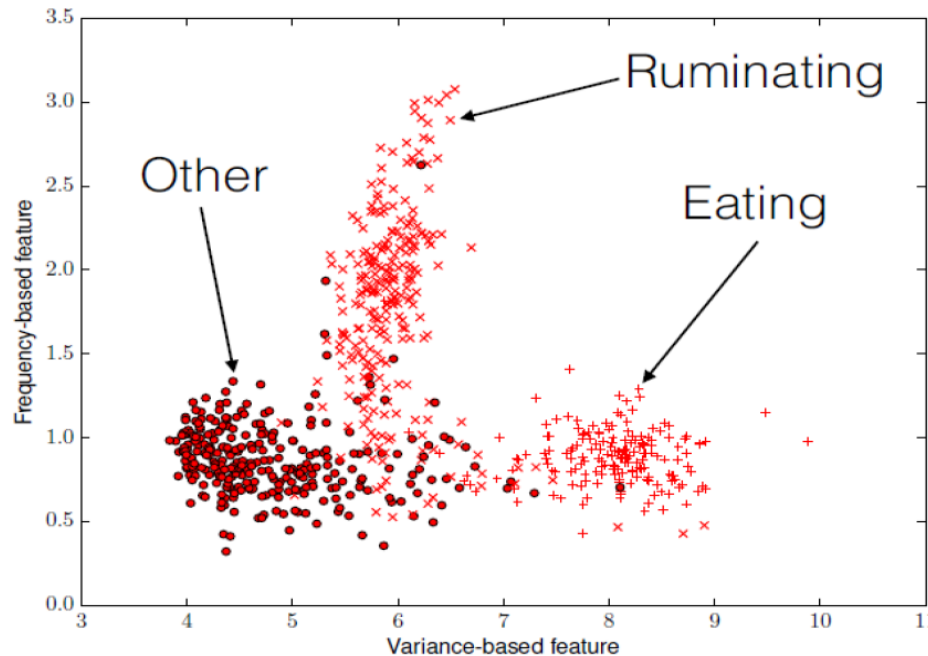




# Activity data as proxy for feeding behaviours



## Clustering Procedure



# ERA Net: Novel Biomarkers

Novel (adjective):

Interestingly new or unusual

Existing biomarkers looked at in novel ways

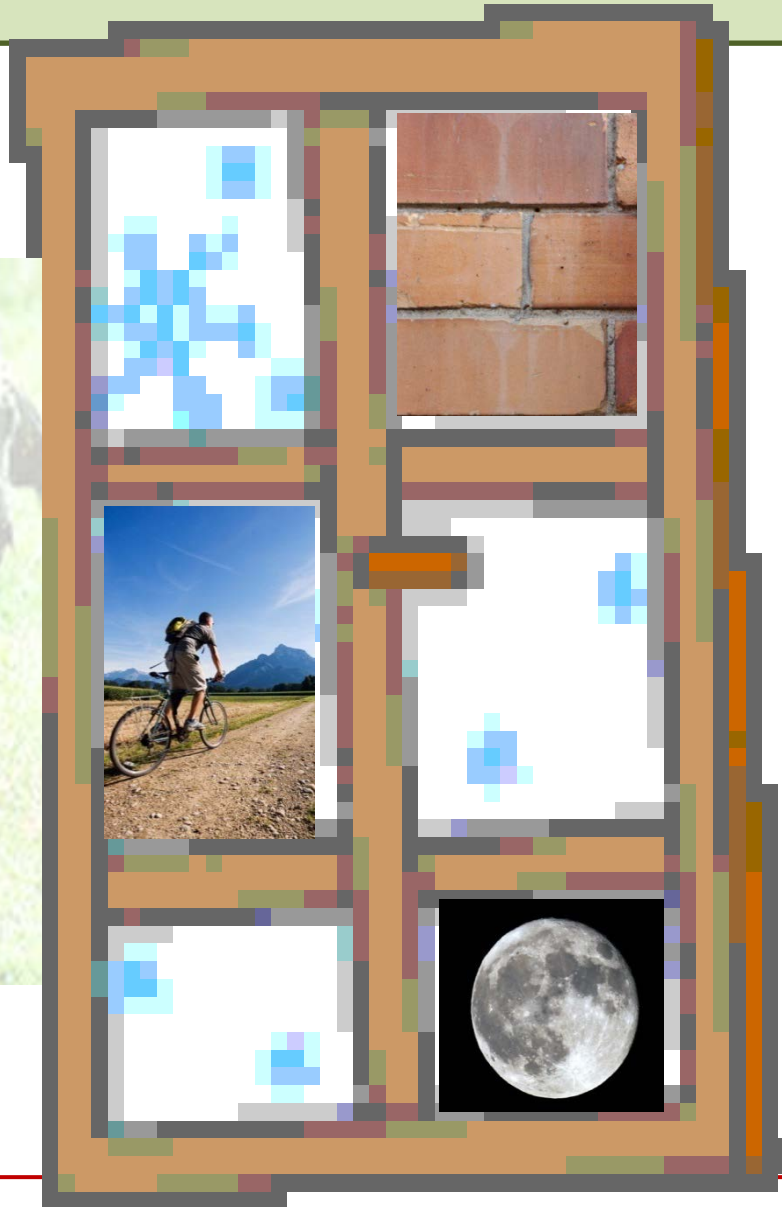
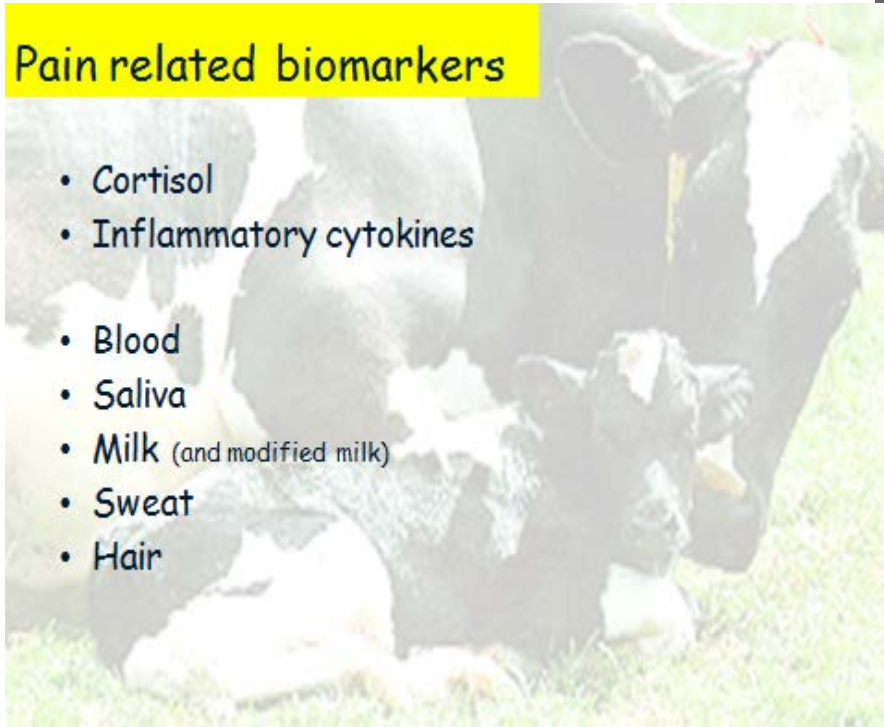
- Focus on:
  - non-invasive sampling
  - automated (robotic) sampling
  - multiple application samples
  - minimal effective data



# A novel approach to stress biomarkers

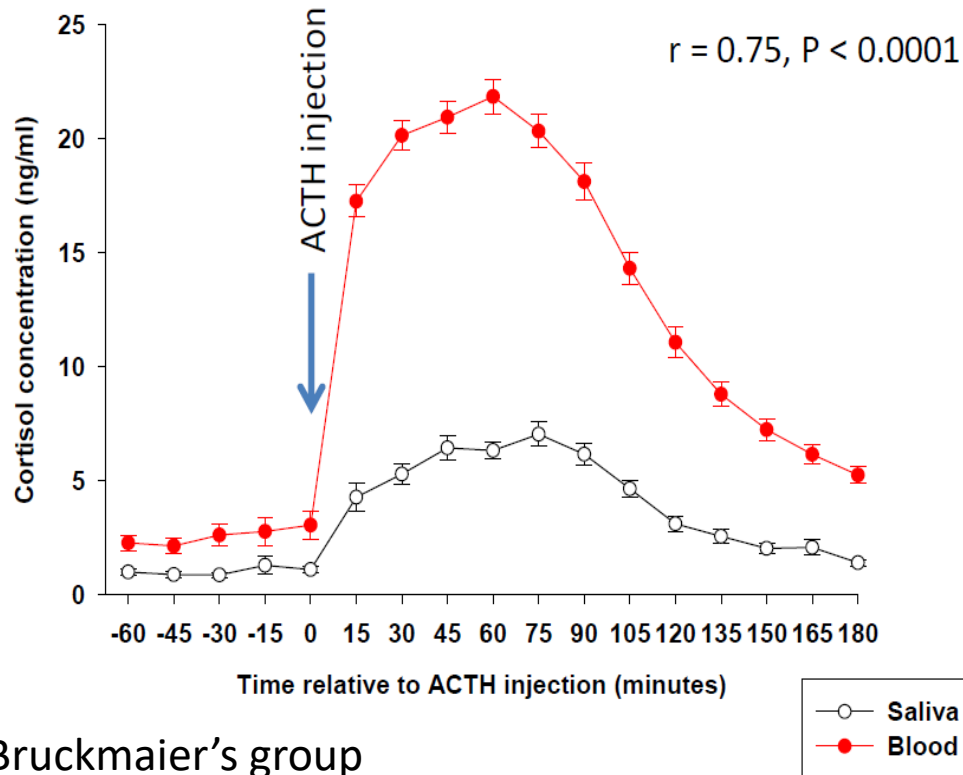
## Pain related biomarkers

- Cortisol
- Inflammatory cytokines
- Blood
- Saliva
- Milk (and modified milk)
- Sweat
- Hair



# Saliva: a non-invasive gold standard?

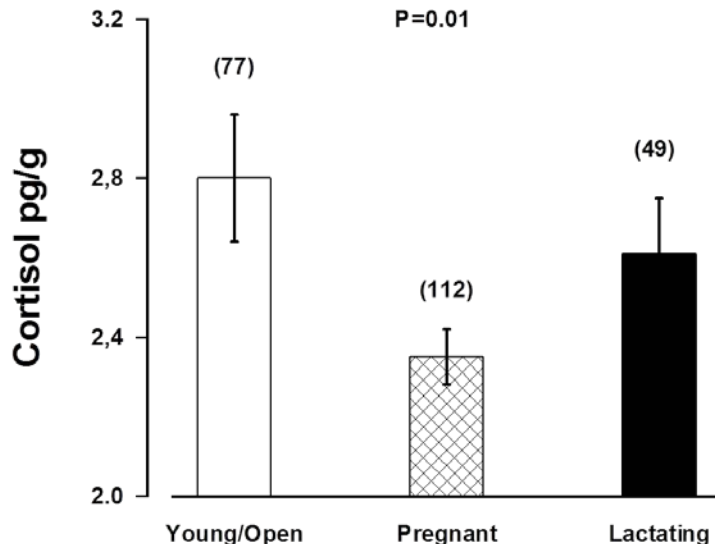
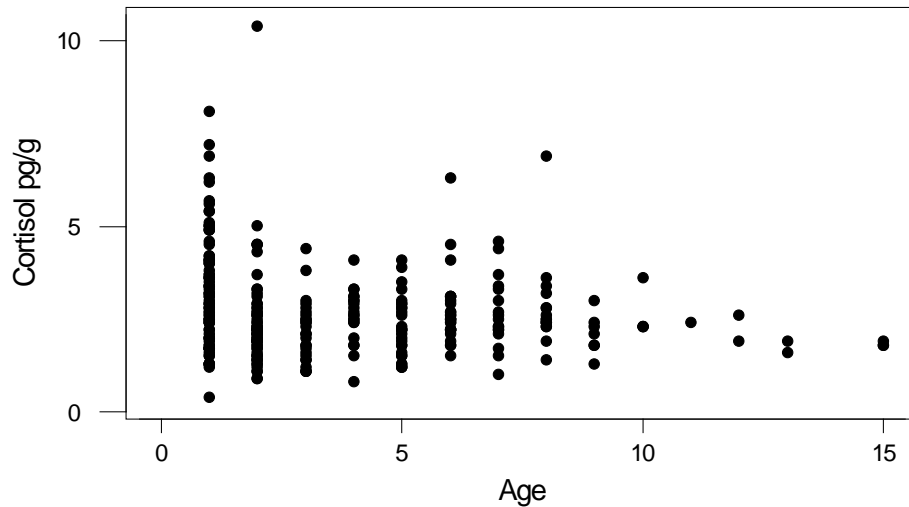
## Results – Experiment 1 ACTH-Challenge



Data from Rupert Bruckmaier's group



# Hair cortisol: representative of chronic stress?



- Younger cattle had higher cortisol
- Pregnant cattle had lower cortisol than lactating cattle
- There were predictable effects of housing (not shown)

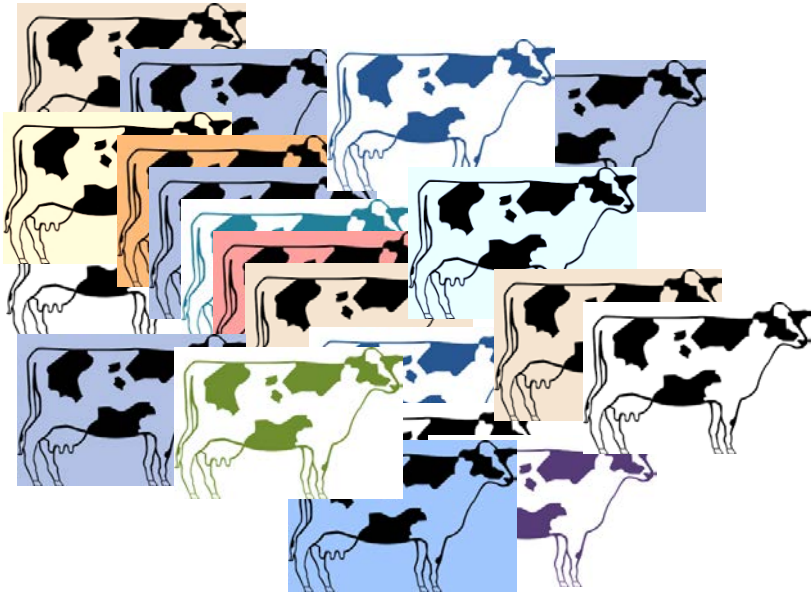
# Interpretation: husbandry is not diagnostic

- How do we interpret different (cortisol) concentrations?
- If we find "useful" changes within the individual cow, does it matter?
- The objective is to deliver TLC to whom it is needed, when it is needed





# Focus on the cow, not the needle!

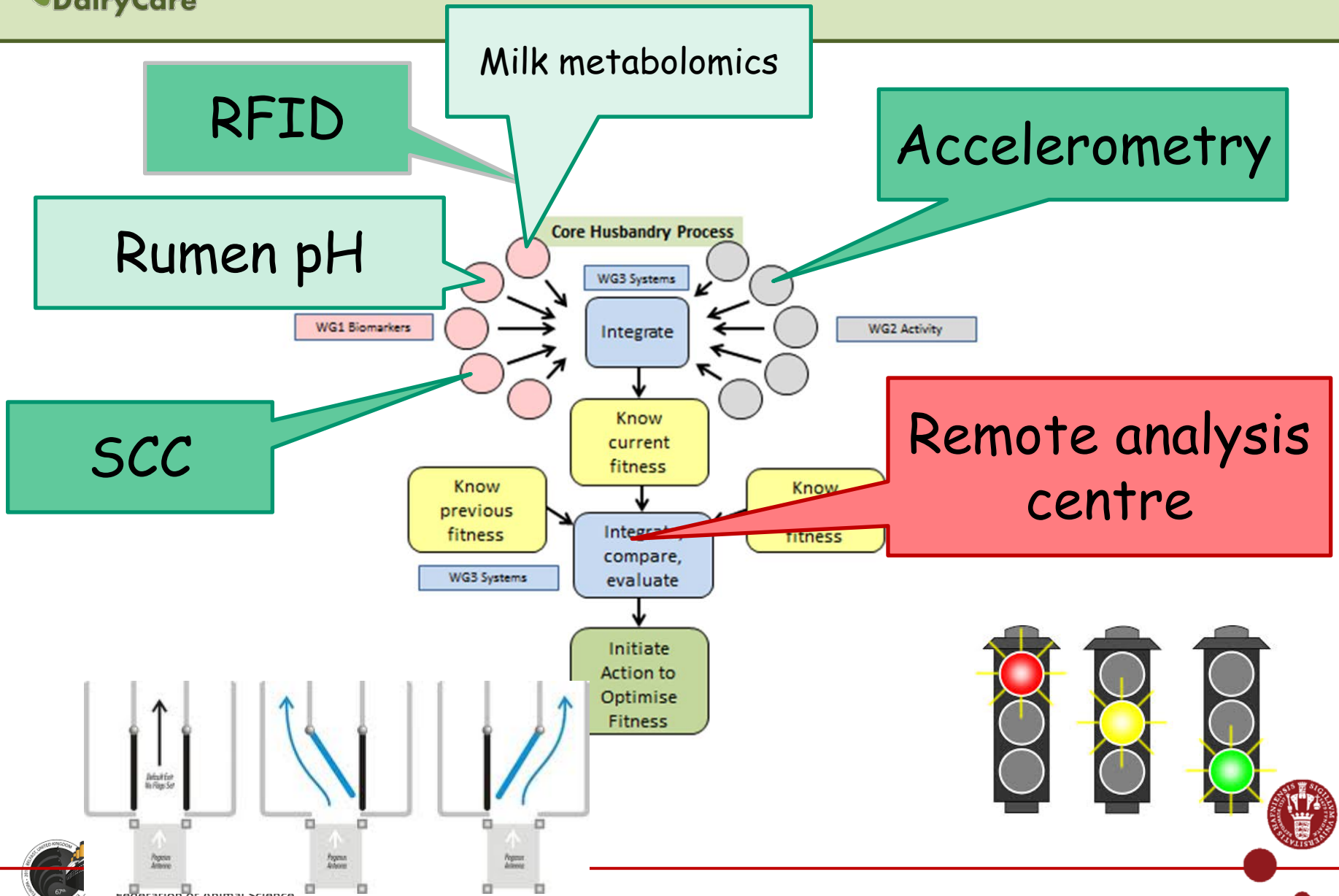


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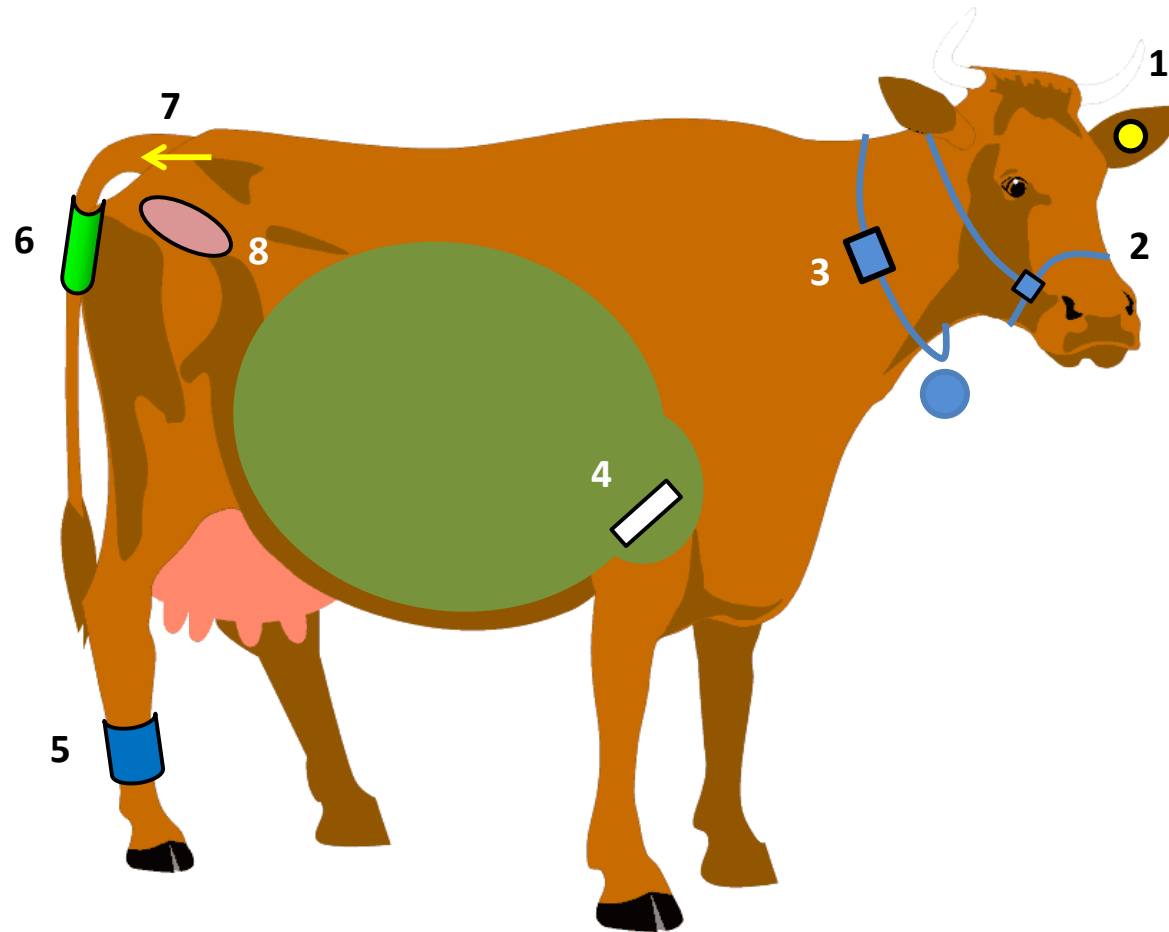


# DairyCare: What could we do now?





# DairyCare: We are not short of data



## Sensors in:

- Ear
- Head collar
- Neck collar
- Rumen
- Leg collar
- Tail collar
- Tailhead
- Vulva



# DairyCare: Getting more out of the data

**ICEROBOTICS**

PRODUCTS RESEARCH ABOUT US SUPPORT **NEWS** CONTACT

## ICEROBOTICS POSTER ON LAMENESS DETECTION PRESENTED AT DAIRYCARE CONFERENCE

March 3, 2015 by IceRobotics



Source: @Repro\_anim

*Validation of the CowAlert system to automatically detect lameness in dairy cattle*

**Activity combined with lying/standing time  
may be predictive of lameness**



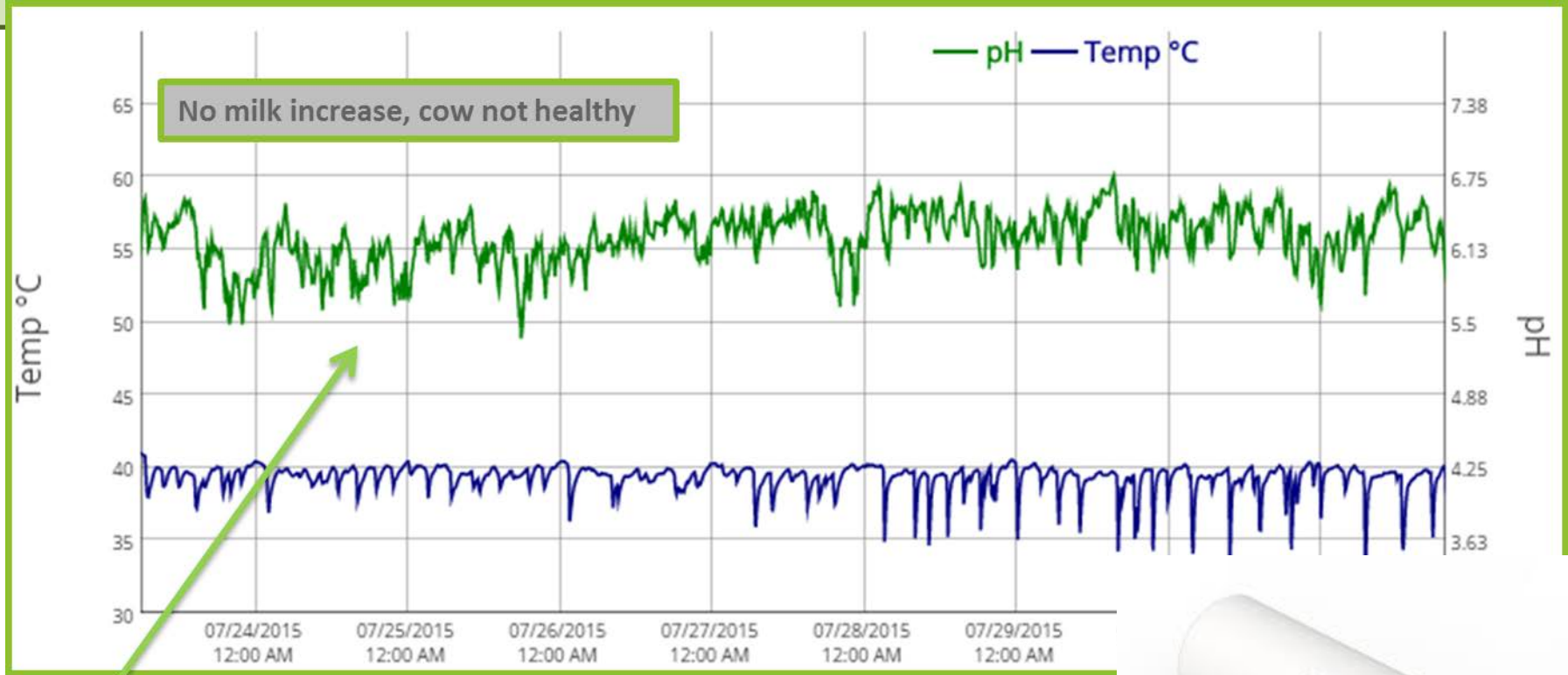
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# DairyCare: More, or less?



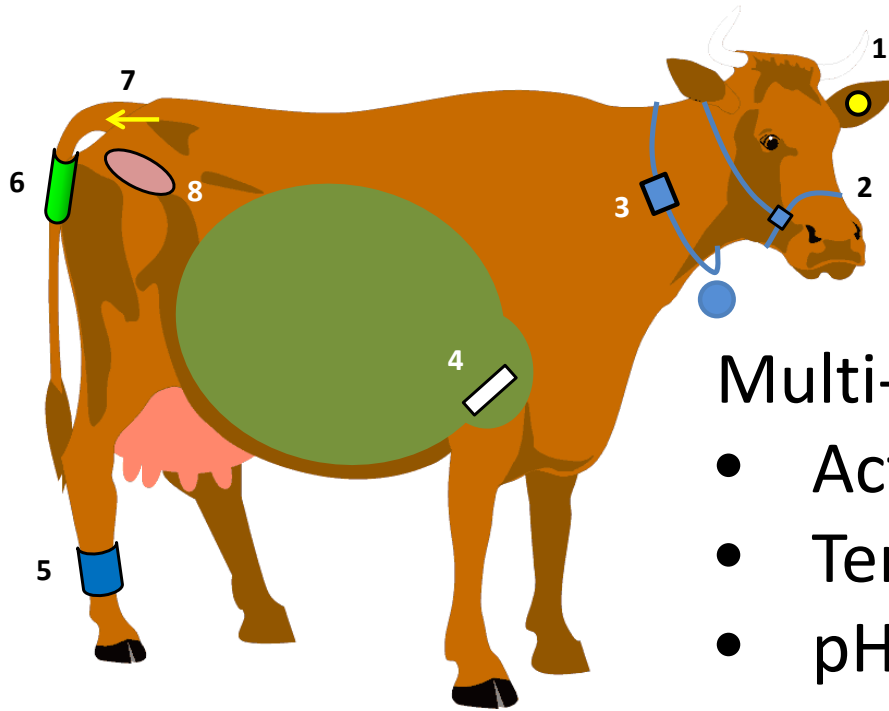
group change: back to close-up with TMR with less carbohydrates

Recovery: more milk unless lower NEL, increase of water intake



## Drinking activity

# derived from rumen temperature



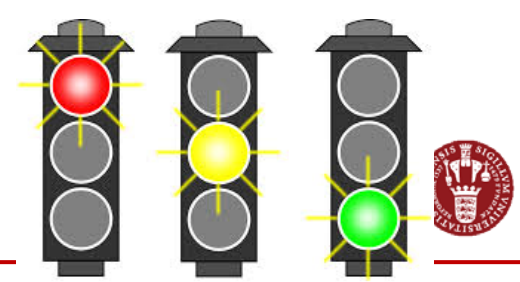
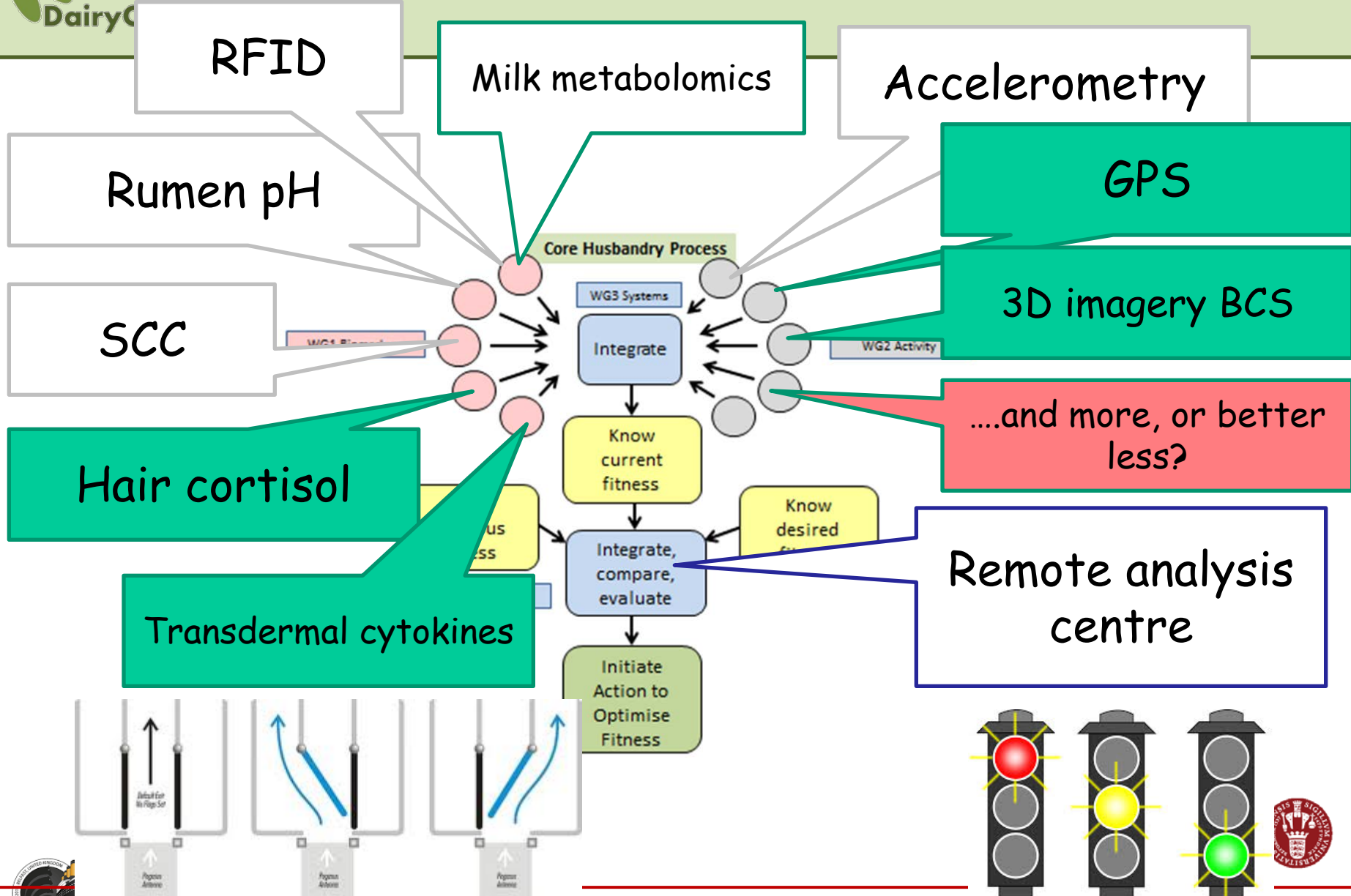
## Multi-application sensor in rumen?

- Activity
- Temperature: water intake
- pH
- Balance
- Feed intake
- Rumen motility.....



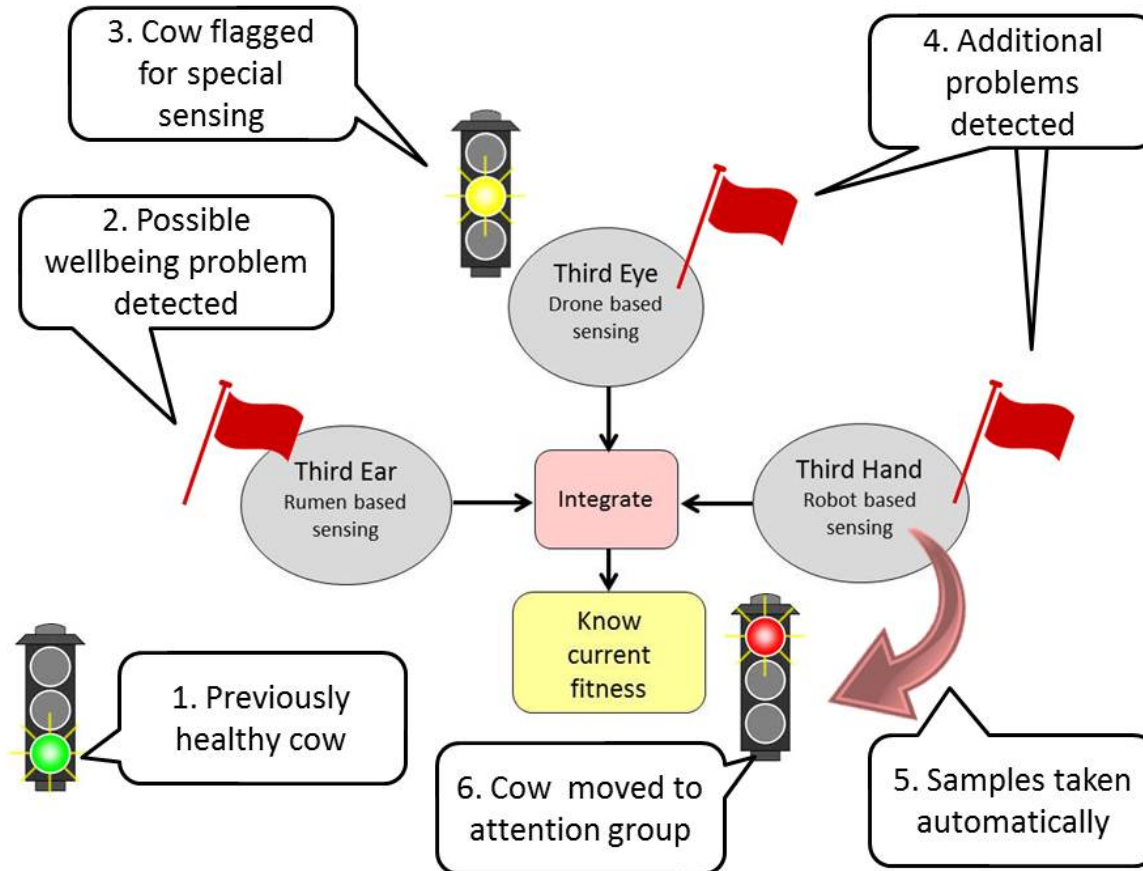


# What could we do in the future?





# DairyCare: "Third Sense" Progressive Integration Model





# DairyCare: Review in Journal of Dairy Research

*Journal of Dairy Research* (2016) **83** 136–147. © Proprietors of *Journal of Dairy Research* 2016. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.  
doi:10.1017/S0022029916000261

## Engineering to support wellbeing of dairy animals

Gerardo Caja<sup>1\*</sup>, Andreia Castro-Costa<sup>1</sup> and Christopher H. Knight<sup>2</sup>

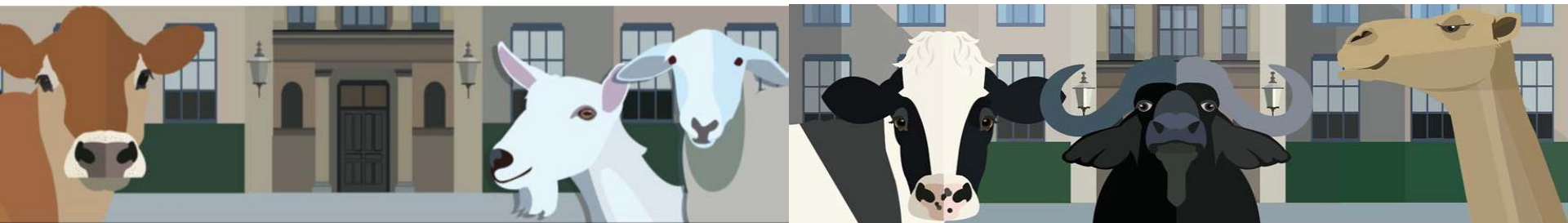
<sup>1</sup> Group of Research in Ruminants (G2R), Department of Animal and Food Sciences, Universitat Autònoma de Barcelona, Bellaterra, Spain

<sup>2</sup> University of Copenhagen IKVH, Dyrslægevej 100, 1870 Frb C, Denmark

Received 17 March 2016; accepted for publication 18 April 2016

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DairyCare:  
Thank you for your attention!



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