Economic Benefits of Antibiotic Growth Promoters in Livestock

Ramanan Laxminarayan
Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data

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Summary

Background Antibiotic drug consumption is a major driver of antibiotic resistance. Variations in antibiotic resistance across countries are attributable, in part, to different volumes and patterns for antibiotic consumption. We aimed to assess variations in consumption to assist monitoring of the rise of resistance and development of rational-use policies and to provide a baseline for future assessment.
Figure 2: Consumption of antibiotics in 2010
Figure: Compound annual growth rate (CAGR) of total antibiotic consumption in Standard Units (SU) per capita for the period 2000-2010 across select countries.
Antimicrobials are widely used in animal sector

- Twenty-seven different antimicrobial classes are used in animals, most of which have human antimicrobial counterparts
- Nine of these classes are exclusively used in animals
- The top three antimicrobial classes by sales for animal use in 2009 were:
  - macrolides,
  - penicillins
  - tetracyclines
National antimicrobial consumption and meat production in OECD (2010)

Grey dots represent the total production and red dots represent intensive production alone.
Largest consumers of antimicrobials in livestock in 2010 and 2030

A) Largest five consumers of antimicrobials in livestock in 2010
B) Largest five consumers of antimicrobials in livestock in 2030 (projected).
C) Largest increase in antimicrobial consumption between 2010 and 2030,
D) Largest relative increase in Antimicrobial consumption between 2010 and 2030.
Posterior distributions for estimates of antimicrobial consumption in OECD countries
Global antimicrobial consumption in livestock (top) and standard deviation (bottom)
Summary estimates

- Global consumption of antimicrobials in food animal production was estimated at 63,151 (±1,560) tonnes in 2010 and is projected to rise by 67%, to 105,596 (±3,605) tonnes by 2030, with hotspots like India where areas of high consumption (30 kg per km²) for industrial poultry production are expected to grow 312% by 2030.

(van Boeckel, PNAS, In Press).
Antimicrobial consumption in livestock in the EU in 2010 for cattle (A), chickens (B) and pigs (C)
Antimicrobial consumption in chickens (A) and pigs (B) in 2010.

Purple indicates new areas where antimicrobial consumption will exceed 30 kg per 10 km² by 2030.
Meat production per head of livestock is increasing

Source: FAOSTAT
Price of broiler, cattle and hog meat and feed additive antibiotics, Washington State

Source: Cromwell (2002)
Meat production and sales of antibiotic feed additives, United States, 1951-1970

Source: Cromwell (2002)
Change in performance of pigs fed antibiotics

Improvement in the Average Daily Growth (ADG) of pigs fed antibiotics over time

- Zimmerman, 1986
- Hays, 1978
- Dritz, 2002
- Miller, 2005
- Van Lunen, 2003

% improvement ADG, Nursery pigs
% improvement ADG, Growing-finishing pigs
Change in performance of pigs fed antibiotics

![Graph showing improvement in the Feed-Conversion Ratio (FCR) of pigs fed antibiotics over time](image)

- Hays, 1978
- Zimmerman, 1986
- Miller, 2003
- Dritz, 2002
- Van Lunen, 2003
# Productivity Impact of AGP Termination in Denmark

<table>
<thead>
<tr>
<th></th>
<th>Broiler Production</th>
<th>Swine Production</th>
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</thead>
<tbody>
<tr>
<td><strong>Weight gain</strong></td>
<td>+2.7%</td>
<td>Weaners: -2.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finishers: +6%</td>
</tr>
<tr>
<td><strong>Time to market</strong></td>
<td>0%</td>
<td>+0.9% (+1.6 days to reach 100kg)</td>
</tr>
<tr>
<td><strong>Feed conversion ratio</strong></td>
<td>+0.9%</td>
<td>Finishers: -1%</td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td>0%</td>
<td>Weaners: +0.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finishers: +0.4%</td>
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</tbody>
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Numbers denoted percent change in value between 1995-1998 and 1999-2001
Impact of control performance on magnitude of treatment effect

Melliere et al., 1973
Response by livestock to supplementation with growth promoters

Barug et al., 2006
Difference in average daily growth between animals raised with and without AGPs

- **1980s literature**
  - Cattle: 8%
  - Chickens: 4%
  - Pigs: 10%

- **2000s literature**
  - Cattle: 2%
  - Chickens: 1%
  - Pigs: 1%
Productivity reductions and costs per produced pig incurred by removing AGPs

<table>
<thead>
<tr>
<th>Productivity reduction</th>
<th>Associated cost, $ per pig produced</th>
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<tr>
<td>Excess mortality</td>
<td>0.6% * $73/pig (20kg)</td>
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<tr>
<td>Excess feeding days</td>
<td>1.6 days * $0.19/day</td>
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<tr>
<td>Increased medication</td>
<td>25500 kg valued at $9.09 million for 23.5 million pigs</td>
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<tr>
<td>Increased workload</td>
<td>30 sec./pig at $25/hour</td>
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<tr>
<td>Total cost</td>
<td></td>
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</tbody>
</table>

Adapted from Kjeldsen & Callesen (2006)
Productivity reductions and costs per produced pig incurred by removing AGPs

- **Increased workload**: (30 sec./pig at $25/hour) - $0.21
- **Increased medication**: (25500 kg valued at $9.09 million for 23.5 million pigs) - $0.39
- **Excess feeding days**: (1.6 days * $0.19/day) - $0.30
- **Excess mortality**: (0.6% * $73/pig (20kg)) - $0.44

**Total cost**: $1.34
Potential loss in annual meat production following AGP withdrawal (in %)
Potential loss in the value of annual meat production following AGP withdrawal
Key messages

1. Global average annual consumption of antimicrobials per kilogram of animal produced was 45,148 (172 mgs per kg) for cattle, chicken and pigs.

2. The growth response to Antimicrobial Growth Promoters (AGPs) is small in optimised production systems.
   - growth response to antimicrobials is less important when nutrition, hygiene practices, the genetic potential of animals and health status of the animal herd or flock are optimal.
Key messages

3. With no major changes in policy, global consumption of antimicrobials is projected to rise by two-thirds by 2030.

4. Projected effects of restricting sub-therapeutic antimicrobial use on livestock production globally vary widely.

5. Economic impact of a phaseout of AGPs could be limited in high-income countries but higher in countries with less optimised production systems.
Global Antibiotic Resistance Partnership

India • Kenya • Mozambique • Nepal • South Africa • Tanzania • Vietnam
Thank you

www.cddep.org/garp
www.extendingthecure.org
Effect of Danish ban on AGPs

Total Consumption of Antibiotics in Danish Animal Production (mt of active ingredients)

- Medication
- Growth Promotion
- Total