Antibiotic consumption study in Irish beef and dairy calves from birth to 6 months of age

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DAFM RSF 11/S/131

EasyCalf®

Project Title

Predisposing factors for disease and immunocompetence in artificially-reared dairy and suckled beef calves from birth to weaning
Materials and methods

Health treatment records were analysed for 79 suckler beef & 44 dairy farms.


From birth to 180 days of life.

Farmers recorded treatment information:
- Calf ID,
- disease event,
- age at treatment,
- drug name,
- number of treatment days,
- and amount of drug administered.
Data recording

- Farmers, enrolled in the study, recorded birth, disease and health treatment, and death information on their calves using standardised recording sheets.

- **Case definitions** were provided to the farmers to assist with the classification of disease.

- Farmers completed and submitted the project recording sheets on a **monthly basis**.

- Long-acting antimicrobials administered more than 7 days apart, or other medications administered more than 3 days apart, were classified as separate **disease events**.
Data recording

- **Crude morbidity** was defined as calves being treated for at least one disease event, attributed to any cause, excluding injury.

- **Calves treated for illnesses other than diarrhoea, pneumonia, navel infection, or joint infection/lameness** were categorised as receiving treatment for ‘other’ disease events.

- Beef calves  \( n = 3204 \)
- Dairy calves  \( n = 5358 \)
Data recording

- Antimicrobial trade name
- **Pharmaceutical** form (oral solution, oral powder, parenteral solutions, tablets, bolus, etc.).
- **Pack size** (in L or mL for liquids, in g or kg for solids, in unit number for bolus or tablets, etc.).
- **Total number of packages prescribed and dispensed** to the farm.
- **Prescribed therapy** (dose, administration frequency, duration).
<table>
<thead>
<tr>
<th>Disease</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhoea</td>
<td>Repeated passing of loose (soup-like) or watery faeces, of normal or abnormal colour, with or without blood content</td>
</tr>
<tr>
<td>Bovine respiratory disease (BRD)</td>
<td>One or a combination of the following clinical signs: increased respiratory effort (including increased respiratory rate, laboured breathing, or open mouth breathing), nasal discharge / snotty nose (a considerable amount of cloudy or pus-like discharge), or repeated coughing</td>
</tr>
<tr>
<td>Navel infection</td>
<td>Warm enlargement of, with or without foul smelling discharge from umbilical structures</td>
</tr>
<tr>
<td>Joint infection / lameness</td>
<td>One or more swollen joints, resulting in lameness, with or without fever</td>
</tr>
<tr>
<td>Bloat</td>
<td>Swollen abdomen and exhibited signs of discomfort and / or respiratory distress</td>
</tr>
<tr>
<td>Dull</td>
<td>Signs of depression, with or without decreased appetite or fever</td>
</tr>
<tr>
<td>Fever</td>
<td>Temperature of greater than 39.5 °C / 103 °F</td>
</tr>
<tr>
<td>Grass tetany</td>
<td>Combination of the following clinical signs: staggering gait, twitching muscles, collapse, trashing, head thrown back, with or without severe paddling convulsions, and diagnosis preferentially confirmed by veterinarian</td>
</tr>
<tr>
<td>Meningitis</td>
<td>Combination of the following clinical signs: lack of suckle reflex, head pressing, extended head and neck, star gazing, blindness, over-reactive to stimuli, and / or seizures, and diagnosis preferentially confirmed by veterinarian</td>
</tr>
<tr>
<td>Mineral / vitamin deficiency</td>
<td>Combination of the following clinical signs: lack of thrive, weight loss, awkward gait, change in hair coat colour, etc., and diagnosis preferentially confirmed by a blood test and / or veterinarian</td>
</tr>
<tr>
<td>Injury</td>
<td>Physical damage or hurt due to a slip, fall, bump, etc.</td>
</tr>
</tbody>
</table>

### Monthly Health Records - Individual Calves from Birth to Yearling

**Please fill out one entry for EVERY CALF (birth to yearling) that gets SICK on your farm**

<table>
<thead>
<tr>
<th>Date (dd/mm/yy)</th>
<th>CALF (EC/animal)</th>
<th>Weaned Off Milk</th>
<th>Illness *</th>
<th>Illness Description (e.g., symptoms, severity, etc.)</th>
<th>Lab Testing</th>
<th>Vet Intervention</th>
<th>Medicine / Product Administered</th>
<th>Recover Date (dd/mm/yy)</th>
<th>Farmer's Time (min / cal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g.: 21/09/14</td>
<td>IT-12-54567-8</td>
<td>YES</td>
<td>S</td>
<td>Cryptosporidia</td>
<td>F</td>
<td>YES</td>
<td>Isolect (I) + Flunixin (F)</td>
<td>29/04/14</td>
<td>80</td>
</tr>
<tr>
<td>e.g.: 25/06/14</td>
<td>IE-12-59568-7</td>
<td>YES</td>
<td>P</td>
<td>Laboured breathing, cough, fever</td>
<td>N/A</td>
<td>YES</td>
<td>Restlor</td>
<td>30/06/14</td>
<td>20</td>
</tr>
</tbody>
</table>

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**Key**
- Illness key: P = Pneumonia / Respiratory Illness (PI3, RSV, IBR, etc); S = Scour (E. coli, Salmonella, Cryptosporidia, Rotavirus, Coronavirus, etc); N = Navel Infection; J = Joint Infection; A = Abortion; I = Injury; M = Mineral / Vitamin Deficiency (e.g., Copper, Iodine, Selenium, etc); Me = Meningitis, TM = Tetany / Milk Fever, O = Other.

**Notes**
- *Days*: Total number of days that the medicine was administered.
- *Quantity*: Please specify how many cc, ml, tubes, bottles, etc. used.
- *Recover Date*: Calves recovered from illness and no longer show signs of disease.

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**Instructions**
- Fill out one entry for EVERY CALF (birth to yearling) that gets SICK on your farm.
- Include all relevant details about the illness and treatment.
- Ensure all entries are accurate and complete.

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**Contact Information**
- Teagasc Calf Health Research Project.
Guidance on the Selection of Appropriate Indicators for Quantification of Antimicrobial Usage in Humans and Animals

L. Collineau, C. Belloc, K. D. C. Stärk, A. Hémonic, M. Postma, J. Dewulf, C. Chauvin

First published: 4 September 2016
DOI: 10.1111/zph.12298
Materials and methods

Summary of product characteristics (SPC) were retrieved from the Health Products Regulatory Authority and drugs were classified by active substance(s).

Guidelines recently published on technical units and appropriate indicators for quantification of antimicrobial usage (Collineau et al., 2017).

Defined daily dose for animals (DDDvet) and defined course dose for animals (DCDvet) were the technical units used to measure antimicrobial consumption.

**DDDvet** represents the assumed average dose per kg animal per species per day. **DCDvet** represents the assumed average dose per kg animal per species per treatment course. **Treatment incidence (TI)** was the indicator used to quantify antimicrobial usage, and the calculations applied were:
The TI provides a standardized technical unit of measurement that quantifies how many animals out of a theoretical group of 1000 animals receive daily an antimicrobial treatment, and the calculations applied were:

\[
TI_{UDDvet} = \left[ \frac{\text{total active substance administered}}{UDDvet \times \text{standard BW} \times \text{total calf days}} \right] \times 1000
\]

\[
TI_{DDDvet} = \left[ \frac{\text{total active substance administered}}{DDDvet \times \text{standard BW} \times \text{total calf days}} \right] \times 1000
\]
Materials and methods

The Population Correction Unit (PCU) is a measurement developed by the European Medicines Agency (EMA) and takes into account the animal population as well as the estimated weight of each particular animal at the time of treatment with antimicrobials.

The milligrams (mg) of antimicrobial used per PCU was calculated.
Results
## Results

<table>
<thead>
<tr>
<th></th>
<th>Calves</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 – 30 d</td>
<td>31 – 90 d</td>
<td>91 – 180 d</td>
<td>0 – 180 d</td>
</tr>
<tr>
<td><strong>Beef</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves #</td>
<td>395</td>
<td>172</td>
<td>87</td>
<td>654</td>
<td></td>
</tr>
<tr>
<td>% of calves treated on farm</td>
<td>12.7%</td>
<td>5.7%</td>
<td>2.9%</td>
<td>20.4%</td>
<td></td>
</tr>
<tr>
<td><strong>Dairy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves #</td>
<td>542</td>
<td>197</td>
<td>56</td>
<td>795</td>
<td></td>
</tr>
<tr>
<td>% of calves treated on farm</td>
<td>10.2%</td>
<td>5.3%</td>
<td>1.9%</td>
<td>14.8%</td>
<td></td>
</tr>
</tbody>
</table>

### Antibiotic treatments administered

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 – 30 d</td>
<td>31 – 90 d</td>
<td>91 – 180 d</td>
<td>0 – 180 d</td>
</tr>
<tr>
<td><strong>Beef</strong></td>
<td>495 (3,107)</td>
<td>213 (3,024)</td>
<td>133 (3,036)</td>
<td>841 (3,204)</td>
</tr>
<tr>
<td><strong>Dairy</strong></td>
<td>606 (5,332)</td>
<td>280 (3,723)</td>
<td>43 (2,891)</td>
<td>929 (5,358)</td>
</tr>
</tbody>
</table>
# Results

## Standard weights (kg)

<table>
<thead>
<tr>
<th></th>
<th>0 – 30 d</th>
<th>31 – 90 d</th>
<th>91 – 180 d</th>
<th>0 – 180 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>60</td>
<td>105</td>
<td>180</td>
<td>135</td>
</tr>
<tr>
<td>Dairy</td>
<td>50</td>
<td>82</td>
<td>139</td>
<td>108</td>
</tr>
</tbody>
</table>

## Days at risk

<table>
<thead>
<tr>
<th></th>
<th>0 – 30 d</th>
<th>31 – 90 d</th>
<th>91 – 180 d</th>
<th>0 – 180 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>91,596</td>
<td>179,172</td>
<td>270,185</td>
<td>540,953</td>
</tr>
<tr>
<td>Dairy</td>
<td>144,866</td>
<td>184,885</td>
<td>250,246</td>
<td>579,997</td>
</tr>
</tbody>
</table>
Results

1,770 antimicrobial treatments were administered to suckler beef (n = 841) and dairy calves (n = 929) between birth and 6 months of age.
<table>
<thead>
<tr>
<th>Antimicrobial class</th>
<th>Number of antimicrobial treatments</th>
<th>TI ddd Mean</th>
<th>TI udd Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beef (841) Dairy (929)</td>
<td>Beef</td>
<td>Dairy</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td>97 160</td>
<td>0.70</td>
<td>0.60</td>
</tr>
<tr>
<td>Amphenicols</td>
<td>128 159</td>
<td>0.48</td>
<td>0.45</td>
</tr>
<tr>
<td>Penicillins</td>
<td>210 164</td>
<td>1.12</td>
<td>0.65</td>
</tr>
<tr>
<td>1\textsuperscript{st} and 2\textsuperscript{nd} GC\textsuperscript{1}</td>
<td>0 1</td>
<td>0</td>
<td>0.02</td>
</tr>
<tr>
<td>3\textsuperscript{rd} and 4\textsuperscript{th} GC\textsuperscript{2}</td>
<td>4 3</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>Sulfonamides</td>
<td>94 161</td>
<td>0.31</td>
<td>0.78</td>
</tr>
<tr>
<td>Macrolides</td>
<td>38 20</td>
<td>0.525</td>
<td>0.59</td>
</tr>
<tr>
<td>Lincosamines</td>
<td>2 0</td>
<td>0.002</td>
<td>0</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>202 181</td>
<td>0.93</td>
<td>1.29</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>63 79</td>
<td>0.15</td>
<td>0.37</td>
</tr>
<tr>
<td>Spectinomycin</td>
<td>3 1</td>
<td>0.002</td>
<td>0</td>
</tr>
</tbody>
</table>
The Population Correction Unit (PCU) is a measurement developed by the European Medicines Agency (EMA) and takes into account the animal population as well as the estimated weight of each particular animal at the time of treatment with antimicrobials. The milligrams (mg) of antimicrobial used per PCU was calculated.

<table>
<thead>
<tr>
<th>Age categories</th>
<th>0 – 30 d</th>
<th>31 – 90 d</th>
<th>91 – 180 d</th>
<th>0 – 180 d</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calves</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>8.0</td>
<td>2.7</td>
<td>1.4</td>
<td>7.3</td>
</tr>
<tr>
<td>Dairy</td>
<td>9.7</td>
<td>3.7</td>
<td>1.0</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Van Boeckel et al. (2015) published a value 45 mg/PCU as a global estimation for food animals in Proceedings of the National Academy of Sciences. 112. 10.1073/pnas.1503141112.
Bacterial profiles generated by MiSeq 16S (V3-V4) amplicon sequencing of DNA extracted from deep nasopharyngeal swabs taken from calves showing BRDC symptoms (Case) and their location/age/time-matched controls (Control). Swabs were taken from calves (14 to 28 days old) on Irish farms and library preparation and sequencing was conducted at Teagasc and Trinity College Dublin.
Mannheimia distribution
MinION Technology – viruses associated with bovine respiratory disease (BRD)

The programmable Voltrax automatic sample prep station for MinION. This can be used for preparing sample directly pen-side from a swab for loading onto the MinION.

Links to the Voltrax web page
https://nanoporetech.com/products/voltrax
https://nanoporetech.com/publications/2016/05/26/voltrax-rapid-programmable-portable-disposable-sample-processor
Conclusions

• Baseline data are now available on antimicrobial drug usage in calves on commercial farms in Ireland.
• No differences in TI between beef and dairy calves.
• Antibiotic usage is low in comparison with other countries.
  » Amoxicillin, Enrofloxacin, Florfenicol, Marbofloxacin, Oxytetracycline
Recommendations

- Only give antibiotics to animals under veterinary supervision.
- Do not use antibiotics to prevent diseases in healthy animals.
- Ensure calves are fed first feed of colostrum within the first two hours of birth (~3 litres) (1-2-3 rule).
- Vaccinate animals to reduce the need for antibiotics and use alternatives to antibiotics when available.
- Promote and apply good practices at all steps of production and processing of foods from animal and plant sources.
- Improve biosecurity on farms and prevent infections through improved hygiene and animal welfare.
Acknowledgements

Participating beef and dairy Farmers
Teagasc Advisors
Animal Health Ireland
ICBF

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Research Stimulus Fund €asyCalf
(RSF 11/S/131)
Thank you for your attention
Antimicrobial sales (2016) by country

Tonnes of active ingredient

Austria
Belgium
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Iceland
Ireland
Italy
Latvia
Lithuania
Luxembourg
Netherlands
Norway
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
Switzerland
United Kingdom

2724.9
102.3