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Pork production has risen steadily in Denmark, despite a voluntary halt to using antibiotics to boost growth.

Get pigs off antibiotics

Frank Aarestrup explains how he helped Denmark to cut the use of antibiotics in its livestock by 60%, and calls on the rest of the world to follow suit.

The amount of antibiotics consumed by livestock worldwide is almost double that used by humans, according to some estimates^{1,2}. In the United States, for instance, about 300 milligrams of antibiotics are used to produce every kilogram of meat and eggs^{3,4}. These drugs are administered not just to treat or to prevent infections. In many countries, they are used to help the animals to grow faster. This is an unsustainable situation. Since many farmers began giving antibiotics to livestock in the late 1940s, people have been infected with strains of bacteria that are resistant to those antibiotics^{1,2,5}.

To try to combat this dangerous trend, the European Union banned the use of antibiotics for growth in livestock in 2006. The practice continues unabated in the United States, despite a statement from the Food and Drug Administration in April suggesting that farmers should stop voluntarily⁶.

Some argue that, without antibiotics, the agricultural industry will collapse. My experience in Denmark proves otherwise. The country is the world's largest exporter of pork, exporting 90% of all it produces, and it did much more than ban the use of antibiotics for growth. It reduced their usage overall and built a comprehensive surveillance system to track and target overuse. It also prohibited veterinarians from profiting from the sale of

drugs to farmers — a practice that continues in the United States and in much of Europe.

Since the mid-1990s in Denmark, the use of antimicrobial agents per kilogram of livestock produced has dropped by 60%. And pork production has actually increased by 50% since 1994, before any interventions began.

Any country trying to limit the use of antibiotics in livestock can learn from what my colleagues and I did in Denmark, adjusting what worked there to local needs. Given how difficult it is to control how resistant bacteria behave and spread worldwide, reducing antibiotic use is something we must do for the future health of all — animals and people.

A GROWING PROBLEM

I got involved in helping Denmark to reduce its overuse of antibiotics almost by accident. In September 1994, I was a recently graduated vet, doing my PhD in bovine mastitis and one of its main causes, the bacterium *Staphylococcus aureus*, when I saw some data that worried me. At the annual meeting of the Danish Veterinary Association in Askov, researchers showed an increase in prescriptions for and usage of cheap

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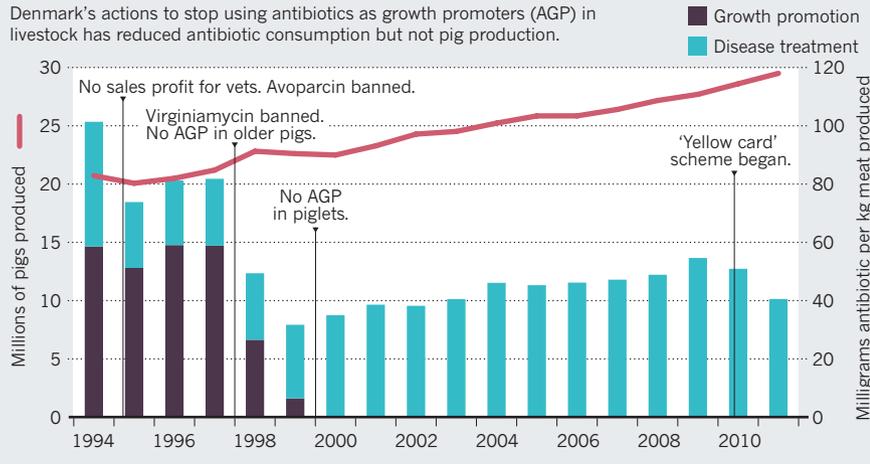
tetracycline in animals — and a concurrent rise in resistance to the antibiotic among bacteria cultured from animals. These data prompted a heated debate and revealed that many vets were making a huge profit from selling antibiotics to farmers.

At that point, scientists were already concerned about the overuse of antibiotics in livestock. Farmers have been using antibiotics to boost growth since just after the Second World War, when there was a lack of good-quality feed. Experiments at the time showed that animals grew faster when fed low levels of the drugs — although researchers have never fully explained why¹. The practice spread quickly. As early as the 1960s, scientists began to see the same resistant bacteria in food animals and humans^{1,7}. This was no surprise. Bacteria linger in skin and faeces and can easily make their way into meat and onto the hands and kitchen counters of people preparing it. So, starting in the 1970s, countries in Europe¹ began banning the use of antibiotics for growth, particularly those drugs that were being used therapeutically in humans⁷.

After some prompting from my collaborator, the German microbiologist Wolfgang Witte, I decided to investigate whether farmers in Denmark prescribed antibiotics to animals purely for growth. I found, to my surprise, that this was common practice. In

BACON BOOST

Denmark's actions to stop using antibiotics as growth promoters (AGP) in livestock has reduced antibiotic consumption but not pig production.



pig production, two-thirds of all antibiotics given were for growth; in poultry, it was around 90% (ref. 1).

Curious, my colleagues and I began to screen faecal samples from healthy chickens and pigs. On 25 January 1995, we isolated for the first time a bacterium that was resistant to one of the growth-promoting antibiotics⁸. Subsequent studies showed a clear relationship between the use of a growth promoter called avoparcin and the widespread occurrence of resistant bacteria¹. This prompted the Danish government to ban the use of avoparcin to promote growth in livestock. Soon after, in 1997, the EU banned all use of avoparcin.

This became a major story in Denmark, and I began travelling to meetings and taking phone calls from the media and government agencies, all while trying to finish my PhD. Eventually, the director of the institute I was working at, the National Veterinary Laboratory in Copenhagen, asked me to focus on antibiotic resistance full time, including monitoring the ban on avoparcin. This became the foundation of the first comprehensive surveillance system to monitor the use and health effects of antibiotics in livestock.

In 1995, we established DANMAP, the Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (www.danmap.org). This collaboration between vets and human-disease epidemiologists monitors antimicrobial usage and resistance in animals, food products and humans in Denmark. It collects and analyses samples from slaughterhouses, vets and hospitals to track the effects of policy intervention on antibiotic usage and to detect new problems. The United States, Canada, Japan and several countries in Europe now have surveillance programmes that are modelled on DANMAP.

Meanwhile, as scientists found more instances of antibiotic resistance, the Danish government banned another growth promoter, virginiamycin, in 1998. That year, following much media interest and political

pressure, and out of concerns for human health, the Danish poultry industry voluntarily stopped all use of antibiotics for growth. The country's pig industry followed in 2000.

Farmers were able to continue to use antibiotics to prevent and treat infections, which provided a back-door route for some of them to obtain inappropriate prescriptions⁹. In 2010, the Danish agriculture ministry began issuing warning letters — dubbed yellow cards — to the pig farmers who had the highest consumption of antibiotics per pig produced. This has led to a reduction in antibiotic use for therapy of almost 25% during the past two years.

Even before Danish farmers cut back on antibiotics, many predicted that the cessation would have a disastrous effect on productivity and the economy. However, in poultry production, it had no negative effects on either the total kilograms of chickens produced per square metre, or the amount of feed used¹⁰. In pigs, reducing antibiotics had no negative effects on productivity, number of pigs produced per sow, average daily weight gain or the amount of feed needed to produce a kilogram of meat⁹. In fact, pork production has increased steadily in Denmark as farmers have continued to modernize (see 'Bacon boost').

WHAT WORKED

There were three secrets to our success in Denmark. We had data showing that antibiotics were becoming a problem; there was political will to enforce regulations; and there was cross-sector collaboration between farmers, researchers and authorities.

One of the most important steps was the ban. But legal action means nothing without a way to monitor compliance. For example, Danish authorities use DANMAP to target the farms that are using the most antibiotics, or the most dangerous classes of drugs. Some countries' surveillance systems are not comprehensive enough. Data are not available

from all animal species, and the systems do not integrate data from humans and animals sufficiently. Some do record antibiotic resistance, but not all of them track usage.

Denmark took another key step that most countries have not yet taken. The government issued legislation in 1995 preventing vets from profiting from selling antibiotics to farmers. The conflict of interest is clear. The more antibiotics farmers use, the more money these vets make. I believe that this decision had a huge impact on the overuse of antibiotics in livestock. Vets in the United States and most of the EU continue to profit from prescribing these drugs.

In my view, it also helped that my scientific colleagues and I were very open about our findings of bacterial resistance. We communicated results in our annual meeting and through regular DANMAP reports, among other methods, even to people who we knew would take issue with what we had to say.

Reducing Denmark's reliance on antibiotics was far from easy. My lab was visited by pharmaceutical executives who did not like what we were finding, and I would be cornered at meetings by people who disagreed with our conclusions. I have even been publicly accused of being paid to produce biased results. Despite such challenges, it has been satisfying to see that Danish farmers and their livestock can thrive without the heavy use of antibiotics. With a little effort, I believe that other countries can and must help their farmers to do the same. ■

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