Genomic Selection for Improved Fertility of Dairy Cows with Emphasis on Cyclicity and Pregnancy
Transition management: Grouping Strategies and Reproduction

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Strategies to Improve Transition Cow Health

- Management
  - Duration of the close-up period
  - Reproductive management
  - Comfort
    - Minimize heat stress
  - House heifers and cows separately
  - Stocking density
  - Regrouping

- Nutritional
  - Intake: dry matter and water
  - Anionic salts
    - ↓ Hypocalcemia
  - Monensin and choline
    - ↓ Ketosis
  - Fatty acids (omega 6)
    - ↑ Pro-inflammatory

- Hormonal
  - rbST
    - ↑ Immunity & ↓ ketosis

- Immunity & ketosis
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“Stress is part of life and it is not inherently bad ... All life forms have evolved mechanisms to cope with the stresses of their lives”

Moberg and Mench, 2000
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“We have come to accept that animals also suffer from the burden of stress, and that when suffering from stress they develop very similar pathologies (to humans) ... while experiencing severe stress, animals can succumb to disease or fail to reproduce or develop properly ...”

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The Biology of Animal Stress: Basic Principles and Implications for Animal Welfare

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• “We have come to accept that animals also suffer from the burden of stress, and that when suffering from stress they develop very similar pathologies (to humans) … while experiencing severe stress, animals can succumb to disease or fail to reproduce or develop properly …”

• “It is the recognition of these harmful effects of stress that has sensitized us to the importance of stress to an animal’s welfare or wellbeing”

• “Our challenge is to differentiate between little non-threatening stresses of life and those stress that adversely affect an animal's welfare”

Moberg and Mench, 2000
Animal Well-being:
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Public Perception  Profitability
Animal Well-being:

Public Perception

Science Based Guidelines

Profitability
Model of the Biological Response of Animals to Stress

Adapted from Moberg and Mench, 2000
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Recognition of a Threat to Homeostasis

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- STIMULUS
- Central Nervous System
  - Perception of stressor
  - Organization of biological defense

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         - Prepathological state
           - Development of pathology

Adapted from Moberg and Mench, 2000
Measurements of Stress Response: Trends in stress biology

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- **Behavior**
  - Removal from the stressful situation (heat stress = shade and water; subordinate cow avoids feeding at the same time as a dominant cow)

Moberg and Mench, 2000
What is the Ideal Stocking Density in the Prepartum Period?
Effect of Overstocking on Feeding Behavior
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  - 1 wk after calving = ↓visit feed time, ↓daily feed time
  - 2 wk after calving = ↓visit feed time, ↑rate of intake
Effect of Feed Bunk Space on Feeding Behavior of Dairy Cows

- Fresh Feed
- Push Up
- Milking

% of cows feeding vs. Time (h)

- 80 cm/cow
- 60 cm/cow
- 40 cm/cow
- 20 cm/cow

Huzzey et al. (2006)
courtesy: T. DeVries
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0:00 3:00 6:00 9:00 12:00 15:00 18:00 21:00

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Huzzey et al. (2006)
Effect of Competition on Feeding Behavior

- No competition (1 cow/bin)
- Competition (2 cows/bin)

Hour

Eating rate (kg/min)

courtesy: T. DeVries

Hosseinkhani et al. (2008)
Overstocking and Commingling Heifers and Cows
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  - Dominant cows = acidosis
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  - Affect metabolism of first lactation cows by increasing cortisol secretion and predisposing them to more lipolysis and insulin resistance/desensitization (Huzzey et al., 2012)
Association Between Prepartum Stocking Density and Production

Oetzel et al, 2007
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• Field trial to evaluate dry cow feed additive
  – Nulliparous animals grouped with parous animals pre- and post-partum

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  - Nulliparous animals produced 0.73 kg/d less milk for every 10% unit increase in stocking density above 80%

- Retrospective data not controlled for changes in ration, season, management, etc.

Oetzel et al, 2007
Hypothesis was that reducing prepartum stocking density (100 vs 80% of headlocks) would improve performance of lactating cows

Nulliparous (n = 324) and parous (n = 404) animals assigned to one of two treatments at 28 d before expected calving date

- 80SD = 38 animals, 48 headlocks, and 44 stalls
- 100SD = 48 animals, 48 headlocks, and 44 stalls

- Nulliparous and parous animals separate throughout the study

After calving, animals from different treatments were commingled in the same pens
Prepartum Pen Design

SD80: 38 cows, 80% headlocks, 86% stalls
SD100: 48 cows, 100% headlocks, 109% stalls
Effect of Stocking Density on Immune, Health, Reproductive and Productive Parameters

-28 -14 0 14 35 56
Effect of Stocking Density on Immune, Health, Reproductive and Productive Parameters
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BCS
LS

Behavior
Calving

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Weekly blood samples
( innate immunity, hemogram, metabolites )

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Exams for RFM and metritis
(d 1, 3, 7, 10, and 14 postpartum)
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BCS LS

-28 -14 0 14

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Exams for RFM and metritis (d 1, 3, 7, 10, and 14 postpartum)

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Endometritis

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• Milk yield and milk composition in the first 150 d postpartum are reported
Effect of Stocking Density on Immune, Health, Reproductive and Productive Parameters

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- Milk yield and milk composition in the first 150 d postpartum are reported
- Reproductive performance after first postpartum AI and pregnancy rate by 305 d postpartum are reported
Stocking Density According to Headlocks

Stocking density, % of headlocks

Days after start of replicate

- 100-Heifers
- 100-Cows
- 80-Heifers
- 80-Cows
Stocking Density According to Headlocks

Stocking density, % of headlocks

Days after start of replicate

Avg. stocking density:
80%L = 74%
100%L = 94%
Effects of Stocking Density on Displacement from the Feed Bunk

Displacement rate ($P = 0.23$): $80\text{SD} = 0.43 \pm 0.03$ vs $100\text{SD} = 0.47 \pm 0.03$

Lobeck et al. (2013)
Effects of Stocking Density on Daily Feeding Time

Lobeck et al. (2013)
Effect of Stocking Density on Lying Time

![Graph showing the effect of stocking density on lying time]

- **Mean daily lying time (h/d)**
- **Day relative to calving**

**TRT - P < 0.05**

**Day - P < 0.01**

**TRT x Day - P < 0.01**
Effect of Stocking Density on Health and Removal from the Herd

- No effect on immune and metabolic parameters and concentration of haptoglobin
**Effect of Stocking Density on Health and Removal from the Herd**

- No effect on immune and metabolic parameters and concentration of haptoglobin

<table>
<thead>
<tr>
<th></th>
<th>80SD, %</th>
<th>100SD, %</th>
<th>( P )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFM, %</td>
<td>5.1</td>
<td>7.8</td>
<td>0.19</td>
</tr>
<tr>
<td>Acute metritis, %</td>
<td>9.9</td>
<td>9.4</td>
<td>0.64</td>
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<tr>
<td>Metritis, %</td>
<td>21.2</td>
<td>16.7</td>
<td>0.11</td>
</tr>
<tr>
<td>Endometritis, %</td>
<td>5.8</td>
<td>7.9</td>
<td>0.35</td>
</tr>
<tr>
<td>DA up to 60 DIM, %</td>
<td>1.0</td>
<td>0.7</td>
<td>0.78</td>
</tr>
<tr>
<td>Removed within 60 DIM, %</td>
<td>6.1</td>
<td>5.1</td>
<td>0.63</td>
</tr>
<tr>
<td>1st AI P/AI, %</td>
<td>36.8</td>
<td>44.0</td>
<td>0.29</td>
</tr>
<tr>
<td>FCM yield, kg/d (±SEM)</td>
<td>34.2 ± 0.5</td>
<td>33.8 ± 0.5</td>
<td>0.56</td>
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</tbody>
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Effect of Prepartum Stocking Density on Pregnancy Rate

Cows not pregnant, %

Days postpartum

80SD
100SD
Stocking Density in the Prepartum Period and Performance
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• 100% stocking density reduced lying time and increased displacement from the feed bunk
Stocking Density in the Prepartum Period and Performance

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• Stocking density did not affect:
  – Immune and metabolic parameters
  – Incidence of health disorders during the postpartum period
  – Body condition and locomotion score during the peripartum period
  – Energy corrected milk yield in the first 150 d postpartum
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• Reduced close-up pen use in approximately 20%
Regrouping of Dairy Cows
Effects of Regrouping of Lactating Cows on Behavior and Milk Yield

von Keyserlingk et al. (2008)
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- Cows evaluated from 3 d before to 4 d after pen change

von Keyserlingk et al. (2008)
Effects of Regrouping of High Producing Dairy Cows on Behavior and Milk Yield

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Effects of Regrouping of High Producing Dairy Cows on Behavior and Milk Yield

• Reduced feed time (↓ 15 min) during the first hour after pen change

von Keyserlingk et al. (2008)
Effects of Regrouping of High Producing Dairy Cows on Behavior and Milk Yield

• Reduced feed time (\(\downarrow 15\) min) during the first hour after pen change
• Increased number of displacements from the feed bunk (\(\uparrow 2.5x\)) in the first day after regrouping

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Pattern of Social Disturbance

All-In-All-Out system = Transient disturbance

Conventional system = Continued disturbance

Adapted from N. Cook
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Conventional system = Continued disturbance  
Adapted from N. Cook
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- Even though cows are social animals, the effects of regrouping large numbers of cows into large pens are questionable

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Pattern of Social Disturbance

All-In-All-Out system = Transient disturbance

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- Even though cows are social animals, the effects of regrouping large numbers of cows into large pens are questionable
  - Dairies with 1,000 to 10,000 lactating cows = close-up pens 50 to 350 cows

Adapted from N. Cook
Weekly Movement of Prepartum Cows

- Far-off cows
- Close-up Cows
- Close-up cows
- Close-up heifers
- Close-up heifers
- Far-off heifers
- Far-off cows
- Hospital
- Maternity
- Postpartum heifers
- Postpartum cows

(Chart showing weekly movement of prepartum cows with various categories and sections.)
Weekly Movement of Prepartum Cows

- Far-off cows
- Close-up Cows
- Close-up cows
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- Close-up heifers
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- Far-off cows
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28 d prepartum
Weekly Movement of Prepartum Cows

- Far-off cows
- Close-up Cows
- Close-up cows
- Close-up heifers
- Close-up heifers
- Far-off heifers
- Far-off cows
- Hospital
- Maternity
- Postpartum heifers
- Postpartum cows
- Calving
Weekly Movement of Prepartum Cows

- Far-off cows
- Close-up cows
- Close-up heifers
- Close-up heifers
- Far-off heifers
- Far-off cows
- Hospital
- Maternity

12 h after calving
Weekly Movement of Prepartum Cows

24 to 48 h after calving
Weekly Movement of Prepartum Cows

5 pen moves within a 50 d period
Effect of Frequency of Regrouping in the Close-up Pen on Immune and Metabolic Parameters, Health, Production, and Reproduction

Silva et al. (2013a; 2013b); Lobeck et al. (2012)
Effect of Frequency of Regrouping in the Close-up Pen on Immune and Metabolic Parameters, Health, Production, and Reproduction

- 567 cows (> 2\textsuperscript{a} lactation) assigned to 1 of 2 treatments:

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  - Conventional (n = 308) - cows entering the close-up weekly to maintain stocking density of 44 Cows/48 headlock (5-15 new cows every week)

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Effect of Frequency of Regrouping in the Close-up Pen on Immune and Metabolic Parameters, Health, Production, and Reproduction

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Silva et al. (2013a; 2013b); Lobeck et al. (2012)
**Effect of Stocking Density on Immune, Health, Reproductive and Productive Parameters**

- Weekly blood samples (innate immunity, hemogram, metabolites)
- Exams for RFM and metritis (d 1, 3, 7, 10, and 14 postpartum)

- Cows were observed daily from 0 to 60 d postpartum for mastitis and DA
- Milk yield and milk composition in the first 305 d postpartum are reported
- Reproductive performance after first postpartum AI and pregnancy rate by 305 d postpartum are reported
Close-up Regrouping Strategy and Stocking Density

Silva et al. (2013a)
Close-up Regrouping Strategy and Stocking Density

Average stocking density:

- Conventional = 86.9%
- AIAO = 71.9%

Silva et al. (2013a)
Effect of Regrouping Strategy on Displacement Rate from the Feed Bunk

Lobeck et al. (2012)
Effect of Regrouping Strategy on Percentage of Cows at the Feed bunk

- **AIAO**
- **Conventional**

The graph shows the percentage of cows eating at the feed bunk over time, with two strategies compared: AIAO and Conventional. The graph highlights the impact of regrouping strategy on feeding behavior throughout the day.
Effect of Prepartum Regrouping Strategy on Cortisol Concentrations

TRT - P = 0.48
Day - P < 0.01
TRT by Day - P = 0.09
*P = 0.04

Cortisol, ng/ml

Days relative to calving

AIAO
Conventional

-14 -7 0 7 14
Weekly Regrouping in the Close-up Period
Weekly Regrouping in the Close-up Period

- No effect on immune and metabolic parameters and concentration of haptoglobin
Weekly Regrouping in the Close-up Period

- No effect on immune and metabolic parameters and concentration of haptoglobin

<table>
<thead>
<tr>
<th>Items</th>
<th>Conventional</th>
<th>AIAO</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFM, %</td>
<td>10.9</td>
<td>11.6</td>
<td>0.82</td>
</tr>
<tr>
<td>Metritis, %</td>
<td>16.7</td>
<td>19.8</td>
<td>0.37</td>
</tr>
<tr>
<td>Acute metritis, %</td>
<td>1.7</td>
<td>3.6</td>
<td>0.22</td>
</tr>
<tr>
<td>DA, %</td>
<td>3.2</td>
<td>1.7</td>
<td>0.38</td>
</tr>
<tr>
<td>Cull/Death within 60 DIM, %</td>
<td>9.1</td>
<td>8.9</td>
<td>0.94</td>
</tr>
<tr>
<td>Cyclic by 53 DIM, %</td>
<td>90.1</td>
<td>90.2</td>
<td>0.97</td>
</tr>
<tr>
<td>P/AI 66 ± 3 d after 1st AI, %</td>
<td>36.3</td>
<td>39.9</td>
<td>0.41</td>
</tr>
<tr>
<td>ECM after 305 DIM, kg/d</td>
<td>34.4 ± 0.6</td>
<td>34.3 ± 0.7</td>
<td>0.88</td>
</tr>
</tbody>
</table>
Effects of Regrouping Strategy on Pregnancy Rate

Cox proportional hazard ratio - $P = 0.49$
Wilcoxon test of equality - $P = 0.85$

Silva et al. (2012)
Weekly Regrouping in the Close-up Period
Weekly Regrouping in the Close-up Period

- AIAO strategy reduces negative interactions among cows in small and medium size pens (< 45 cows)
Weekly Regrouping in the Close-up Period

- AIAO strategy reduces negative interactions among cows in small and medium size pens (< 45 cows)
  - The number of negative interactions appears to return to 'normal' within 2 to 5 d after regrouping
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  - The number of negative interactions appears to return to ‘normal’ within 2 to 5 d after regrouping
- AIAO strategy had no benefit to:
  - Immune and metabolic parameters
  - Health, production, or reproduction
- ↓ Stocking density in AIAO strategy (AIAO = 73% vs conventional = 87%) = ↑ Cost to build close-up cows’ facilities in 16%
Health and Performance of AIAO Cows Regrouped before Calving
Health and Performance of AIAO Cows Regrouped before Calving

- 17 cows did not calve within 35 d and were regrouped within 4 d before calving (1 to 24 d before calving)
Health and Performance of AIAO Cows Regrouped before Calving

- 17 cows did not calve within 35 d and were regrouped within 4 d before calving (1 to 24 d before calving)

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<thead>
<tr>
<th>Item</th>
<th>AIAO</th>
<th>Regrouped AIAO</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twins, %</td>
<td>3.8</td>
<td>0</td>
<td>0.42</td>
</tr>
<tr>
<td>Male calf, %</td>
<td>47.3</td>
<td>47.1</td>
<td>0.99</td>
</tr>
<tr>
<td>Metritis, %</td>
<td>20</td>
<td>17.7</td>
<td>0.81</td>
</tr>
<tr>
<td>DA, %</td>
<td>1.8</td>
<td>0</td>
<td>0.59</td>
</tr>
<tr>
<td>Cyclic by 53 DIM, %</td>
<td>89.6</td>
<td>100</td>
<td>0.19</td>
</tr>
<tr>
<td>P/AI after 1st AI, %</td>
<td>38.3</td>
<td>62.5</td>
<td>0.06</td>
</tr>
<tr>
<td>ECM, kg/d</td>
<td>32.3 ± 1.4</td>
<td>39.1 ± 2.4</td>
<td>&lt; 0.01</td>
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</tbody>
</table>
Management Strategies to Optimize Health and Performance
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• Aggressive reproductive management
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• Close-up period > 21 d
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Management Strategies to Optimize Health and Performance

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- Anionic salts
- Feed bunk space
Management Strategies to Optimize Health and Performance

• Aggressive reproductive management
• Close-up period > 21 d
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• Feed bunk space
  – 27.5-35” per cow
    • Pens without headlocks
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- Aggressive reproductive management
- Close-up period > 21 d
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  - 27.5-35” per cow
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  - Smooth surface, easy to clean and remove stale feed
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- Close-up period > 21 d
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  - Allow for 3% leftover
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• Water availability
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  – 1 trough/20 cows
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• Comfort
  – Heat abatement
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• Comfort
  – Heat abatement
  – Clean, dry comfortable bedding
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• Comfort
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  – Clean, dry comfortable bedding

• Grouping strategy
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  – Reduced changes in feed composition
  – 100% stocking density
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  - 1 trough/20 cows
  - Clean water
- Comfort
  - Heat abatement
  - Clean, dry comfortable bedding
- Grouping strategy
  - Separate heifers from cows
  - Reduced changes in feed composition
  - 100% stocking density
  - 80% if commingling
Thank you!!!

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