Possible impact of the “yellow card” antimicrobial scheme on meat inspection lesions in Danish finisher pigs

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Abstract
In 2010, the “yellow card scheme” adopted by the Danish Veterinary and Food Administration imposed restrictions on pig farmers who used more antimicrobials than twice the average. We studied the impact on antimicrobial consumption and vaccine use based on data from the monitoring programme Vetstat covering the time period January 2010 and July 2011. The decrease in antimicrobial consumption was pronounced for all age groups treated for either gastro-intestinal or respiratory disease. Data from meat inspection of finisher pigs from before and after introduction of the scheme were compared (N=1.7 million finisher pigs). Nine lesions of chronic nature and infectious origin and the code “condemned” were selected. Logistic regression models with year and week as explanatory variables were used to identify whether the prevalence of a lesion changed from 2010 to 2011. The most common lesion seen was chronic pleuritis (~23%) while the other lesions occurred less-commonly (<1%). For osteomyelitis, pleuritis, chronic arthritis and condemnation, no differences were observed between the 2 years. The prevalence of chronic peritonitis (OR=1.5), umbilical hernia (OR=1.2) and chronic enteritis (OR=1.2) were statistically higher in 2011 compared to 2010, whereas it was lower for tail bite infection (OR=0.6), chronic pericarditis (OR=0.6), and chronic pneumonia (OR=0.7) (P<0.001). Our results indicate that marked reduction in use of antimicrobials is associated with a short-term increase in the prevalence of specific lesions found during meat inspection and higher coverage of vaccines against respiratory diseases might impact the prevalence of chronic pneumonia positively. Other factors that impact on pig health were not included in the study. Moreover, effect of productivity was not evaluated.

Introduction
Discussion about prudent use of antimicrobials in animal production is on-going. There is concern about the development of bacteria that are resistant to the antimicrobials commonly used to cure infections in both humans and livestock. However, it might be speculated that animal health might deteriorate if diseased animals are not treated, hereby jeopardizing animal welfare.

In 2010, the “yellow card scheme” adopted by the Danish Veterinary and Food Administration imposed restrictions on pig farmers who used more antimicrobials than twice the average. Such an approach might have negative implications for the pig health. We therefore decided to study the potential impact on pig health. This paper shows the main part of the results – more details can be found in Alban et al. (2013).

Material and Methods
We made use of the antimicrobial consumption and vaccine use data from the monitoring programme Vetstat, covering all treatments between January 2010 and July 2011. A linear regression using the ordinary least square regression method was fitted to the antimicrobial use data by use of Microsoft Excel® and the R² was calculated. Based on the linear regression, the relative decrease (%) in consumption was calculated for a 12-month period. A similar exercise was made for the vaccine data.

Data from meat inspection of finisher pigs from before and after introduction of the scheme were compared. A total of 1.7 million finisher pigs originating from 2,765 pig farms were included in the analyses. These pigs were all slaughtered on one large Danish abattoir. These data covered the first 9 weeks in 2010 and 2011, respectively. Nine lesions of chronic nature and infectious origin and the code “condemned” were selected.

Logistic regression models with year and week as explanatory variables were used to identify whether the prevalence of a lesion changed from 2010 to 2011. Possible clustering due to correlation within herds and between weekly shipments of animals originating from the same herd was taken into account in the models. The software programme SAS was used for this part of the analysis.

In datasets that are very large, statistical significance is easily obtained. Moreover, we had 10 different models, which would make it easier to obtain statistical significance by chance. Therefore, we applied a significance level of 1% in the univariable models and 0.1% in the final model instead of the customary 5%. Moreover the Odds Ratio – as a measure of biological importance – had to be <0.9 or >1.1.
Results

The decrease in antimicrobial consumption was pronounced for all age groups treated for either gastro-intestinal or respiratory disease. Vaccine use increased in general: PCV2-related infections (+31%), gastro-intestinal disease (27%), and respiratory infections (21%). Figure 1 shows the decline in the use of antimicrobials for the gastro-intestinal diseases, whereas figure 2 shows the increase in the use of vaccines: PCV2-related infections: +31%, gastro-intestinal disease: +27%, respiratory infections: +21%.

The most common lesion seen was chronic pleuritis (~23%) while other lesions occurred less-commonly (<1%). For osteomyelitis, pleuritis, chronic arthritis and condemnation, no differences were observed between the 2 years. Chronic peritonitis (OR=1.5), umbilical hernia (OR=1.2) and chronic enteritis (OR=1.2) were more prevalent in 2011 compared to 2010, whereas tail bite infection (OR=0.6), chronic pericarditis (OR=0.6), and chronic pneumonia (OR=0.7) occurred less-frequent ($P<0.001$) (Table 1).

Discussion

The introduction of the Yellow Card scheme led to a substantial decrease in the consumption of antimicrobials in pigs in Denmark. This enabled a national evaluation of the impact on the health of pigs. Meat inspection data can be seen as indicators of health although there are inherent weaknesses in such data. These weaknesses were minimised by choosing data from one abattoir only. These data were considered the best available at the time for the purpose of our study. Later, more refined analyses including data describing productivity can be made.

The current permit limits for antimicrobial use in the yellow card scheme were set by the Danish Veterinary and Food Administration based on an intention to focus on the herds with the highest use. Naturally, when the consumption decreases among the farmers with the highest use, a permit limit defined as twice the average consumption will decrease. When considering the future permit limits, a thorough assessment should be conducted to find appropriate permit limits, which will not be leading to under-treatment and thereby poor animal health and welfare.
The amounts of antimicrobials used per pig are already low in Denmark compared to other countries with a similar pig production (European Medicines Agency, 2011). The existing low use has an effect on the total release of resistant strains of zoonotic bacteria into environment as such, which can be demonstrated by the relatively low prevalence of resistance seen in zoonotic bacteria of human and animal origin (DANMAP, 2011). As long as the existing hygienic measures are kept in place, both in primary production and at slaughterhouse level – the food safety risk related to antimicrobial resistant strains of zoonotic bacteria on meat will remain low. Therefore, a further decrease in use of antimicrobials in production animals in Denmark might have limited impact on food safety.

Moreover, strict measures in one country’s animal production have a limited impact on the general release of resistant strains, when animals, humans and meat are moved freely between European Member states as well as in and out of the European Union. Initiatives regarding prudent use of antimicrobials in humans and livestock on a European or global level are therefore welcomed.

A system like the yellow card might not as easily be introduced in other pig-producing countries due to the unique structure of the Danish pig production where almost all producers and slaughterhouses are member of the same organisation and most producers operate with high biosecurity measures (SPF-system).

Table 1. Results of analyses of effect of year in 10 logistic regression models describing association between year and each of 10 specific lesions found at meat inspection of 1.7 million Danish finisher pigs at one large abattoir during the first nine weeks of the year 2010 and 2011, respectively.

<table>
<thead>
<tr>
<th>Model with lesion as dependent variable:</th>
<th>Frequency of lesion in 2011 compared to 2010</th>
<th>Fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Random effects</td>
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<tr>
<td></td>
<td>Covariance subject Parameter estimate Standard Error</td>
<td>Parameter estimate Odds Ratio Standard Error P-value (Wald’s)</td>
</tr>
<tr>
<td>Chronic peritonitis&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Herd 0.2619 0.0238 0.4332 1.54 0.0313 &lt;0.0001</td>
<td></td>
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<tr>
<td>Umbilical hernia</td>
<td>Herd 0.6340 0.0397 0.2058 1.23 0.0314 &lt;0.0001</td>
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<tr>
<td>Chronic enteritis</td>
<td>Herd 0.1534 0.0183 0.1645 1.18 0.0313 &lt;0.0001</td>
<td></td>
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<tr>
<td>Chronic enteritis</td>
<td>Week 1.1032 0.0135</td>
<td></td>
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<tr>
<td>Condemnation&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Herd 0.4813 0.0371 0.1184 1.13 0.0382 0.0019</td>
<td></td>
</tr>
<tr>
<td>Chronic arthritis</td>
<td>Herd 0.5229 0.0387 --0.0236 0.98 0.0373 0.526</td>
<td></td>
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<tr>
<td>Chronic arthritis</td>
<td>Week 1.0329 0.0124</td>
<td></td>
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<tr>
<td>Chronic pleuritis</td>
<td>Herd 1.3188 0.0415 --0.0439 0.96 0.0104 &lt;0.0001</td>
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<tr>
<td>Chronic pleuritis</td>
<td>Week 5.4904 0.0684</td>
<td></td>
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<tr>
<td>Chronic pneumonia</td>
<td>Herd 0.6746 0.0402 --0.3413 0.71 0.0344 &lt;0.0001</td>
<td></td>
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<tr>
<td>Chronic pneumonia</td>
<td>Week 1.08 0.0129</td>
<td></td>
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<tr>
<td>Chronic pericarditis&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Herd 0.7885 0.0585 --0.5233 0.59 0.0484 &lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>Tail bite infection&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Herd 0.9499 0.5343 --0.6030 0.55 0.0354 &lt;0.0001</td>
<td></td>
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</tbody>
</table>

<sup>a</sup>: The dependent variable consisted of the number of finisher pigs (y) in which a specific lesion was recorded at meat inspection divided by the number of pigs (n) sent for slaughter from that producer in a week. Week was kept in all models as a categorical variable.

<sup>b</sup>: The model specifying both herd and week as random effects did not converge, therefore a reduced model was run with only herd as a random effect.

<sup>c</sup>: The model specifying herd as a random effect did not converge, therefore a reduced model was run without any random effects.

n.a.: Non applicable
Conclusion
Our results indicate that marked reduction in use of antimicrobials is associated with a short-term increase in the prevalence of specific lesions found during meat inspection, and higher coverage of vaccines against respiratory diseases might impact the prevalence of chronic pneumonia positively.

References
