Regulatory Control of Antibiotics to Manage Antibiotic Resistance
Annual Report: 2004
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Prepared by
Agricultural Compounds and Veterinary Medicines Group
New Zealand Food Safety Authority

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SUMMARY
The ACVM Group has updated all antibiotic product registrations and applied the new conditions that:

• remove growth promotion as an approved use, unless the active ingredient is not used in human medicine and is not implicated in the development of cross resistance;
• establish a stratification of limited use and veterinary involvement based on the level of concern about resistance developing for particular active ingredients; and
• impose reporting obligations for active ingredients of concern.

The Antibiotic Resistance Steering Committee has been reconvened and an Expert Panel has been commissioned to update the 1999 report and address issues that have arisen since that report was written. The regulatory programme will be further considered in light of the recommendations of the Steering Committee when they are available.

Total sales of antibiotics have increased but the increase appears to coincide with marked increases in livestock numbers. The 2003 sales statistics and the review of antimicrobial use in the intensive livestock sectors indicate that there is a high level of commitment to the principle of prudent use of antibiotics.
A revised methodology for collecting and analysing sales statistics was applied to the 2003 data in an attempt to reduce variations in interpretation and the subjectivity of some of the estimates. The new methodology was applied in retrospect to the 2002 data as well. While some of the statistics differed as a result of this re-examination, the revised totals were not materially different from those reported.

From now on reports will be prepared using this year’s methodology, and reports should begin to show reliable trends as the same collection and analysis protocols are applied to subsequent survey data.
INTRODUCTION
This report concerns the management of antibiotics used as veterinary medicines in New Zealand. Previous annual reports were based on annual sales statistics (in the form of kilograms of active ingredients) voluntarily supplied to the ACVM Group of the New Zealand Food Safety Authority.

The registrations of all antibiotics now include a statutory requirement to provide annual sales data in the form of kilograms of products sold during the year. This report relates to the first year's (2003) statistics under the new regulatory requirements. All sales statistics have been converted to kilograms of active ingredients by the ACVM Group based on the approved formulation. This was done to eliminate variations in methodology. The ACVM Group has reviewed its 2003 report using the new methodology and found that the statistics in that report would have differed but not in a material manner for any of the active ingredient families.

Previous reports included kilograms of active ingredients used in particular species based on estimates from the registrants of products. This introduced an element of uncertainty in regard to products registered for use in a number of different species. For this year's report registrants were not asked to estimate how much they thought their products were used in particular species. Consequently, the report is based on all the approved uses for each product.

In place of the use estimates, reviews of common use practices have been carried out in the pork and poultry industries and a description of those practices has been included. It can be assumed that sales and use information is closely related in regard to products formulated and supplied for a particular purpose, such as intra-mammary preparations.

The families of active ingredients have been altered from previous reports to highlight antibiotics that had been included in the ‘other’ category. The ‘other’ category now includes only oleandomycin, florfenicol and polymixin, which have not been identified as a high risk in regard to antibiotic resistance in humans.

This report provides summaries of sales by antibiotic family, route of administration and approved species. The summaries do not include ionophores or quinoxalines. These products are not used in human medicine and are not likely to be used because of their toxicity to humans. Their modes of action are unique and there is no evidence to suggest that they contribute to antibiotic resistance in humans. There is no obligation on registrants of products to report annual sales of ionophores and quinoxalines. However, these active ingredients and the parasiticide substances are referred to in the descriptions of antimicrobial use from the relevant industry sectors in the appendices to this report. This gives a more complete view of medication practices in those industries but the practices are not relevant to the antibiotic resistance issue.
Statistics for 2002 have been included to show any obvious trends but fine comparisons should not be made between the particular entries because of the difference in methodology between the two years. It is intended that this report and the methodology supporting it be the baseline for future comparisons.

**ANTIBIOTIC SALES SURVEY AND COMMENTS ON USE**

The following statistics are from sales data for 2003 provided by registrants in the form of kilograms of product sold in a 12-month period. The conversion to kilograms of active ingredient sold, done by the ACVM Group, was based on the approved formulation for the product. The statistics have been analysed according to:

- total kilograms of active ingredient from all registered products;
- kilograms of active ingredient by approved route of administration; and
- kilograms of active ingredient by approved species.

The statistics from 2002 have been included in the first table to provide a point of reference with last year’s report. The methodology of collection and analysis is sufficiently different to make any assumptions about minor trends questionable.

**Table 1: Summary of antibiotic sales in kilograms of active ingredients in family groups***

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Macrolides/lincomamides</td>
<td>6279</td>
<td>5011</td>
</tr>
<tr>
<td>Penicillins</td>
<td>11065</td>
<td>13708</td>
</tr>
<tr>
<td>Clavulanic acid</td>
<td>73</td>
<td>141</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td>1176</td>
<td>1076</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td>1509</td>
<td>3458</td>
</tr>
<tr>
<td>Sulphonamides/Trimethoprim</td>
<td>2998</td>
<td>4429</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>2325</td>
<td>2134</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Novobiocin</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Nitro-imidazoles</td>
<td>60</td>
<td>105</td>
</tr>
<tr>
<td>Nitrofurans</td>
<td>168</td>
<td>111</td>
</tr>
<tr>
<td>Bacitracins</td>
<td>26579</td>
<td>27264</td>
</tr>
<tr>
<td>Bambermycin</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Virginiamycin</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Orthosomycins</td>
<td>453</td>
<td>0</td>
</tr>
<tr>
<td>Fusidic acid</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>other</strong></td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>52702</td>
<td>57557</td>
</tr>
</tbody>
</table>

*Does not include sales of ionophores
** includes oleandomycin, florfenicol and polymixin
Previous reports have included ionophores and quinoxalines in the total for the year. For example, the total sales reported for 2002 was 108051, including 53107 kilograms of ionophores and 676 kg of quinoxalines (carbadox). This inflated the sales statistics relative to antibiotic resistance. It is considered that reporting the sales statistics as in the table above provides a more relevant perspective that will be used in subsequent reports. Given this change, there appears to have been an increase of 9% in total sales of active ingredients. The growth of the livestock industry sectors is sufficient in itself to explain the increase in volume.

The increase was not the same across all active ingredient families. Increases have occurred for penicillins (2643 kg increase), sulphamamide/trimethoprim (1431 kg increase), bacitracin (685 kg increase), tetracyclines (1949 kg increase), and nitro-imidazole (45 kg increase). Decreases can be noted for macrolide/lincosamide (1268 kg), cephalosporin (100 kg) and aminoglycoside (191 kg). This continues a trend noted in last year’s report and is consistent with the desired outcome of reducing dependence on active ingredients of human health significance. Small increases occurred in fluoroquinolone (5 kg increase), fucidic acid (1 kg increase), and novobiocin (1 kg increase), but the increases are so small that their significance cannot be judged.

Table 2: Sales by active ingredient family and approved route of administration

<table>
<thead>
<tr>
<th>Family</th>
<th>Total (kg)</th>
<th>Oral (kg)</th>
<th>Injection (kg)</th>
<th>In-feed (kg)</th>
<th>In-water (kg)</th>
<th>Intramammary (kg)</th>
<th>Other (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macrolide lincosamide</td>
<td>5011</td>
<td>9</td>
<td>866</td>
<td>3996</td>
<td>85</td>
<td>41</td>
<td>14</td>
</tr>
<tr>
<td>Penicillin</td>
<td>13708</td>
<td>537</td>
<td>8520</td>
<td>0</td>
<td>18</td>
<td>4624</td>
<td>10</td>
</tr>
<tr>
<td>Clavulonic Acid</td>
<td>141</td>
<td>114</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Cephalosporin</td>
<td>1076</td>
<td>249</td>
<td>139</td>
<td>0</td>
<td>0</td>
<td>669</td>
<td>19</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>3458</td>
<td>22</td>
<td>1297</td>
<td>1671</td>
<td>221</td>
<td>96</td>
<td>152</td>
</tr>
<tr>
<td>Sulphonamide Trimethoprim</td>
<td>4429</td>
<td>3943</td>
<td>188</td>
<td>200</td>
<td>0</td>
<td>0</td>
<td>98</td>
</tr>
<tr>
<td>Aminoglycoside</td>
<td>2134</td>
<td>329</td>
<td>1080</td>
<td>9</td>
<td>123</td>
<td>581</td>
<td>11</td>
</tr>
<tr>
<td>Fluoroquinolone</td>
<td>28</td>
<td>16</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Novobiocin</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Nitro-imidazole</td>
<td>105</td>
<td>13</td>
<td>0</td>
<td>81</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nitrofurans</td>
<td>111</td>
<td>0</td>
<td>0</td>
<td>110</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bacitracin</td>
<td>27264</td>
<td>0</td>
<td>0</td>
<td>27263</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bambermycin</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Virginiamycin</td>
<td>28</td>
<td>0</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Orthosomycin</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fucidic acid</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>56</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>48</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>57557</td>
<td>5232</td>
<td>12114</td>
<td>33358</td>
<td>458</td>
<td>6088</td>
<td>308</td>
</tr>
</tbody>
</table>
The ‘other’ category includes topical and eye or ear products, and some vaginal products. The intra-mammary products are exclusively products for dairy cattle. They may be used to treat mastitis off-label in other species, but only under veterinary prescription.

The sales statistics show that 39,048 kgs of antibiotics were sold for administration orally. This makes up 68% of the total amount of antibiotics sold in New Zealand for use in animals.

It is generally agreed that administration of antimicrobial products orally (including in-feed or in-water) is the most likely route to produce resistance that could be transferred to humans. While it is possible that resistance could develop in people via other routes (and in some unique circumstances where exposure to resistant bacteria is amplified, the likelihood can be significantly greater), it is generally accepted that the likelihood is low.

However, the statistic of orally administered antibiotic has to be refined to focus on its significance relative to antibiotic resistance being transferred to humans. Rather than focus on the total amount administered orally it is more useful to look at the amount of antibiotics of high concern (macrolides/lincosamides, cephalosporins, fluoroquinolones, aminoglycosides and virginiamycin) that were sold for use in feed for animals that are likely to provide produce for human consumption. Because fluoroquinolones and cephalosporins are not used in feed in New Zealand and the small amount of virginiamycin is sold for use in horses, the only amount that is particularly of interest from an antibiotic resistance perspective is the use of macrolides in pig and poultry feeds. There are about 4100 kilograms of macrolides administered orally or 7% of the total kgs of antibiotics sold for use in animals. This amount would be administered to an annual production population of 700,000 pigs and 83,000,000 chickens.

Table 3: Sales by active ingredient by approved species

<table>
<thead>
<tr>
<th>Family</th>
<th>Total (kg)</th>
<th>Companion animals (kg)</th>
<th>Cattle (kg)</th>
<th>Pig/poultry (kg)</th>
<th>Multi-species (kg)</th>
<th>Other (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macrolide lincosamide</td>
<td>5011</td>
<td>9</td>
<td>44</td>
<td>516</td>
<td>4443</td>
<td>0</td>
</tr>
<tr>
<td>Penicillin</td>
<td>13708</td>
<td>469</td>
<td>4915</td>
<td>18</td>
<td>8307</td>
<td>0</td>
</tr>
<tr>
<td>Clavulonic Acid</td>
<td>141</td>
<td>97</td>
<td>23</td>
<td>0</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Cephalosporin</td>
<td>1076</td>
<td>249</td>
<td>688</td>
<td>0</td>
<td>139</td>
<td>0</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>3458</td>
<td>22</td>
<td>96</td>
<td>0</td>
<td>3330</td>
<td>10</td>
</tr>
<tr>
<td>Sulphonamide Trimethoprim</td>
<td>4429</td>
<td>83</td>
<td>66</td>
<td>200</td>
<td>4080</td>
<td>0</td>
</tr>
<tr>
<td>Aminoglycoside</td>
<td>2134</td>
<td>7</td>
<td>556</td>
<td>78</td>
<td>1487</td>
<td>5</td>
</tr>
</tbody>
</table>
Companion animals are primarily dogs and cats. The Cattle category includes both beef and dairy cattle. The category ‘Other’ includes products for fish, aviary birds and pigeons. The multi-species category includes all the products that are approved for use in a range of species and for which it is not possible to know exactly how much is sold for use in each species. Products in the multi-species category include a few general mass medication in-feed products such as those containing tetracyclines. Most of the in-feed products are specially formulated for particular species and are included in either the pig/poultry or cattle category. The multi-species category does include oral therapeutic products that are to be administered orally (not in feed or water supply) to individual animals.

LIVESTOCK SECTOR USE OF ANTIBIOTICS
In light of the fact that the protocol for the collection and analysis of sales data was altered for this report, the following livestock sector descriptions do not include any statements on trends in the statistics for the last three years. Nevertheless, the sales statistics for 2003 and the descriptions of common antimicrobial use in the intensive livestock industry sectors indicate that there is generally a high level of support for the principle of prudent use of antibiotics.

Animal population statistics

<table>
<thead>
<tr>
<th>Animal</th>
<th>Population (million)</th>
<th>Farms (thousands)</th>
<th>Population/farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>humans</td>
<td>3.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sheep</td>
<td>39.5 (02)</td>
<td>13 (02)</td>
<td>3000</td>
</tr>
<tr>
<td>dairy</td>
<td>5.2 (02)</td>
<td>14 (02)</td>
<td>370</td>
</tr>
<tr>
<td>beef</td>
<td>4.5 (02)</td>
<td>8 (98)</td>
<td>560</td>
</tr>
<tr>
<td>deer</td>
<td>1.6 (02)</td>
<td>2 (98)</td>
<td>800</td>
</tr>
<tr>
<td>pigs</td>
<td>0.7 (03)</td>
<td>0.36 (02)</td>
<td>1900</td>
</tr>
<tr>
<td>broilers</td>
<td>80.7 (03)</td>
<td>0.15 (03)</td>
<td>538000</td>
</tr>
<tr>
<td>layers</td>
<td>2.9*</td>
<td>0.12 (03)</td>
<td>24200</td>
</tr>
</tbody>
</table>

*approximately 200,000 day-old chicks per month placed on farms to maintain the 2.9 million national flock
Sheep, dairy, beef and deer statistics were taken from the Agriculture Statistics 2002. The number of farms was not updated in the 2002 report so the statistics from the 1998 report have been inserted. Beef and sheep numbers are trending downward although there has been a recent increase in sheep numbers. The sheep statistics are a point in time number after the main slaughter season and before lambing. It does not include lamb numbers, which would increase the total by around 100,000 head. However, this is largely irrelevant because very few lambs would ever be treated with antibiotic products.

Dairy cattle and deer numbers have shown increases. However, it is felt that the increases or decreases in stock numbers for sheep, dairy, beef and deer would not vary materially if 2003 statistics were available, so it was considered that the 2002 statistics could be used for any comparison.

On the other hand, there have been marked increases in pig and poultry numbers and the 2002 statistics would not be representative. Pig statistics were supplied by the Pork Industry Board and show an increase for the last three years. The 2003 figures have been inserted because they will relate more closely with the latest antibiotic sales statistics.

Poultry statistics were provided by the Poultry Industry Association of New Zealand. Once again the 2003 statistics are considered to be the most representative when compared to the latest antibiotic sales report.

The ACVM Group does not have statistics on numbers of dogs and cats or horses. While it may be possible that resistance could transfer from these species, they are not considered to be likely pathways.

**Cattle and sheep**

As noted in previous reports, beef cattle and sheep are not generally intensively raised in New Zealand. They are raised on pasture with almost no routine concentrate feed supplementation. Antibiotic use is limited to individual parenteral therapeutic use, with limited cohort in-feed treatment in special circumstances, usually in-contact animals in calf-rearing operations exposed to particular disease challenges. The sales statistics most relevant to beef cattle and sheep would be those for multi-species and injectable products.

Dairy cattle are also raised on pasture but diets are often supplemented to maximise production. The trend is to increasing herd size with the associated health management challenges. Nevertheless, the animals are managed on pasture rather than concentrated in feed lots.

In addition to the antibiotic treatment practices that are similar to those for beef cattle, there is a significant use of intra-mammary preparations to treat and control mastitis. The intra-mammary products are formulated and packaged...
specifically for that purpose. The amount and range of active ingredients can be identified in the seventh column of table 2.

Mastitis treatment and control can be divided into:
- therapeutic treatment during production; and
- therapeutic treatment during the inter-production period, i.e. dry period.

The significance of antibiotic use for the treatment and control of mastitis in the development of resistance in human pathogenic bacteria has not been the attention of research because of the limited opportunity for human exposure due to a number of factors. The current Antibiotic Resistance Expert Panel (see below) is addressing this issue to provide advice on how much attention this pathway should be given.

**Poultry**
The poultry industry in New Zealand has been steadily growing. Production management is intensive and medication has traditionally been in-feed, although in-water medication has its uses. Birds are usually medicated on a flock basis and the industry has been adjusting to the prudent use of antibiotics in line with the New Zealand antibiotic resistance management initiatives.

The sales statistics most relevant to use in this industry are column 5 in tables 2 and 3. These statistics should be viewed in light of the review of common antimicrobial use practices within the industry (see appendix 1). Medication programmes are under veterinary supervision and strictly regimented. A very limited range of active ingredients is used, with preference for actives that are least likely to result in an antibiotic resistance problem.

**Pigs**
The pork industry is presently experiencing a period of growth that is reflected in the higher population statistics. Previous issues of this report inappropriately presumed a greater dependence on herd medication than is actually the case. The ACVM Group reviewed common practices and the report is provided in appendix 2. Parenteral therapeutic treatment of individuals appears to be the preferred industry regime with limited but important dependence on prophylactic treatment with a few antimicrobial active ingredients to manage specific disease challenges. The sales statistics most relevant are columns 4, 5 and 6 in table 2 and columns 5 and 6 in table 3. It must be noted that the greater proportion of the amounts in column 5 of both tables would be used in the much larger poultry sector.

**Horses**
A relatively small number of horses are processed for human consumption. This is for export markets and horsemeat is not commercially available in New Zealand for human consumption. Antibiotic medication is almost exclusively therapeutic treatment of individual horses. The sales statistics most relevant are
in column 4 in table 2 and column 6 in table 3. The relatively small amount of infeed Virginiamycin sold is used to manage cases of founder in horses.

**Companion animals**

This group is primarily composed of dogs and cats. The statistics in column 3 of table 3 refer to products that are specifically registered for dogs and cats. The route of administration statistics that are most relevant in table 2 are in columns 3 and 4 with some topical and eye or ear products being included in column 8. There is no mass medication and, therefore, antibiotic use would be almost exclusively therapeutic. The ACVM Group has recognised that there are certain circumstances (discharge from ear infection cases or faecal contamination) in which people may be exposed to resistant bacteria, and it has adjusted the conditions of registration for certain products to take account of this possible pathway.

**ANTIBIOTIC RESISTANCE STEERING COMMITTEE AND EXPERT PANEL**

In late 2004 the ACVM Group reconvened the Antibiotic Resistance Steering Committee to review the issue of antibiotic resistance and the progress of the antibiotic resistance management strategy. A new Expert Panel was commissioned to address technical issues and to provide recommendations and a report to the Steering Committee. The Expert Panel’s report is expected to be available in July 2005.
APPENDIX 1: ANTIMICROBIAL USE IN THE POULTRY INDUSTRY

Introduction
The following information was provided by veterinary technical advisors and the Poultry Industry Association.

This paper describes the antimicrobial use practices in the poultry industry in New Zealand. The poultry industry is vertically integrated, incorporating breeding flocks, hatcheries, production units and associated feed manufacturing companies. It is primarily based on chicken and chicken egg production, with small specialist production of other species such as turkeys, ducks, pheasants and quail. Production can be grouped into the following:

- Breeding operations;
- Hatcheries;
- Broiler production;
- Egg production; and
- Feed manufacture.

The scope of the review covers antimicrobial use practices in breeding, broiler and egg production. Antimicrobial use is not considered relevant to hatchery operations, and feed manufacture is governed by the programmes and treatment decisions made in the three production areas. Antimicrobial use is described in a broad context, including anticoccidial, anti-protozoan and antiparasitic as well as antibacterial treatment, while antibiotic use and antibiotic resistance as an issue is usually limited to antibacterial treatment.

New Zealand has some non-commercial layer hen poultry. There are an estimated 11,000 properties that have poultry of which approximately 400 are commercial meat and egg operations. Ninety seven percent of the commercial poultry production is in the vertically integrated poultry meat industry. The breeding operations produce eggs for the hatcheries and day-old birds are supplied to both broiler and egg production units. The breeding operations have strict biosecurity controls to ensure both minimal health problems on the breeding farms, and disease free birds for production units. Similar biosecurity controls are practiced on the commercial operations run by the poultry meat processing companies. The hatcheries and the poultry feed manufacturers also provide strict quality and biosecurity controls.

The health status of poultry in New Zealand is very high compared with other countries. There are very few problems with disease in commercial operations because of the biosecurity controls and the absence of infectious bursal disease (IBD), which causes suppression of the immune system in birds. Very few of the pathogens that plague the industry internationally are present in New Zealand.
This simplifies health management considerably, reducing the potential need for antimicrobial products.

Most health problems in New Zealand relate to ubiquitous organisms (coccidia sp, *Clostridium perfringens*, and *E. coli*) that are normal inhabitants of the intestinal tract of birds. Because the organisms are usually present, the occurrence of disease is usually multi-factorial, relating to immune status of the birds combined with environmental and management stress factors.

Antimicrobial use practice varies but in general the following describes common practices. They are described in relation to the three production areas (i.e. breeding, broiler productions and egg production). Variations in management practices in these areas are mentioned because of the impact those practices have on the health of the birds and, consequently, the treatment regimes

**Broiler production**

Broiler birds are introduced (via the commercial hatcheries) to the production unit as day-old birds from controlled parent breeding flocks. Birds are reared for 28-52 days (depending on the size bird required for the market) and stay in the same production unit for the whole time. “Rearing to slaughter” can be divided into three stages (i.e. starter; finisher or grower; and withdrawal) based on the age/size of the birds and the formulation of the feed.

The starter stage is the first 14-17 days. It is the period of greatest health challenge in which the birds are faced with multiple stress factors that can result in an imbalance that would favour the overgrowth of potentially pathogenic bacteria. It is also in this stage that coccidia numbers can begin to increase even though coccidiosis as a disease condition does not appear until the birds are older.

The finisher or grower stage is usually divided into two steps:

- Grower or finisher 1, which lasts to day 22-25; and
- Grower or finisher 2, which lasts from the end of the first grower/finisher stage to approximately day 34.

Clinical signs of disease are managed in this stage through the effectiveness of the programmed medication that was initiated in the starter stage (see below). Other conditions such as *E. coli* enteritis (*E. coli* is not a major cause of enteritis) or femoral head necrosis (Staph sp) can occur but these are most likely not treated if they occur towards the end of the stage because of the withholding periods required to avoid violative residues. The reasons for not treating may vary but usually relate to:

- Cost versus the benefit of treatment to the producer;
- Potential for violative residues through treating too close to slaughter; and
- Time required for the antibiotic to achieve the desired effect.
The withdrawal stage lasts from the end of the grower/finisher stage until the birds are sent to slaughter at 37-52 days (slaughter can start as early as 28 days).

Withdrawal refers to the removal of medications from feed in order to comply with maximum residue limits. Relevant medication is excluded from the withdrawal feed and instructions are issued to ensure that the grower/finisher feed is gone before the withdrawal feed is introduced. However, a significant number of farms would continue to medicate with zinc bacitracin as there is no withholding period because it is not absorbed from the gut of poultry.

Usual practice (representing 97% of commercial production) in the industry is to initiate antimicrobial treatment (a coccidiostat and an antibiotic) via feed immediately on the introduction of chicks to the production unit. Treatment is continued until the end of the grower/finisher stage.

A number of ionophores (salinomycin, narasin, lasalocid, monensin), sometimes in combination with nicarbazine, are added to the feed to control coccidia. A coccidiocide (to eliminate coccidia) is generally not used for extended periods because the constant low-level exposure to the organism results in a useful and sustained level of immunity.

An antibiotic is also added to the feed on day 1 to avoid necrotic enteritis (*Clostridium perfringens* and dysbacteriosis (a non-specific bacterial enteritis). The antibiotics used are zinc bacitracin (95% of the time) and avilamycin (5% of the time). The occurrence and severity of clinical signs of necrotic enteritis is unpredictable because of the multi-factorial influences. However, flocks that have been left untreated at times for other development or research reasons have shown 10-80% of farms affected with high morbidity and mortality. This level of morbidity and mortality could be expected if programmed treatment did not occur. With normal treatment programmes, morbidity and mortality are kept to a minimum.

At times other antimicrobial products are used for therapeutic purposes to treat bacterial infections such as *E. coli* septicaemia or femoral head necrosis (Staph sp) but this practice is rare (estimated to be 6 flocks out of 4,000 per year or 0.00015 flocks per year).

When therapeutic treatment is used it usually occurs in the starter stage. Treatment usually consists of either apramycin (in feed or water) or amoxicillin in water for 4-7 days and relates to a specific disease challenge. Other active ingredients (e.g. registered products containing tylosin, lincomycin, neomycin or virginiamycin) could be used, but they are not used by the major companies. Virginiamycin has become totally impractical to use for the control of necrotic enteritis because of the strict conditions on registration. While it could be used
for the treatment of *E. coli* and Staph sp infections, it is not used because it is considered inappropriate when there are effective options.

**Breeding production**

Birds on breeding farms produce eggs for the hatcheries to provide stock for production units. Birds in the parent flocks and eggs from those birds are not used for food for human consumption. Birds are introduced onto rearing farms at one-day old and reared for 18-22 weeks. They are then shifted to laying farms and kept until they are between 64 and 72 weeks.

The length of time birds are kept produces additional disease challenges that do not have time to occur in a broiler operation. Consequently, treatment practices are different. However, because of the biosecurity control used on breeding farms, the birds are free of specific poultry pathogens (such as Mycoplasma, which is an important cause of respiratory infections on commercial egg production units). Either no programmed medication occurs or only zinc bacitracin is added to the feed for the whole of the production cycle to minimise clinical signs of necrotic enteritis.

Internal parasites can occasionally be a problem. When necessary, birds are treated with ivomectin, levamisole or flubenol.

Occasionally, when flocks are found to be positive for salmonella, the flock is treated (in the water at the time the birds are shifted to the laying farm; and/or pulse treated [1 week in 6 weeks] in the feed) with therapeutic levels of apramycin. This has been done on only 4 or 5 farms in the last 3-4 years.

Bacterial enteritis can occur at times and the birds are treated with apramycin or amoxicillin in the feed for 4-5 days. Tylosin or neomycin has been used rarely for enteritis (including brachyspria).

**Turkey production**

Total production of turkeys in New Zealand is quite small. Disease challenges and antimicrobial use practices in turkey production are the same as for chickens, but the production period is longer. Range turkeys and turkeys housed on dirt floors are subject to challenge with Blackhead (histomoniasis) and control products are essential. Products used for this are dimetridazole and furamycin. Birds are sent to slaughter as late as 70 (up to 120 days free range) days instead of 28-52 days for broiler birds. Salmonella positive breeding flocks are treated the same as chicken breeding flocks that are positive. Breeding birds are not used for human consumption.

**Egg production**

The commercial egg production cycle consists of a rearing and a laying stage as for breeding farms, but the eggs produced are used for human consumption. The
rearing stage lasts for 16-20 weeks. The birds are shifted to laying farms and kept until they are 104-112 weeks old.

The management of egg production in New Zealand shows the greatest variability, but 90% of the commercial production is from caged birds. It is not common practice to use a coccidiastat in laying flocks. Normally antibiotics are not used on laying farms except to treat mycoplasma (see below).

If mycoplasma is a problem on the farm, common practice is to start medicating the birds with tylosin when they are shifted to the laying farm. If the problem is persistent, medication may continue for the full production cycle. It is estimated that 16% of layer birds (spread over the range of farm types) would use tylosin as a continuous treatment. This treatment would be used only if the serology testing on the farm confirmed *Mycoplasma galisepticum*. In 2-5% of cases tylosin is given as a high dosage for a short term. The effective alternative, where practical, appears to be maintaining flocks free of mycoplasma or vaccination of the flock.

For most caged birds on commercial units the biosecurity controls are stringent and the disease challenge and use of antimicrobial products is basically the same as for breeding production.

Twenty-five per cent of birds are housed in multi-age sheds. This limits the ability to control the introduction of specific pathogens. Control of disease is quite different in free-range operations. Flocks are generally smaller, and more often ‘all in all out’. Different diseases will occur in free-range operations. Approximately 4% of birds are kept in barns and 6% of birds are free range (some of these would use zinc bacitracin and flubenol).

Cholera is a growing problem in free-range egg production units, and is generally treated with amoxicillin. A cholera vaccine is available and is generally preferred. It is noted that 1% of commercial production is produced to organic standards (supposedly medicated with products approved for organic use only -- approved products do not include any of the antibiotics or coccidiostats used by the rest of the industry). The organic units are likely to be free range.

Any production unit on which the birds are exposed to the environment will have a greater challenge from parasites and pathogens. This will affect the antimicrobial use practices in about 10% of commercial laying birds. This may result in more reliance on treatment programmes and more therapeutic interventions and, possibly, a need to rely on a wider range of products on these farms than is described above for the bulk of production.

**Backyard production**

It is estimated that 12,000 properties in New Zealand have some kind of poultry. While there may be some trade in produce for human consumption from these...
properties, it is understood to be a relatively small amount, with most of the produce for own use and not for supply to third parties. The birds on these backyard properties are seldom, if ever, treated with antimicrobial products other than for coccidiosis.

**Summary**

Almost all of the commercial poultry industry has rigorous biosecurity and management processes that limit the impact of specific pathogens. Health problems are usually associated with opportunist organisms, such as *Clostridium perfringens*, *E coli* and coccidia species. These organisms only cause problems when a number of environmental, management and health status factors produce an imbalance within the birds.

Antimicrobial use can be divided into:

- programmed disease control use; and
- therapeutic use in response to a specific disease challenge.

Programmed disease control use appears to be most common in meat production. The industry depends on in-feed medication with a range of ionophores to control coccidia and zinc bacitracin (95% of the time) or avilamycin (5% of the time) to control necrotic enteritis.

While therapeutic intervention is possible, it appears to be a very rare occurrence in meat production (.0005 flocks per year). In all production types it appears that either apramycin or amoxicillin are the preferred active ingredients and only used at therapeutic levels in the face of a specific disease challenge. Tylosin appears to be the preferred active ingredient to control mycoplasma in commercial egg production when serological results confirm the *Mycoplasma galisepticum.*
APPENDIX 2:
ANTIMICROBIAL USE IN PIG PRODUCTION

INTRODUCTION
The following information was provided by veterinary technical advisors of the Pork Industry Board.

The production of pig meat on commercial farms in New Zealand has two core components:

- the production of piglets until weaning at about 4 weeks of age by breeding sows, referred to as the ‘breeding herd’; and
- the growing of piglets from weaning to slaughter weight (pork or bacon), known as the ‘grower herd’.

The majority of pork producers breed and raise their own pigs, and thus have both breeding and grower herds. These farms are known as ‘farrow to finish’ operations. While the breeder and finisher herds on a particular farm are usually in very close proximity to one another, from the point of weaning, breeder and grower pigs are almost never in direct contact. They are housed, fed and managed very differently. Breeding animals are often housed individually or in small groups, are individually identified with ear tags, and have a recorded history either on paper or on computer. These pigs are often fed individually by hand. The value of breeding stock is greater than their slaughter value. Where possible sows are treated as individual animals.

Grower pigs are usually fed, managed and housed in groups. These groups can be quite large (100-200 pigs) and they are not routinely identified unless they have received an individual treatment. Grower pigs usually reach bacon weight (80-90kg liveweight) before they are 22 weeks of age. As a result they are not on the farm for more than 18 weeks after weaning, with the majority being marketed before this.

There are a growing number of farms, particularly in the South Island, that specialise in either the production of weaners (outdoors) or growing them on.

The breeder and grower herds are usually divided into several distinct stages during the breeding and production cycles. These are: for breeding herds, mating, farrowing and dry (gestating) sow; for grower herds, weaner, grower and finishing.

On most farms each stage is housed in a distinct area, building, or part of a building on the farm, although there has been a global trend to reduce the number of physical moves that growers experience because each relocation introduces a moving stress and often also involves the disruption of socially
stable groups. The combination of stress and mixing has a marked impact on feed intake, which in turn facilitates the transmission of pathogens between pigs, and makes the pigs more susceptible to pathogens they may already carry. Even where grower pigs are moved only once after weaning, they pass through conceptual stages that require distinct environmental conditions and nutritional needs.

Subsequently, the diet changes as pigs grow. The names of these diets generally match the stage of growth e.g. creep (dry feed available to the piglet but not to the sow), weaner, grower, and finisher feed. On some farms, due to the design of the facilities and age of the farm, it is necessary for growers to move five or more times.

Before piglets are weaned they are referred to as suckers. This is also an important stage in the life of the grower pig, but is usually regarded as part of the breeding herd because the pigs essentially rely on their dam for feed and have little direct feed cost associated with them. Most piglets are weaned between 3- and 5-weeks of age, although on some small farms that have inadequate facilities for the housing of weaned pigs, weaning may occur later. While piglets are on the sow they are usually introduced to a dry feed (creep diet) towards the end of the period to support growth and to facilitate the transition to an all dry diet at weaning. Nevertheless, the volume eaten by most piglets while they are on the sow is relatively small and highly variable in amount. For this reason, the diet is an inappropriate means of administering treatments at this stage if they are needed. With very few exceptions, treatments are administered individually, and they may be routine.

When piglets are weaned, they are moved to a different location. For most pigs this involves a short walk to a different shed on the farm, although it may also involve transport to an altogether different site or farm. On farrow to finish farms, the weaner period lasts between 4 and 10 weeks. The length of the weaner stage is largely determined by the throughput of pigs and the amount of weaner space available. For example, if 100 pigs are weaned per week and there are 600 weaner spaces (say in six rooms each with four pens), then each pig will spend six weeks in the weaner stage (less a day or two for cleaning between batches).

With very few exceptions, weaning occurs on one day of the week and the pigs weaned are regarded as a distinct group or batch. Thus pigs are moved into and out of each stage as a group of a similar age rather than size or weight, although many farmers would size (and sex) pigs within a batch when allocating individual animals to pens. As pig production is relatively consistent, on any given farm there is usually a strong correlation between age and weight. For example, pigs may be moved out of the weaner facility to a grower facility at 10 weeks of age, and at that time they may weigh an average of 28 kg. Many farmers weigh pigs between stages and monitor these carefully, using deviations from the expected
weight range as an important diagnostic tool to alert them to nutritional or health issues not otherwise obvious, or to assess the impact of these.

When pigs are sold as weaners to specialised grower farms, it is common for the pigs to go through an initial weaner stage on the farm where they are born and to not be transported until they are about 8 weeks of age. These pigs are often housed in a single facility at the grower unit, on an all-in all-out basis until they are sold. Straw or sawdust bedded, low cost shelters are being increasingly used for this purpose in the South Island.

At the end of the weaner stage, pigs are transferred to the grower facility. This may involve further movement of the pigs (e.g. to larger pens as they grow) or it may be physically indistinct from the finishing stage. Where pigs are moved many times, often within a single shed, the system is referred to as continuous flow. This commonly involves mixing as well. As noted, the trend is to reduce the amount of moving and mixing. For example, the 100 pigs weaned as a batch into a single room with four pens may again be moved as a batch into a zone within a grower shed with four pens where they are physically separated from other pigs in that shed. Ideally this also involves a separate air space. The group is subsequently moved out as a batch (say when they are 16 weeks old) into a finisher shed. The vacated zone is then cleaned and disinfected before the next batch is moved in. This system is referred to as all-in, all-out and is universally recognised as the preferred way to manage growing pigs as it minimises the transmission of pathogens between groups of pigs while also avoiding much of the stress associated with moving. All-in, all-out management systems by nature are less reliant on medication.

**TREATMENT OF PIGS**

Present practice usually involves a combination of routine and reactive treatments for a variety of reasons. The treatments (veterinary medicines) include vaccines, mineral and vitamin supplements, anthelmintics, antimicrobials, anti-inflammatory and reproductive hormones. Some treatments, such as hormones, are applied only to breeding animals and for the purpose of reproductive management, e.g. oxytocin and prostaglandin are used to assist with farrowing of sows. No other hormones are used in pigs in New Zealand.

Because of the way in which pigs are farmed, sows typically receive individual treatments while grower pigs are commonly treated as a group. Routine antimicrobial treatments are applied on some farms at particular stages of growth to manage endemic diseases that would otherwise negatively impact on the health, welfare and performance of the animals. The routine treatments applied to grower pigs are likely to be in the form of medicated feed or water. Treatments are fed to the whole population for a specified time and at a specified stage.

Therapeutic group treatments may also be introduced from time to time when specific signs of disease are noticed. Considerations that are perhaps unique or
of different relevance to the veterinarian prescribing treatments for pigs include
the diet that the pigs are eating, feed lines, silos, and withholding time following
treatment. For example, the withholding period is more relevant as pork
producers generally cannot hold batches of pigs that are due for slaughter on the
farm because their spaces are required by the next batch of pigs coming through.
This limits the products that are available for the treatment of finisher pigs where
the treatment is to be applied in the feed or water. Most of the reactive treatments
take the form of parenteral administration to individual affected animals and
occasionally to in-contact animals as well.

A limited range of antimicrobial products is registered for use exclusively in pigs.
These are usually ones that are intended to be incorporated into feed for pigs
and are formulated accordingly. There are others that have been approved for
use in a wide range of animals, including pigs. They are usually products
intended to be administered parenterally with dosage recommendations
appropriate for each species.

Some products used are not specifically registered for use in pigs, but are used
at the discretion of the prescribing veterinarian as allowed for in the product
registration. Most of the products are prescription animal remedies (PARs) with a
few exceptions, e.g. the ionophores and carbadox. It is notable that in the
following description of the antimicrobial treatments commonly applied in each
stage of production, there is only a limited range of active ingredients regularly
used in pigs.

**FARROWING TO WEANING**
The first stage in production is from farrowing to weaning. It lasts for about 3-5
weeks and is characterised by a high stress point associated with antenatal
adjustment.

**Routine treatments**
All piglets are born with varying degrees of iron deficiency (baby pig anaemia).
Where the piglets do not have direct access to soil, they are routinely treated with
a parenteral iron preparation. While this is not relevant to antimicrobial therapy, it
is a factor affecting the stress level in the antenatal period.

Piglets on farms where farrowing occurs indoors and where coccidiosis has been
identified usually receive a single dose treatment with the antimicrobial toltrazuril
(Baycox™) within the first 4 days of life. It is probable that as many as 50% of all
piglets receive this treatment. This product is not a PAR product.

Eye teeth are cut and tails docked within 3 days of birth to minimise injuries later
in production. If done with care and with proper procedures, subsequent infection
is minimised. However, infection can occur as from other neonatal infections
ascending the umbilical cord or from skin abrasions where piglets graze the skin
on their knees when scrabbling to suckle. On some farms, and probably for a
variety of reasons, it is necessary at times for each piglet to receive a single treatment with an injectable antibiotic (e.g. penicillin or cephalosporin) to avoid septic polyarthritis. Where piglets that develop septic arthritis (with or without preceding prophylactic treatment) are identified, it is normal practice to treat pigs daily until considered clinically cured. Penicillin is most commonly used for this purpose.

Creep feed is introduced to support growth and facilitate the transition at weaning. It is often medicated with zinc oxide and an acidifier to prevent scours. It is not usually medicated with any antimicrobial products.

**Conditions to be treated when they occur**

**Scours**

Neonatal (*E coli*) scours that occurs from 0-5 days of age is the most important individual disease problem amongst pre-weaned pigs. Many farms vaccinate breeding gilts and sows before they farrow in order to provide passive protection to the piglets. This strategy greatly reduces the incidence of neonatal scours. Occasional litters are sometimes affected, especially where the gilt or sow becomes sick at farrowing. Where sows are not vaccinated, significant outbreaks can occur and these generally provide the farmer with the motivation to vaccinate. When a litter develops neonatal scours, piglets are individually treated with oral neomycin alone or in combination with sulphonamides and/or a parenteral treatment with trimethoprim/sulfonamide. In-contact animals not showing symptoms are likely to be treated as well. Medication is not incorporated into feed because the animals would not be eating dry feed at this stage. Electrolytes are usually provided in a bowl to supplement fluid intake. This may have a medication such as neomycin added to it.

**Polyarthritis**

The incidence of polyarthritis varies greatly from farm to farm. Where the incidence is high without treatment and no risk factor can be identified or readily addressed, a routine treatment may be prescribed (see above). Approximately 5% of animals may be expected to develop polyarthritis in any facility. These animals are treated individually with therapeutic doses of parenteral penicillin, amoxycillin, tylosin or ceftiofur.

**Greasy pig disease**

Generalised dermatitis of bacterial origin (*Staphylococcus hyicus*) may occur, but it is usually very uncommon. Individual affected animals are treated with therapeutic doses of parenteral penicillin or amoxycillin.

**Pneumonia**

While respiratory disease is uncommon in suckers, it is the biggest disease problem affecting growers and finishers throughout the world. The main risk factor for respiratory disease is *Mycoplasma hyopneumoniae* (MH). The vast majority of farms that are infected with this organism now vaccinate all grower
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pigs and suckers against it. The use of MH vaccine has increased steadily over the past 10 years and has dramatically reduced the usage of antibiotics for the treatment of growing pigs.

WEANING

The weaning period usually lasts for 4-8 weeks. At this stage the pigs are called weaners. The transition from sucking to weaning is a significantly stressful period. Animals are moved and regrouped and introduced to a new environment and marked changes in diet. Consequently, weaning is a period of high disease challenge.

Routine treatments

Weaner feed is regularly medicated with Mecadox Plus™, a combination of carbadox and morantel, to control the following conditions:

- Glasser’s disease (*haemophilus parasuis*);
- *Streptococcus suis*;
- Salmonellosis;
- Ileitis (*Lawsonia intracellularis*);
- Swine dysentery (spirokettal enteritis).
- *Ascaris suum*.

It is possible that as many of 80% of pigs grown receive this treatment for at least part of the weaner stage.

Weaners may receive treatment for mange. This may be applied topically (e.g. phos-met) or by injection (e.g. doramectin, ivermectin). The injectable anthelmintics also protect against internal parasites. Whipworm (*Trichuris suis*) is a significant problem on most farms where piglets are born outdoors. It is normal practice on such farms to treat pigs with flubendazole in feed when they are weaned.

*E coli* scours (post-weaning colibacillosis) is potentially a major problem over the week immediately after weaning as the piglets are removed from the protective qualities of the sow’s milk while also undergoing a change in diet, disruption in feed intake, and are exposed to a multitude of other stress factors. The incidence of post-weaning colibacillosis is dramatically reduced by the inclusion of zinc oxide (3000 ppm) in the creep feed. Other additives such as organic acids (acidifiers) are routinely added to further assist in the management and reduction of this disease. When post-weaning colibacillosis occurs at an unacceptable level, despite efforts to manage the problem, an antibiotic may be routinely offered for the first 3-7 days after weaning. This is commonly included in the water via a controlled delivery device. Neomycin is the antibiotic most likely to be used to treat this disease.

On some farms, an antibiotic such as oxytetracycline (Terramycin 200) or tiamulin-chlortetracycline (Tetramutin™) is included in the creep and/or weaner
feed. However, this treatment is largely historical and is unlikely to be prescribed by a veterinarian because the efficacy of the treatment is questionable. On individual farms, other specific treatments may be prescribed for unique problems of particular purposes. For example, when pigs are weaned into multiple pens, those that are sick or doing poorly are often penned together. It would not be uncommon for this group to receive a course of medication. An example given was the provision of Lincospectin™, a combination of lincomycin and spectinomycin, via a separate water supply, to the sick pen for 1-2 weeks after weaning.

On some farms it is necessary to treat weaners intermittently, perhaps for the control of ileitis (*Lawsonia intracellularis*). Examples given include the use of Lincospectin™ or tylosin (Tylan™) for 5 days once a month.

**Conditions to be treated when they occur**
Pigs may be treated for a range of non-specific conditions by movement to a sick pen that may be provided with medication in feed or water (see above).

On some farms, group treatment is initiated in response to certain conditions. For example, neomycin may be included in the water or feed only when an outbreak of post-weaning scours occurs. Similarly, soluble amoxicillin may be prescribed for a farm that has intermittent outbreaks of *Strep suis*, but for inclusion only when early signs of an outbreak are detected.

Injuries and non-specific lameness and pneumonia can occur. These are treated as with other age groups (see below) with an appropriate parenteral antibiotic.

**GROWING AND FINISHING OPERATION**
The growing/finishing period usually last for about 8 to 14 weeks, depending on the age at which pigs are transferred from the weaner stage and the time required to reach market weight. The period is usually divided into the grower stage for most of the time and the finisher stage during which the diet is changed to a finishing formulation.

**Routine treatments**
The medication that is included into grower and finisher feeds depends on the particular problems that occur on that farm. Traditionally, respiratory disease was controlled through strategic or continual inclusion of antibiotics in pig feed. Over the last decade *Mycoplasma* vaccines have become readily available and this has reduced the amount of antibiotic usage by more than 50%.

Currently, the vast majority of antimicrobials that are used in the pork industry are required to control enteric infections, most notably ileitis (*Lawsonia intracellularis*), spirochaetal colitis (*Brachyspira pilisicoli*), and swine dysentery (*Brachyspira hyodysenteriae*).
On farms where spirochetes are the main cause of enteritis in the grower and finisher herds, it is common for the ionophore monensin (or salinomycin) to be included in one or more feeds continuously. Without prophylactic treatment there can be 90-100% morbidity ranging from ill-thrift to death.

Ileitis is very common, and it is believed that every farm in the country is infected with this organism. Exposure within farms is considered inevitable, although morbidity appears to vary considerably from farm to farm. The disease presents itself in several forms and has several different names i.e. porcine adenomatosis, proliferative enteropathy, necrotic enteritis. In the chronic forms it causes inappetence and weight loss. Mortality is generally low. The acute form (porcine haemorrhagic enteritis) occurs in finisher pigs that have not developed adequate immunity and is inevitably fatal. This disease must be managed via prophylactic treatment to prevent severe loses (severe illness and death). However, as over-treatment can suppress the development of immunity and thus predispose pigs to the acute form, pigs must either be given intermittent treatment or be treated until they are slaughtered. Specialist pig veterinarians prescribe pulse treatment for the control of this disease. The regime that is required is determined for the individual farm and is based on both experience and on-farm trials. Treatment typically includes the inclusion of tylosin in feed at between 40 and 100 ppm for 5-7 days, every 3-5 weeks. Other antimicrobials are also used for the same purpose, e.g. Lincospectin™.

Tetracyclines have been used widely in the past, but are now rarely used as respiratory disease is less of an issue and it is also of questionable efficacy.

**Conditions to be treated when they occur**

Tail bite injuries treated with parenteral penicillins for 3 days to prevent infection.

Rectal prolapse (morbidity approximately 1%) is treated with parenteral penicillins for 3 days to prevent infection.

Despite the use of MH vaccine, respiratory disease outbreaks do still occur from time to time. Where the farm is also infected with *Actinobacillus pleuropneumoniae*, mortality can be very high. A range of products is used to treat pigs when a respiratory outbreak occurs. Treatment is invariably in feed although individual animals that are showing signs of respiratory distress are also treated parenterally with penicillin, amoxicillin, oxytetracycline, or ceftiofur. The most significant in-feed antibiotic used is the macrolide tilmicosin (Pulmotil™) because of its very high efficacy, although its usage amongst finisher pigs is limited because it has a long withholding period. Other products that may be used include tiamulin (Dynamutilin™), tylosin (Tylan™), lincomycin (Lincomix™), lincomycin-spectinomycin (Lincospectin™).
Leptospirosis very rarely establishes in grower herds these days – perhaps 1% per year. However, when infection is identified, serious efforts are taken to eradicate it for the protection of farm and abattoir staff. Oxytetracycline is usually included in feed and in all diets at 1000ppm for three weeks, with the exception of those pigs destined for slaughter in the next two weeks, in conjunction with other initiatives, e.g. vaccination of the grower herd against leptospirosis.

BREEDING OPERATIONS
Breeding farms consist of breeding age animals in stable management systems. Replacement stock are either selected from within the herd or sourced from a recognised breeding company. Apart from seasonal climatic variations, farrowing (parturition) is the primary point of stress at which disease challenges are significant.

Routine treatment
Sow herds routinely receive a range of vaccines and anthelmintic treatments. They are not now routinely medicated with antibiotics, although historically oxytetracycline was administered in feed twice a year on most farms. This is not common practice anymore although, when used, it does produce a notable response, perhaps through the control of *Eperythrozoon suis*. Identification of leptospirosis in the herd would also lead to medication with oxytetracycline.

Antibiotics are included in several of the disease eradication programmes that are used to eliminate certain important pathogens from pig herds. The most notable examples are the eradication of swine dysentery and MH (*Mycoplasma hyopneumoniae*). Both of these examples include treatment of the sow herd with high doses of antibiotics for a given therapeutic period. However, after the programme is complete, continued treatment to keep the disease under control would no longer be necessary. Swine dysentery, for example, can be eradicated through the use of high doses of tiamulin for 3 weeks (to eradicate current infections) followed by low dose treatment for 3 months (to prevent reinfection). Mycoplasma can be eradicated through a partial depopulation technique that removes the grower herd from the farm but retains the sows. For about six weeks the sow herd is heavily medicated with a succession of tiamulin, tilmicosin and lincomycin.

Parturition interventions may include a routine single administration of penicillin to prevent infection.

Conditions to be treated when they occur
Parenteral treatments usually consist of 3 days administration at therapeutic doses.

Mastitis (approximately 5% morbidity) is treated with parenteral trimethoprim or tylosin.
Post farrowing fever (approx 5% morbidity) is treated with parenteral penicillins.

Lameness (usually joint swelling in 2-3 animals at any one time) is treated with parenteral penicillins or tetracyclines.

Injuries and abscesses (1-2% per year morbidity) are treated with parenteral penicillins.

Cystitis and vulvar discharges are treated with a parenteral penicillin (amoxicillin) or tylosin.

Erysipelas (unusual) is treated with parenteral penicillin.

Pneumonia treatment is with tylosin or tyldicosin.

APPENDIX 3:
SALES STATISTICS SPREADSHEETS