

# Translating individual on-line sensors data into animal welfare parameters

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# **Animal – environment interactions with impact on welfare**

- human-animal (milking and milking management)
- facilities-animal (self feeders, free stalls, milking robot)
- housing-animal (space and space sharing)
- management- animal (feeding, cooling)

# Five Freedoms that satisfy animal welfare

- Freedom from thirst, hunger and malnutrition
- Freedom from lack of appropriate comfort and shelter
- Freedom from pain, diseases and injuries
- Freedom from fear and stress
- Freedom to display most normal patterns of behaviour
- Freedom from frustration

# How can we decide about conditions that satisfy animal welfare requirements?

## Ask the cow

An animal manifests its feelings and well being by its behavioural and physiological response

Quantify behavioural, physiological and performance responses to the animal environment interactions described above

Under optimal conditions, these responses can serve as welfare references standards

# Quantify behavioural and physiological responses – sensors and software

- Behaviour
  - Activity monitoring sensors: Lying time and bouts(day, night), standing and walking (time and speed), feeding (trough, self feeders) behaviour (time, bouts), preferable allocations
- Physiology
  - Milking variables: milk let down time, milkability
  - Heart rate, body temperature, rumination time, rumen PH
- Performance
  - MY, milk composition, BW, BC

**Optimal conditions under which  
welfare is assessed**

**?**

# Lying behaviour – time and bouts

- Individual variations
- Along lactation variations
- Lactation number variations
- Season variations
- Physiological variations
- Housing facilities

# Freedom that satisfy animal welfare

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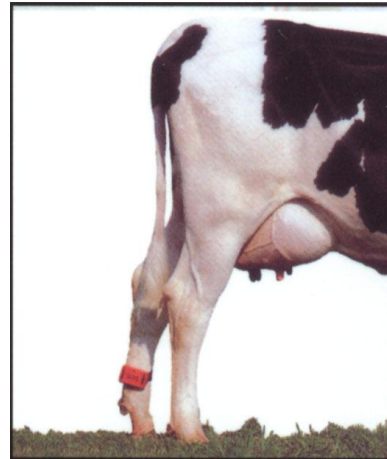


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# Lying behaviour – time and bouts

- There are several sensors, commercially available that measure these variables



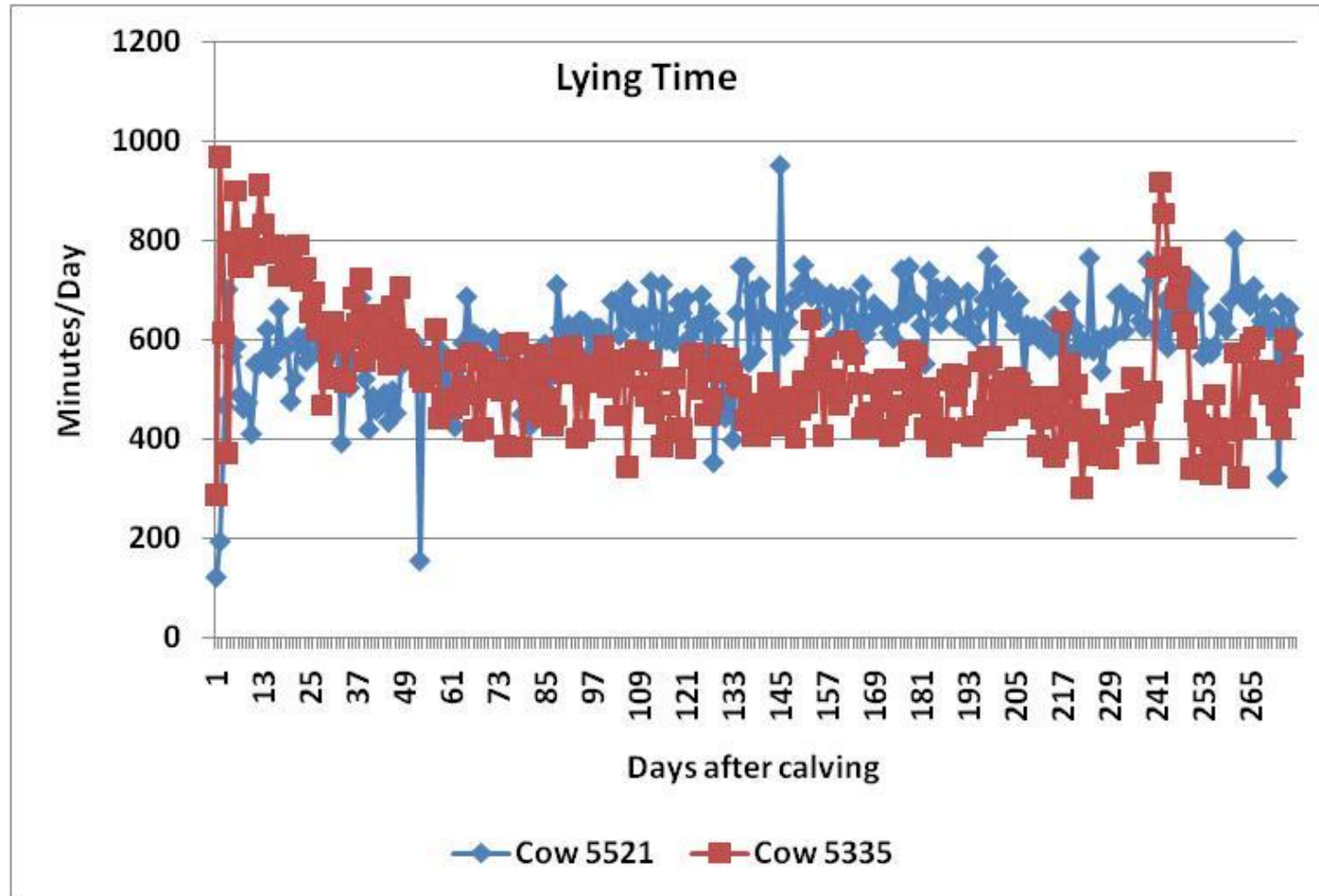
**IceRobotics**

**III S.A.E. AFIKIM**  
COMPUTERIZED DAIRY MANAGEMENT SYSTEMS

# Lying behaviour – fully roofed no stall barn

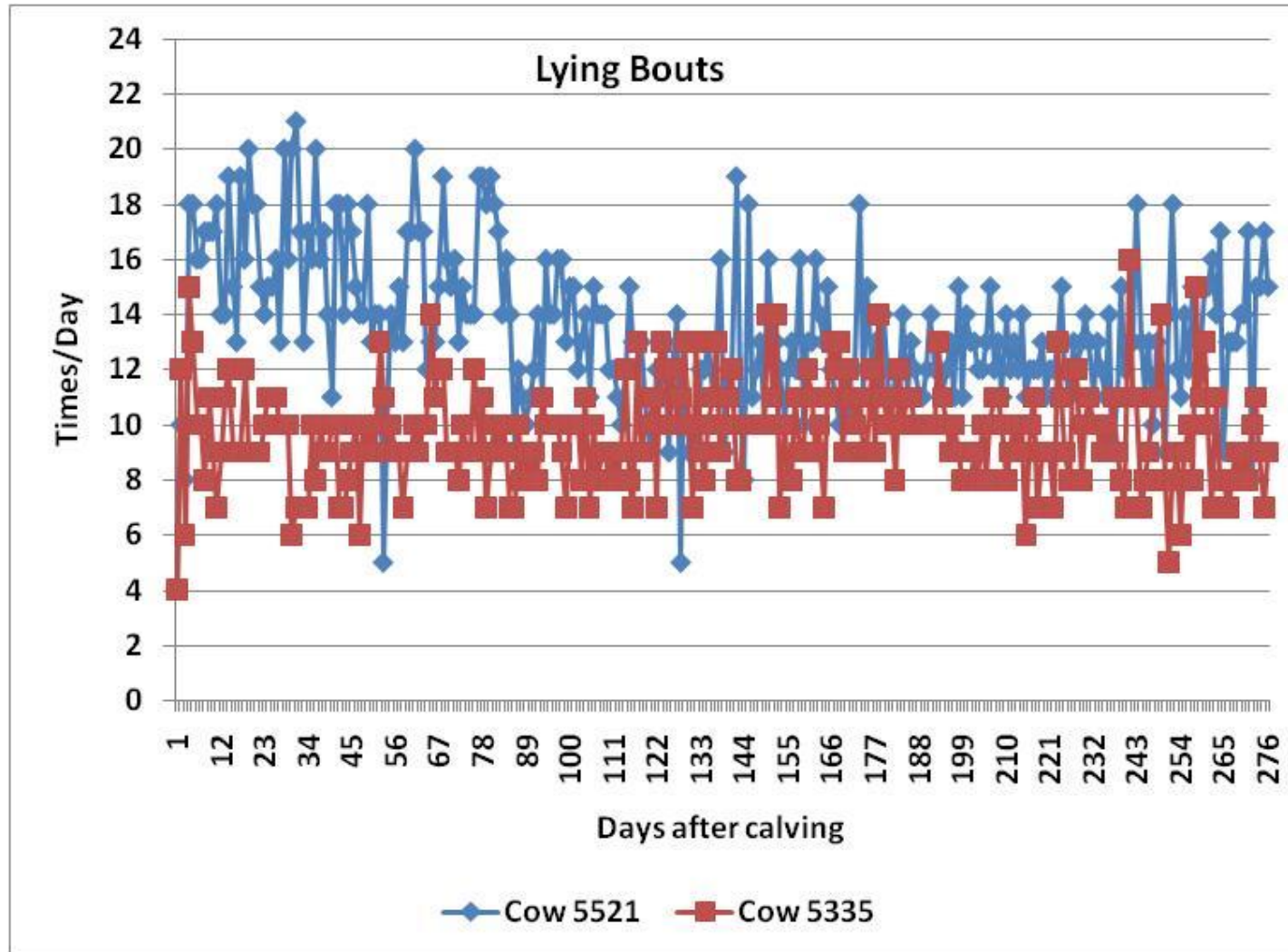


# Lying behaviour – fully roofed no stall barn

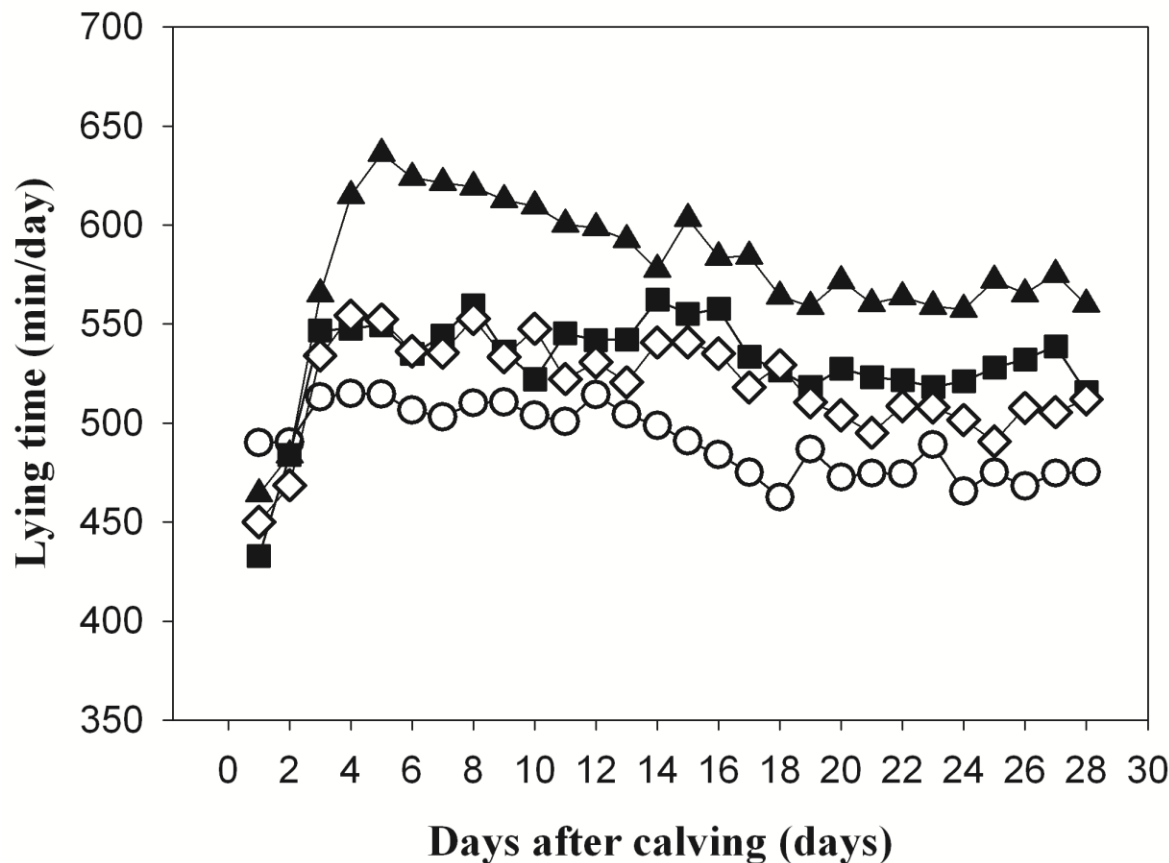




# Lying behaviour – fully roofed no stall barn

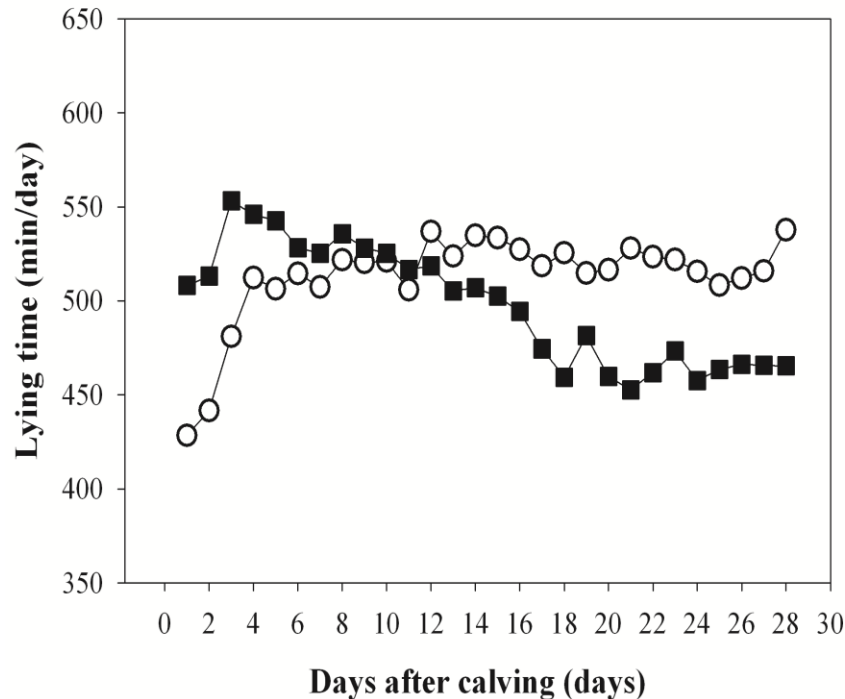


# Lying time – lactation, summer winter



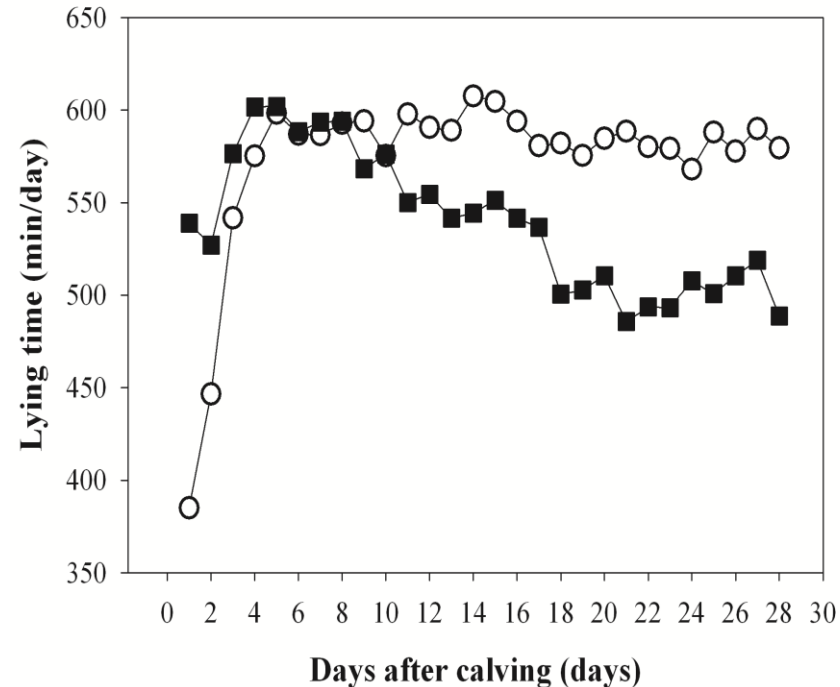
Summer and winter lying time of cows with two lactations and with three or more lactations (○ Summer – Lactation 2, ■ Winter – Lactation 2, ◇ Summer – Lactation 3 and more, ▲ Winter – Lactation 3 and more).

# Lying time – summer winter and correlation between milk production and lying time



Lying time of summer calving cows with positive and negative correlation between milk production and lying time

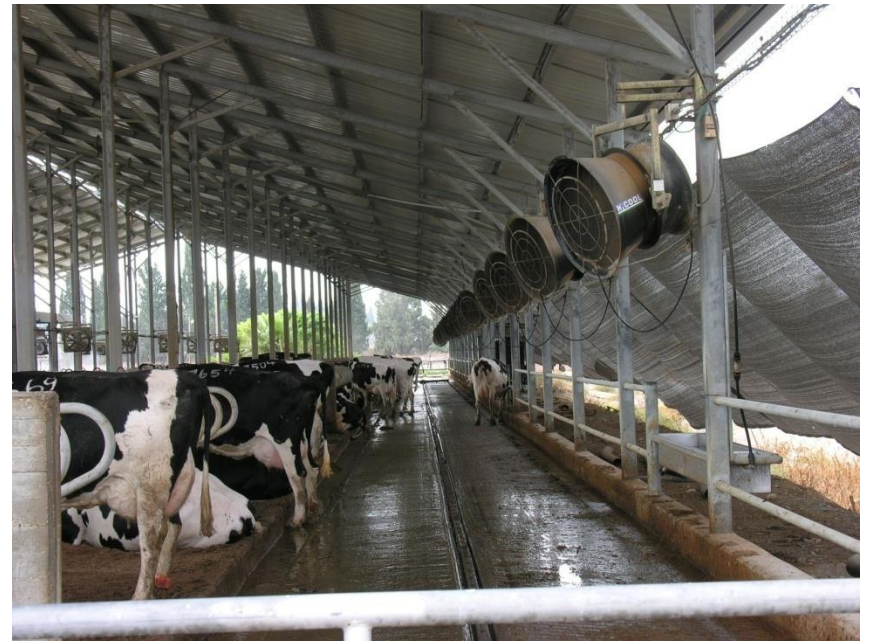
(○ Positive correlation, ■ Negative correlation).



Lying time of winter calving cows with positive and negative correlation between milk production and lying time

(○ Positive correlation, ■ Negative correlation).

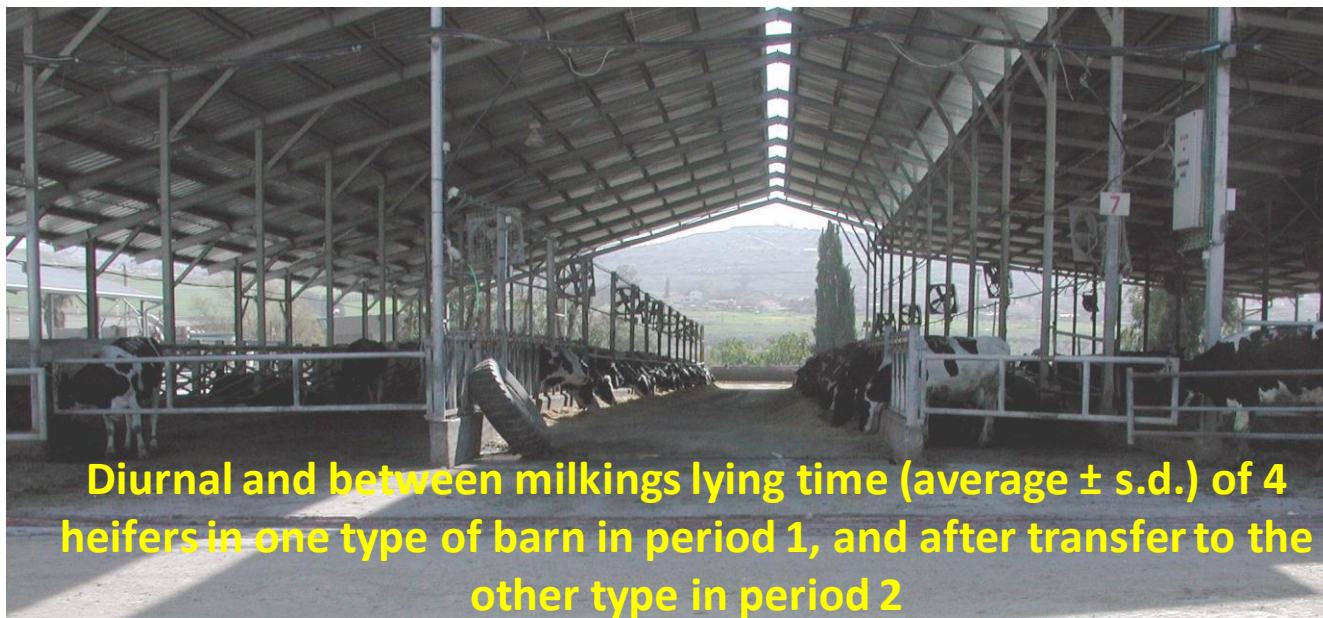
# Lying time – free stalls





# Lying time – fully roofed no stall barn vs free stalls





Time interval	Period 1 (min)		Period 2 (min)	
	No-stall	Free-stalls	No-stall	Free-stalls
04:30 - 12:30	153 $\pm$ 41 <sup>*a</sup>	120 $\pm$ 39 <sup>*</sup>	178 $\pm$ 55 <sup>a</sup>	126 $\pm$ 55
12:30 - 20:30	110 $\pm$ 45 <sup>*</sup>	113 $\pm$ 48 <sup>*</sup>	148 $\pm$ 46 <sup>a</sup>	78 $\pm$ 43
20:30 - 04:30	254 $\pm$ 51 <sup>*a</sup>	180 $\pm$ 56 <sup>*</sup>	259 $\pm$ 58 <sup>a</sup>	200 $\pm$ 75
24h total	517 $\pm$ 73 <sup>*a</sup>	414 $\pm$ 77 <sup>*</sup>	585 $\pm$ 75 <sup>a</sup>	404 $\pm$ 69

<sup>a</sup> significant differences ( $p < 0.01$ ) within period

<sup>\*</sup>Significant differences of the same group ( $p < 0.01$ ) between periods,

**No change in milk production and body weight was observed following transfer**

# Translating individual on-line sensors data into animal welfare parameters

- In the case of lying behaviour
  - Individual variability
  - Season effect
  - Facilities effect and maintenance
- 1. Diversion of individual cow values from group values
- 2. Diversion of individual cow values from its own normal values

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# Milking

- The one single action in the conventional dairy operation that humans interact with animals routinely
- 2-3 times a day
- Not always by the same people

# Freedom that satisfy animal welfare

- Freedom from thirst, hunger and malnutrition
- Freedom from lack of appropriate comfort and shelter
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This indications can be obtained from two sensors, ID, milk meter, automatic cluster detacher and a timer

The arrangement time in the milking parlor (first and last ID in the milking group)

Time between successive milking groups (last cluster detachment, first attachment)

Group milking time (first cluster attachment, last detachment)

Time group spends in the parlor (first ID, group release)



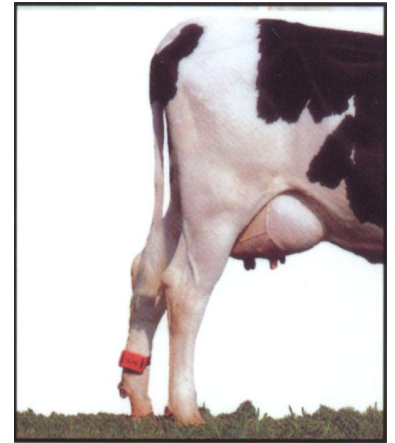
Waiting time of each cow (time between ID and attachment)



Milking time of each cow (time between attachment and detachment)

**Amount milked at any time interval**

**Milk flow rate at any time interval along milking**



All of which are variables that can provide reliable information about **pain fear and stress**

**Milk yield of morning milking (MY), Average milking time (AMT), average peak flow, and parlor performance parameters, of an exceptional morning milking compared to the same parameters of the regular previous morning milking. All differences are significant ( $P < 0.05$ )**

<b>milking</b>	<b>MY (kg)</b>	<b>AMT (min)</b>	<b>Peak flow (kg/min)</b>	<b>Between loads (min)</b>	<b>First to last ID in load (min)</b>	<b>Loads per hour</b>	<b>Milking time (h)</b>
<b>Normally average 47.2% of cows flow &lt;1 kg/min in the first 15 sec after attach</b>							
<b>Regular</b>	<b>11.9</b>	<b>5.20</b>	<b>2.29</b>	<b>5.4</b>	<b>3.2</b>	<b>8.23</b>	<b>4.13</b>
<b>Exceptionally 65.9% of cows flow &lt;1 kg/min in the first 15 sec after attach</b>							
<b>Exceptional</b>	<b>11.4</b>	<b>5.52</b>	<b>2.07</b>	<b>4.3</b>	<b>2.6</b>	<b>8.87</b>	<b>3.83</b>



# Translating individual on-line sensors data into animal welfare parameters

- In the case of milking
  - Group values of milking cohorts is more practical for welfare assessment than Individual values
  - Season effect (?)
  - Facilities effect and maintenance (size, type, milking equipment, milking routine)
- 1. Diversion of cohorts, milking groups or herd values from expected normal values

# Conclusions

- **Sensors on individual cow basis provide most of the information we need to evaluate dairy cows well being in any dairy that is equipped with them**
- **We have to decide about the environmental, physiological and local conditions under which behavioural and physiological standards indicate adequate wellbeing**
- **Diversion from normal behaviour of activity and physiological variables on individual and group values is likely to be the most efficient tool to assess changes in dairy cow well being**

# **Conclusions**

**The dairy operation is NATURE for the dairy cow**

# Thank You

