Lessons from the Danish Ban on Antimicrobial Growth Promoters

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Introduction

The purpose of this report is to analyze the Danish ban on antimicrobial growth promoters (AGPs) in order to conclude suggestions for stakeholders in the US to similarly restrict AGPs from the meat supply chain. The analysis includes: 1) a description of the Danish pork industry; 2) the application of veterinary medicine1 in Danish foods; 3) a review of the stakeholders behind the ban; 4) an assessment of the effects of the ban on antimicrobial consumption and productivity; 5) the US meat industry’s response to the Danish example; 6) a counter to the US meat industry’s arguments; and concludes with 7) some suggestions for stakeholder strategies that could support a similar restriction on AGPs in the US.

Denmark is a good example to use for this analysis, because it has a sizeable, industrialized meat industry; it has 10 years of experience of AGP-free meat production; and there is detailed data available about the effects of the ban on antibiotic resistance due to a government funded monitoring system. In addition, the Danish success is often cited in the debate on antibiotics usage in the US. For example, in 2010 a Danish delegation of researchers and meat industry representatives were invited to the US Congress to talk about their experience regarding the ban. Efforts in the US regarding AGPs restriction are topical -- with current policy discussions on food safety issues and the problem of antibiotic resistance on the political agenda.2

1. The Danish Pork Industry

The pork industry is the leading sector of the Danish meat industry. Around 5,000 pig farms produce approximately 28 million hogs annually. About 90% of pork production is exported which makes Denmark the largest exporter of pork in the world (DAFC, 2011). Despite the high cost of production the Danish swine industry is competitive on the global market. According to Hamann (2006. pp 94-95) this can be attributed to:

a) The structure of the industry. Pork harvesting, processing and merchandising activities are handled by farmer-owned cooperatives. There are two pork cooperatives: the Danish Crown (93% of pig processed) and TiCan (7%). This cooperative structure has been the basis of developing high levels of food safety, animal welfare and traceability standards. This structure also made the Danish swine industry capable of supplying requested volumes and quality of pork to processors all over the world.

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1 Including antibiotics use
2 i.e. Preservation of Antibiotics for Medical Treatment Act (PAMTA) and FDA Food Safety Modernization Act
b) Traceability. Farmers are subject to guidelines on production methods (regarding housing, medication and transportation) and regulation on traceability. There is a system in place which gives full traceability of animals from farm to slaughterhouse.

c) Branding.

d) Research and Development. Denmark has strong research capacities within primary production and processing of pigs. Much research has been carried out to improve efficiency of production and the breeding material.

2. Veterinary Medicine Usage in Danish Food Animals

AGPs were gradually banned in Denmark in the 1990s due to concerns about antibiotic-resistant pathogens. The Danish legislation mandates judicious use of antibiotics in the meat industry. Therefore, the distribution of veterinary medicine takes place through authorized pharmacies based on veterinary prescription. Similarly, veterinary prescription is required in order to obtain medicated feedstuff from feed mills. Treatment can only take place in case of diagnosed infection.

All medication use must be recorded and reported to VETSTAT by the prescribing veterinarian. VETSTAT is an IT-based register which collects and processes data of the order and the use of prescription drugs, growth promoters and coccidiostats in Danish food animals. Pharmacies, veterinaries and feed mills are required to send data to the register. From these three sources there is detailed data available comprising farm identity, species, age group, disease group, identity of medicine, amount, date of purchase and identity of the prescribing veterinarians.

VETSTAT, in operation since August 2000, is based on the Copenhagen Recommendations (MFAF, 2011). In 1998, at an EU conference in Copenhagen on antibiotic resistance, participants discussed the problem and developed recommendations to the European Commission (for details see page 8 of this report). Following this conference, Henrik Dam Kristensen, the Danish Minister for Food, Agriculture and Fisheries decided to create a register of prescription drug consumption of food animals with the vision to reduce its antibiotics consumption. This register is an important source for researchers to examine the association between antibiotic consumption and resistance development. It gives the authorities a powerful tool to reveal misuse/illegal use of antibiotics. Moreover, it helps veterinarians in their advisory work—hog and cattle producers have been required to receive monthly veterinary visits since 1996. The purpose of these visits is to assist farmers on the use of medications and on other herd health related issues. The veterinarian also inspects compliance with national and EU animal welfare regulation (see information on monthly visits on page 3).

3. How Did the Ban on AGPs Come about in Denmark (historical perspective)?

Worries regarding antibiotics resistance arose in 1969, when the Swann Committee recommended to the British parliament that antimicrobials used in human medication should not be used for growth promotion in food animals. While the debate was mostly happening at the international level, the topic was also frequently discussed in Denmark.

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3 This chapter is based on the internal report of the Technical University of Denmark.
4 A chemical agent added to animal feed (as for poultry) that serves to retard the life cycle or reduce the population of pathogenic coccidia to the point that disease is minimized and the host develops immunity.
5 For more information about the recommendations see: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=1116
6 This chapter is based on the internal report of the Technical University of Denmark.
It is important to mention the context in which the debate emerged and took place. The end of the 1980s and the beginning of 1990s can be described as a time when risks and manmade hazards became part of the global agenda. There are a series of events that mark this transition to this so called ‘risk society’:

- In 1986, the downside of agricultural production methods became a hot topic in the Danish media, due to frequent incidents of water pollution.
- In 1996, the Bovine spongiform encephalopathy (BSE), commonly known as mad-cow disease, in Great Britain created not only a global fear of foodborne diseases from animal origin, but also resulted in the biggest political-institutional crisis of the EU system. Based on this incident the structure and the openness of EU science committees have radically changed, and priority was given to the so called ‘precautionary principle’.7
- In the middle of the 1990s a new approach dealing with the three components of risk (risk assessment, risk management and risk communication) entered the field of international food science.

The efficiency of the industrialized Danish meat industry brought along unintended consequences, such as salmonella outbreaks in the 1990s. These events focused a lot of media attention on food safety in the country, which ultimately fostered a public debate on antimicrobial resistance.

An important stakeholder group, the Danish veterinaries, shared the same concerns as scientists regarding antibiotics resistance. At the annual meeting of the Danish Veterinary Association in 1995, there was a discussion on whether veterinaries were too generous with antibiotics resale. (In Denmark at that time the resale of antibiotics constituted a part of the veterinarians’ income.) The discussion was indeed about whether veterinaries should no longer have economic incentives to sell antibiotics to farmers. It was decided that limits would be placed on the amount of antibiotics Danish veterinarians had the right to sell. At the same time, hog and cattle farmers with over a certain number of animals8 were required to receive monthly veterinary visits.

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7 The precautionary principle can be used in cases when urgent measures are needed in the face of possible danger to human, animal or plant health, or to protect the environment, but the available scientific data is not enough or not conclusive regarding the risk. In such cases the burden of proof falls on those whose actions pose the risk.

8 It is mandatory for herds with 100 adult cattle or more, 200 cattle or more, 300 hogs or more, 3000 finisher pigs or more, 6000 piglets or more. (4800 cattle and hog farms met this requirement in 2010)
This meant that the veterinarians’ loss on the antibiotics resale was compensated by the fee of these obligatory visits. After this new rule the veterinary profession was viewed differently, namely that the veterinarians became advisors instead of drug providers.

There were other changes that led to a more judicious use of antibiotics in food animals in Denmark. For example, since 1995 the prescription for antibiotics has to be renewed after 35 days. Veterinarians are allowed to prescribe antibiotics to a maximum of 5 days of treatment of a diagnosed disease. Each veterinary prescription is registered and there is an inventory on antibiotics sale.

The DANMAP (Danish Integrated Anti-Microbial Resistance Monitoring and Research Programme; see figure 1) was established in 1995. It is financed by the Health Ministry and the Ministry of Agriculture and Fisheries. The DANMAP is an annual report which gathers information on Danish antimicrobial resistance and antibiotics use in animals and humans. DANMAP uses the VETSTAT as a main source of information.

DANMAP describes the annual consumption of antimicrobial agents and the occurrence of resistance in different reservoirs. In addition, it includes considerable research activities associated with the DANMAP program. The main chapters of DANMAP 2009 were antimicrobial consumption in animals (pigs, cattle, poultry, fur animals, aquaculture and pet animals), antimicrobial consumption in humans, resistance in zoonotic bacteria, resistance in indicator bacteria, resistance in human clinical bacteria and resistance in diagnostic submissions from animals.

The design of DANMAP is based on the ‘from farm to fork’ concept, which is ideal, because it is an easily understandable phrase and catches the basic philosophy behind the Danish way of thinking about antibiotics resistance in the 1990s. DANMAP is a result of the cooperation between different stakeholders on the supply-chain, which is essential to provide useful and internationally comparable data.

Based on the DANMAP reports, the European Food Safety Authority concluded that antibiotics resistance in the Danish population is lower than in the rest of EU.

In March 1995, an FAO/WHO expert panel met to discuss the deployment of the principles of risk assessment and risk management in food production. This meeting represented a change in the way food safety was perceived. Food safety at that time was preoccupied with epidemiology; a backwards-looking perspective which draws its conclusions based on gathered and measureable data. While risk assessment has a forward looking approach which uses models and mathematical projections. (Note: Regarding the antibiotics debate in the US the same epidemiology vs. risk approach controversy can be observed. While public health advocates point out the potential serious risk associated with non-judicious use of antibiotics, the industry argues that there is only a few cases of antibiotics resistant infections, thus this shows the risk is low.)

In the 1990s, European researchers started to pay more attention to the problem of antibiotics resistance. A German researcher, Wolfgang Witte Vibeke Rosdahl contacted the Deputy Director of Statens Serum Institute (SSI)⁹, because vancomycin resistance enterococci (VRE) were found in German food animals, people and water supplies. Before the resistance was found in Germany the Danish Zoonosis Center worked on the hypothesis that antibiotics in animal feed could cause antibiotics-resistance in humans. The key researchers in this field were Niels Frimodt-Møller, Henrik Wegener and Frank Aarestrup who were also consultants for SSI, who were discussing the danger of antibiotic resistant salmonella and staphylococci.

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⁹ ‘SSI is a public enterprise under the Danish Ministry of Interior and Health. For more than 100 years SSI’s main task has been to secure the preparedness towards infectious diseases and congenital disorders. The tasks have been expanded, and today, SSI is an international research, production and service enterprise.’ (Source: www.ssi.dk)
Influenced by the German study, the Danish Zoonosis Center decided to conduct research regarding VRE in Danish food animals. The findings of the research were shocking—VRE was found in 80% of the samples from poultry farms with conventional production methods, while there was no VRE found in the samples from farms with organic production methods. Results clearly showed that the use of antibiotics (especially avoparcin) as growth promoters was responsible for the VRE in food animals, because such use of drugs was not allowed in organic production.

The Danish Zoonosis Center in collaboration with SSI conducted further research that showed that resistance could be transmitted from animals to humans. One of the researchers, Niels Frimodt-Møller was concerned that the gene which made VRE resistant is able to transfer resistance to other types of bacteria. The results of the study and the researchers’ concerns were presented to the meat industry at a roundtable meeting. Researchers especially emphasized how resistance-problems can harm Danish export interests. Good argumentation was crucial at this point, because researchers could not refer to clinical cases to support their arguments. However, according to the participating researchers, the meat industry responded very well to the “export argument,” and voluntarily stopped the use of avoparcin in animal production. The meat industry decided to cooperate, although it considered the antibiotics problem to be overemphasized compared to the actual risk it posed. The industry was under strong political and media pressure and so they did not have other options than to support the ban in order to win the public.

In 1995 a TV documentary called ‘The Filthy Medicine’ was produced by the national TV and radio channel, DR, in cooperation with the key Danish researchers of antibiotics-resistance. The documentary led to a strong political and media interest in the subject. A few days after the broadcast, Henrik Dam Kristensen, the Minister for Agriculture and Fisheries, prohibited the use of avoparcin as growth promoters. The ban was in contradiction with the legislation of other EU Member States, and so Denmark received 6 weeks from the EU to prove the health risk associated with the use of avoparcin.

The pharmaceutical company, Roche, the main producer of avoparcin, started a press campaign against the Danish ban. After Henrik Dam Kristensen’s statement, the company announced that its director would fly to Denmark to influence the case. This announcement had the opposite effect than intended—it gave more public support to the ban. The Danish Ministry of Agriculture referred to EU’s precautionary principle in the defense of the ban. The Ministry’s position was supported by researchers not only from Denmark, but also from Sweden, Germany and the Netherlands.

The Danish scientific arguments were not well received by the Scientific Committee on Animal Nutrition, which was asked by the European Commission to assess the safety of AGP usage in food animals. The committee consisted of people who knew much about animal feed, but very little about diseases. The problem of antibiotics resistance was out of the sight of the committee members because they did not possess sufficient knowledge of microbiology. They had a background in chemistry, which was not adequate to understand how antimicrobial agents have the potential to create resistance.

Moreover, while the pharmaceutical industry was not willing to recognize the scientific conclusions presented by the Danish side, they could not refute it either. The pharmaceutical industry tried to

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10 Similar research was conducted on US poultry farms with very similar findings: Sapkota et al. (2011): Lower prevalence of antibiotic resistant enterococci on US conventional poultry farms that transitioning to organic practices. Available from: http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.1003350


11 Avoparcin and vancomycin are closely related and give the same resistance in bacteria.

12 Due to the increasing concern of antimicrobial resistance regulations at export markets could be tightened in the near future or export markets can develop preferences for AGP-free meat, both of which would result in lost export markets for the Danish farmers, if they do not act now.

13 Avoparcin was never used in US livestock

14 EU committee
influence the scientific committee and attacked the credibility of the researchers who supported the ban. The members of the committee came from different European countries, where the pharmaceutical industry had strong influence on politics, which meant that the industry’s arguments found their ways to the committee’s discussion. In other words, the Danish researchers and the Danish politicians were up against a very strong pharmaceutical lobby with economic interest at stake.

German researchers and German politicians initially supported the Danish case, which gave Denmark a strong ally. But the biggest difference was made when France joined the Danish side, especially the scientific evidence which was provided by a reputable French professor, Patrice Courvalain (from the Pasteur Institute). At the end of 1996 Anthony van den Bogaard’s research showed that the VRE level in animals and in humans was reduced by 50% after a ban was implemented in the Netherlands. Only England and Belgium voted against, and avoparcin got banned in the EU in 1997.

The next growth promoter that was banned in Denmark was virginiamycin\textsuperscript{15}. Henrik Dam Kristensen banned this antibiotic on the 16th of January 1998, and the EU followed the Danish example the year after. Beside virginiamycin there were three other growth promoters (bacitracin\textsuperscript{16}, tylosin\textsuperscript{17} and spiramycin\textsuperscript{18}) that were prohibited. England and Belgium voted against the ban, probably because the pharmaceutical industry lobbied heavily among the British representatives.

After the ban was accepted the pharmaceutical industry acted promptly and tried to reverse the decision. They filed a lawsuit at the European Court of Justice (ECJ). Denmark, the European Commission, and the European Parliament were all brought into court. On the plaintiff side stood the pharmaceutical industry (represented by Pfizer) and the Belgian Farmer Association. They challenged not only the scientific evidence, but also the entire legal process that led to the ban.\textsuperscript{19} In the end, ECJ ruled in favor of the ban, and in 2002 the European Council made a decision that all growth promoters should be phased out by 2006.

The international debate over food safety was intense in the mid 1990s. Not only because it was an important political issue, but also because the pharmaceutical industry had one billion dollars of profit annually at stake. There were two international conferences where the resistance problem was set on the public agenda, and where the conflict between pharmaceutical interest and independent research clearly manifested.

There was a meeting in Berlin in 1997, where all the stakeholders of antibiotics-resistance were represented. At that time neither the industry nor EU’s trading partners were aware of how controversial the topic actually was. The conference gave rise to the first coalition of scientists who were concerned about antibiotics-resistance. This coalition was absolutely crucial in the later ECJ case, given that without the coalition’s support Danish and Swedish researchers wouldn’t have been able to provide enough evidence for their argument.

The other influential conference on antibiotics resistance was organized by the director of the National Board of Health\textsuperscript{20}, Einar Krag, in Copenhagen in 1998. The goal of the meeting was to get an overview of the resistance problem and to develop recommendations to the European Commission. The Danish organizers wanted to have a solution-oriented discussion of antibiotics usage instead of a debate about

\textsuperscript{15}It is used in the US as AGP.
\textsuperscript{16}It is used in the US as AGP.
\textsuperscript{17}It is used in the US as AGP.
\textsuperscript{18}It is not used in the US.
\textsuperscript{19}The lessons we can learn from the ECJ case is how the precautionary principle is interpreted regarding antimicrobial use and how is the risk assessment approach understood in the EU. (See T-13/99 from 135. to 170.)
\textsuperscript{20}The National Board of Health is the supreme national healthcare authority in Denmark.
whether antibiotics resistance is a problem, therefore, they decided not to invite the industry. Instead they ensured that both veterinary and human medicine science were represented at the meeting.

The purpose of the conference was accomplished—the so called Copenhagen Recommendations were developed. According to the summary report of the conference, the meeting was successful, because the Danish organizers set a tight agenda, which was in line with the concerns of the researchers and authorities. This was the first time that the industry was exposed to collective criticism from European veterinary and human medicine researchers. They had a strong body of evidence based on replica studies from different EU countries with the same results as the Danish and German studies.

In response to the exclusion and to indicate their concern, the pharmaceutical industry decided to organize a ‘shadow conference’ at the same time and place as the official conference. The Copenhagen conference was not concerned about cross resistance between animals and humans, which was proven to be the weak point of the meeting. The pharmaceutical industry picked up on this and raised doubts about the human health risk associated with antibiotics resistance, its impact and sources. However, the pharmaceutical industry’s attempt to influence the political agenda in Europe did not succeed. This was partly due to the fact that scientific evidence about antibiotics resistance was gathered and analyzed since the mid 1990s and together with the data from DANMAP they created a strong body of evidence.

The Danish meat industry, the other important stakeholder of the Danish antibiotics policy, was willing to accept the findings of the researchers. Their ‘there might be something to it’ attitude together with the economic calculations, political and media pressure made them voluntarily stop the use of avoparcin and virginiamycin. Moreover, the Danish swine industry decided to stop all use of antimicrobial growth promoters in finishing pigs by April 1998 and in all swine by January 2000. The Danish poultry producers voluntarily discontinued all use of antimicrobial growth promoters in broiler chicken in 1998.

Danish researchers held a conference in 2002, where an independent expert panel based on systematically gathered data concluded that the complete Danish ban against antimicrobial growth promoters resulted in lower level of resistance in food animals. Before the ban there were already a low number of clinical cases in which patients could not be treated due to antimicrobial resistance. The resistance level in the Danish population remained low which researchers attribute to the ban.

What were the Reasons of Success (analytical perspective)?

The Danish efforts to stop antimicrobial growth promoters can be summarized in a static model describing the actors, processes and special characteristics.

a) The Danish method. The Danish actions were based on strong scientific data and a clear paradigm: collecting and monitoring data from each level of the supply chain, i.e. from both animals and humans (the ‘from farm to fork’ concept). The scientific basis of the method was challenged and tested by both industrial interests and formally by the EU.

b) Researcher elite. The researcher community working on the problem of antibiotics resistance is the leader of its field; internationally recognized, respected and often quoted.

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22 This chapter is based on the internal report of the Technical University of Denmark and on telephone conversations with Jørgen Schlundt.

23 This model was developed by researchers at the Technical University of Denmark.
c) **Specialized institutions.** As a central unit, DANMAP monitors the resistance level in humans and animals in Denmark. DANMAP is at the same time the embodiment of the ‘from farm to fork’ concept, a monitoring system and a communication strategy.

d) **Conflict culture.** Among the various stakeholders, the concern around antibiotics is characterized by different interests and different perceptions of the problem. There are many stakeholders with business interests oppositional to the position of independent researchers and authorities. The conflict around antibiotics created the necessity in Denmark for a regulation that prevents a potential resistance problem.

e) **Political changes.** Political-administrative changes took place in Denmark in the mid 1990s; matters relating to food and nutrition legislation were transferred from the Ministry of Health to the Ministry of Agriculture and Fisheries, which after 1996 was called the Ministry of Food, Agriculture and Fisheries. The new Minister for Food, Agriculture and Fisheries was granted far greater power to act than the Minister for Agriculture and Fisheries have had before. The close cooperation between researchers and the political level had tremendous importance for Danish developments in antibiotics legislation.

f) **Changes in the farmers associations.** The Danish farmer associations in the mid-1990s was characterized by their new openness and pragmatism, which – even though they were skeptical about cross resistance between animals and human – helped them to engage in several voluntary agreements in this area.

g) **Global business interests.** Pharmaceutical companies had a vital economic interest because antimicrobial growth promoters continued to be legal food additives to animal feed. They were also interested in the debate on cross resistance between animals and humans. The pressure from the industry actually strengthened the Danish efforts in many ways; the Danish scientific monitoring model is now recognized and legitimized by the EU.

f) **Risk agenda.** Uncertainty and fear were crucial elements in the 1990s food safety debate, which was beneficial for the researchers’ arguments.

g) **Media coverage.** The resistance debate received a lot of media attention because the public was very perceptive of the risk associated with foodborne diseases. Antibiotics resistance especially got public attention, because it is not just a disease but a chronic condition one can die of. The media coverage of the resistance problem created urgency and a fearful atmosphere, which politicians, authorities, researchers and even the meat industry could relate to.

Additional information from Jørgen Schlundt regarding the Danish example:

- The meat industry was opposed to the ban to begin with, but after seeing the alliance between scientists and politicians, they realized the ban would happen anyway, and therefore, it was easier to work with the scientists than against them.

- The new food safety approach to salmonella – which was also based on the ‘from farm to fork’ principle – helped the case by giving evidence against the ‘higher prices’ argument. After the new food safety regime was implemented there was only a 1-2% price increase, which was hardly noticeable by consumers.

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24 He is the Deputy Director of the National Food Institute
Danish scientists were focusing on conducting conclusive studies and publishing it in international journals and on engaging the political level. After this it was not difficult to get the media’s attention.

The political level in Denmark traditionally pays attention to science and works together with scientists on important issues.

4. What are the effects of the Ban?

Aarestrup and his colleagues analyzed the changes in antimicrobial consumption and productivity by Danish swine farms between 1992 and 2008. They concluded that long-term swine productivity was not affected negatively by the Danish ban on AGPs. Actually the production of weaning pigs increased 47% from 1992 to 2008 and the mean number of pigs per sow, per year increased from 21 in 1992 to 25 in 2007. The average daily gain for weaning and finishing pigs was higher in 2008 than in 1992, but mortality rates were similar in those years (Aarestrup, F. et al., 2009. pp. 728-729.)

Antimicrobial consumption was 100 mg/kg of swine produced in 1992, this decreased to 31 mg/kg in 1999, however, it rose up to 49 mg/kg in 2008 (see figure 2). According to the latest data from DANMAP 2009 antimicrobial consumption increased further to 54.6 mg/kg of pork (DANMAP 2009 p. 27.)

The steps of the Danish antibiotics policy can be observed by looking at the changes of antimicrobial consumption by Danish swine farms. After the veterinarians were deprived of making profits on resale of antibiotics, there was a reduction in consumption of antimicrobials. The ban on avoparcin (1995) and on virginiamycin (1998) had only a marginal effect on both therapeutic and overall antimicrobial consumption. Stopping the use of all AGPs in finishing pigs (1998) did not result in higher antimicrobial consumption for therapeutic indications. However, following the removal of AGP use in all pigs (2000), there was increase in therapeutic drug consumption. Since 2002 the consumption of antimicrobials for therapeutic indications has continued to increase, mainly the use of tetracycline and macrolide antimicrobials (Aarestrup, F. et al., 2009. pp. 729-730). It is important to highlight that macrolides and tetracyclines are not as important drugs in human medicine as third-generation cephalosporins and fluoroquinolones consumption of which has actually decreased after the ban (Aarestrup, F. et al., 2009. p. 731).

Before the ban certain antimicrobials, like tylosin, were used in the Danish herd both for growth promotion and for therapeutic indications. For example, in the case of macrolides the total consumption (both as

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25 Cephalosporins were only 0.13% of total antimicrobial consumption for swine in 2008.
26 The registered fluoroquinolone use in Denmark was only 5 g in total.

We can conclude that the Danish pork industry not only survived without AGP but actually expanded during the past two decades (from 18.4 million hogs annually in 1992 to 28 million in 2010).

5. US Industry Response to the Danish Example

The US meat industry, pharmaceutical industry, and the American Veterinary Medical Association (AVMA) generally argue that the Danish example should not be followed. According to these stakeholders a ban on AGPs would hurt animal health and result in an increase in the use of therapeutic antibiotics. They also claim that there is little indication that the ban actually helped to reduce the number of antibiotic resistant infections (Downing, J. 2011). Moreover, they reason that it would make production more costly which would increase the price of meat.

6. Counterclaim to the US Industry Arguments

Danish researchers offer several explanations for the increase in use of therapeutic antibiotics. It may have been caused by outbreaks of known and new diseases. The porcine multisystemic wasting syndrome (PMWS) is a new disease among swine, which was first diagnosed in Danish herds in 2001. This theory is supported by the fact that the geographic distribution of PMWS mirrors the regional differences in antimicrobial consumption in Denmark. Another explanation is that there was a 50% reduction in the purchase price of commonly used antimicrobials, which could have been an economic incentive to use antibiotics over other disease control measures (Aarestrup et al, 2009. p. 731). There were other changes that have directly or indirectly influenced antimicrobial consumption for therapeutic indications: recommendations for the inclusion of protein in the feed have changed over time, as have the production systems, trade between farmers and price on antimicrobials and feed (Aarestrup, F. et al, 2009. p. 732).

There is data available from other European countries regarding the correlation between the ban on AGP use and antimicrobial consumption—in Switzerland the ban had no effect on the use of therapeutic drugs. In Finland the antimicrobial treatment of diarrhea in swine herd did not increase significantly after the ban. In Norway actually a significant reduction in the consumption of therapeutic drugs can be observed after the AGP ban. However, in Sweden, after the ban, the consumption of antimicrobials for therapeutic indications started to increase up to the point that after 10 years, the actual antimicrobial consumption is back to the prior ban level (Aarestrup, F. et al, 2009. p. 732)\(^27\). These findings suggest that one cannot jump to the conclusion that a ban on AGP use automatically increases the antimicrobial consumption for therapeutic indications, there are many factors that contribute to the changes in therapeutic drug use.

The US industry’s claim that a ban on AGPs hurt animal health has not been proven true, because data shows that mortality rate of Danish swine was not negatively affected by the ban (Aarestrup, F. et al, 2009. p. 731). Neither did the ban increase the cost of meat for consumers (Rogers, L. 2009). Furthermore, average daily gain (key indicator for productivity) actually increased after the ban (Aarestrup, F. et al, 2009. p. 731).

The level of antibiotics resistance in the Danish population remained low after the ban, while among the US population it is a growing problem. Nevertheless, the US industry is right in one thing: infections by resistant pathogens cannot be attributed only to antimicrobial use in livestock. It is a complex issue; the

\(^{27}\) It is interesting to compare the amount of antibiotics used in Danish pork to the amount of antibiotics used in hogs produced for instance by Smithfield in the US. In Denmark the antimicrobial consumption was 54.6 mg/kg of pork in 2009. According to Smithfield’s 2010 CSR report the antimicrobial consumption at Murphy-Brown (a company owned farm) was 0.097 lbs/100 lbs of pork sold in 2009, this equals 970 mg/kg of pork (Smithfield, 2011 p.54).
presence of antibiotic resistant pathogens depends on the use of antimicrobial agents in humans, the level of resistance in domestic food, level of resistance in imported food and influence of travel abroad (Hammerum et al., 2007 pp. 1637-1638). However, the antibiotics usage in food animals is a key variable in this equation and in the US 80%\textsuperscript{28} of antimicrobials are consumed by animals (Downing, 2011), therefore, it is the main contributor to antibiotics resistance in the country.

Alternative methods were implemented by the Danish farmers to compensate for the removal of AGPs and to combat new diseases, like PMWS. Farrowing houses and nursery environments were improved. The weaning age was increased from 21 days to 28 or 35 days. There were dietary changes implemented: inclusion of fiber, restricted feeding in the first two weeks in nursery, and usage of probiotics, diet acidification and zinc supplementation. Good sanitation was also a key to success (Steinhart & McMullen, 2005). These alternative methods that keep the herd healthy without AGPs should be considered by the US meat industry.

As a response to the higher therapeutic drug consumption, the Danish Ministry of Food, Agriculture and Fisheries implemented a so called ‘Yellow-card-system’ in 2010. Those farmers and veterinarians who administer the highest antimicrobial consumption receive a ‘yellow card’. The card means that the farmer together with the veterinarian has to work on a solution to decrease the consumption of antimicrobials (Møller & Jensen, 2010).

7. Conclusion: Lessons for the US

The Danish way of dealing with the problem of antimicrobial use in food animals is a very enlightening example, with some useful conclusions for the US. However, we have to keep in mind that there are certain differences between the two settings.

Included here is a comparison of key stakeholders of the Danish antibiotics debate to the key stakeholders of the issue in the US. Some stakeholder strategies are identified that could move the US towards restricting AGPs:

a) Meat industry. The meat industry in the US operates differently than in Denmark. It is vertically integrated, but instead of the cooperative model, privately owned/shareholder companies process and pack the meat while contracting out the actual framing to Concentrated Animal Feeding Operations (CAFOs). The drawback of the CAFO model is that processor companies contend they have no responsibility for restriction of AGP as a result of the separate ownership and that CAFOs are responsible for any change in AGP use.

In the cooperative model there is no market competition between the farmers, which helps them work together on improving animal health and productivity. However, in the resistance debate this was the reason why researchers could not use the ‘market advantage argument’ and instead they had to reason with the ‘export interest argument’. In the US both arguments can be used with the ‘export argument’ being even more convincing now than in the Danish example, because important US trading partners and competitors (EU, New Zealand and South Korea) have implemented restrictions and prohibitions on the use of certain antimicrobials in food animals. There is a Congress Research Service Report\textsuperscript{29} available about how US export interests might be hurt because of the tightened regulation of its key export markets.

\textsuperscript{28} According to federal figures from 2009. The Union of Concerned Scientists estimates it to be 70%.

It was relatively easy to move the Danish meat industry towards support, because they were open to discuss the problem and listen to the researchers. Economic reasoning, political and media pressure was used to change their opposition status to support. Currently, the US meat industry is not supportive of restrictions on antibiotics usage; however, the industry may alter its response if the food service sector changed its purchasing policies to antibiotic free meat. This market pressure together with economic reasoning (including referring to the data on Danish productivity) may help to change industry practices.

b) Veterinarians. The veterinarians in Denmark realized the magnitude of the health risk associated with non-judicious use of antimicrobials; therefore, in exchange for economic compensation they supported the changes in public policy. In contrast, according to the official opinion of AVMA the human health risk associated with antibiotics usage in livestock is small. However, it seems that this group of stakeholders is divided, because some members of the AVMA Task Force on Antibiotic Use actually agreed that the risk is serious enough to justify some restriction regarding antibiotics usage (Downing, 2011).

c) Pharmaceutical industry. Regarding the pharmaceutical industry the same level of interest and opposition can be expected in the US. However, it seems that the industry realized their strong opposition leads to their exclusion from the discussion, therefore, they took a different approach and they try to get into meaningful dialogues with other stakeholders.

d) Scientists. The key to the Danish success was the alliance between scientists and politicians. Their strong cooperation moved the different stakeholders towards support. A similar cooperation in the US would lead to changes in the industry.

The scientists in the US are divided into two groups: independent scientists and industry related scientists. Independent scientists have a strong body of evidence proving the link between antimicrobial use and antibiotic resistance in humans. However, industry related scientists work on questioning these studies and providing proof that without AGPs more pathogens would enter the meat processing system which would consequently result in a higher human health risk (Downing, 2011). This industry strategy of funding counter-studies and questioning independent scientists was also used in Denmark. However, because of the strong coalition of leading European scientists and their alliances with the political level, the industry’s strategy was proven to be ineffective. In the US, independent scientists try to engage politicians, but apart from some dedicated politicians the political level as whole does not seem to be ready for this alliance.

e) Political level. Antibiotics resistance is on the political agenda in the US. The Preservation of Antibiotics for Medical Treatment Act (PAMTA) was introduced to the Congress by Representative Louise Slaughter in 2009. Committee hearings were held, but the bill did not make it to the vote. In 2011 the bill was reintroduced to the Senate by Senator Diane Feinstein and to the House of Representatives by Slaughter. This shows that there are dedicated politicians in both chambers who are listening to scientists and want to stop the non-judicious use of antimicrobials on US farms. However, the meat and the pharmaceutical industry lobby against these legislative efforts.

When we are talking about the Danish example we also need to keep in mind the differences between the political system in Denmark and in the US. Denmark has a unitary government which is typically associated with more rapid policy change and less need to compromise compared to the federal system. In the ‘antibiotics battle’ this form of governance luckily met with high level of authority of the new Ministry of Agriculture, Food and Fisheries and a political will to

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30 In the unitary system there is a clear chain of command linking the different levels of government so that lower levels are strictly subordinate to higher levels (Buse & Walt, 2005. p. 82.).
initiate change. However, due to Denmark’s EU membership, Danish politicians had to get an approval for their policy from the EU Commission. This sub-national level was where the battle really took place among different stakeholders bearing similarities to the policy making process in federal systems.

Moreover, the Danes have a parliamentary system, which in the field of policy making means that the power is centralized in the executive which allows more rapid and decisive action to be taken by the government. Meanwhile policy development process in the presidential system is more open with more possibilities for interest group to exert influence which inevitably slows down the process and in certain cases hinders policy change. Therefore, we cannot really foresee if and when the antibiotics use in the US meat production will be regulated.

f) Civil society. NGOs, public health associations, and consumer organizations in the US actively engage in the discussion of antibiotic use, their interest in the topic attracts media and political attention. They build alliances (see legal case against FDA), which makes them stronger and more visible.

g) Media. The media coverage is important in the antibiotic debate; however, it seems from the Danish example that if the resistance problem is already on the political agenda, it is easy to get the media’s attention.

Stakeholder strategies can be categorized based on what variable of the political feasibility of policy change one is trying to influence. The following stakeholder strategy analysis is based on the categories discussed by Buse & Walt (Buse, & Walt, 2005 pp. 182-184) with examples from the Danish case:

Perception strategies: changing how stakeholders understand the issue

a) Creation of an easily understandable linguistic concept. In Denmark the ‘from farm to fork’ concept was used both in the fight against salmonella and in the fight against antibiotics resistance. Through this concept both food safety problems and their solution and the complicated science behind them were easily understood by the politicians, the media and the public.

b) Obtain systematic data about antimicrobial consumption both in humans and in animals (currently there are only estimates available). The National Antimicrobial Resistance Monitoring System (NARMS) only monitors resistance, but does not collect data on consumption. In order to see the whole picture and to have stakeholders understand the volume of the problem and accept the arguments of the scientists, the information on antimicrobial consumption is crucial.

c) Support the risk approach towards the resistance problem (instead of epidemiology).

d) Change how antibiotics use is perceived by the meat industry: Antibiotics use is considered to be mainly an animal health/welfare issue by the meat industry31; they see it as a necessity to keep animals healthy. However, researchers agree that it is indeed a food safety issue, which poses a threat to human health. Shifting the meat industry’s perception of the problem from animal health to food safety is important because it would help to engage them in a meaningful dialogue about antibiotics use. Also the arguments about better and safer products (market advantage) would have more weight in the discussion.

31 It is discussed under the animal welfare/health chapter of CSR reports of all ICCR meat companies (Tyson, Hormel and Smithfield).
e) Creation of alliances (politicians, media and researchers). Negotiations and collaboration between stakeholders in general provide a unique legitimacy of decisions and problem solving as well as a significant communication and marketing advantage.


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http://www.foedevarestyrelsen.dk/Dyr/Dyresundhed Og Dyresygdomme/Sundhedsraadgivning/Obligatorisk_sundhedsraadgivning_Og_egenkontrol_med_dyrevelfaerd/Sider/Forside.aspx


ECJ cases: [http://curia.europa.eu](http://curia.europa.eu)
T-13/99 Pfizer; T-70/99 Alpharma