WORLD ANIMAL PROTECTION

Is factory farming killing us?

An economic and health assessment of the human burden of antibiotic resistance related to the use of antibiotics in UK farms

Foreward

We are all part of one interconnected system. From the food we eat, to how we treat animals and planet we live on, it all impacts our own health. So, it should come as no surprise when I say that our global food system is broken.

We, at World Animal Protection UK, have released a series of investigative reports into the UK food system in the past year. Each one charting how factory farming – and by this I mean intensive livestock farming where animals are kept in too closer quarter than is natural or healthy for them, with limited access to daylight or fresh air – is impacting on our health. From the rise of superbugs in our rivers and in the meat products in our supermarkets to this report, which demonstrates the impact and cost on our NHS and human health, as a result of the overuse of antibiotics within our food chain. Everyday millions of farmed animals are slaughtered around the world. They live short lives, of incredible stress and cruelty, pushed to their mental and physical limits. Factory farming has successfully produced ever higher quantities of cheap meat and animal products, but at the cost of treating each animal like a mere cog in a machine.

In the UK, where we pride ourselves on high standards and on being a 'nation of animal lovers', however an estimated 80% of our farmed animals are produced in factory farms. Animals in such farms, like humans experiencing such levels of fear and frustrations, find their immune systems compromised. The answer so far has been to give antibiotics to prevent illness amongst factory farmed animals. This has a consequence that we are now seeing in both animals and humans; the increasing rise of cases of anti-microbial resistance (AMR). This means human illnesses are starting to be untreatable by antibiotics. We are on the edge, of yet, another global health crisis.

We need to imbed a 'One Health' approach, where we recognise that the way we treat animals impacts humans directly. AMR not only causes suffering, illness and death for humans, but has economic and emotional impacts for our society. This report highlights the risks of irresponsible antibiotic use on UK factory farms. It is estimated that NHS has had to deal with almost 2,000 deaths last year due to resistant bacterial infections associated with antibiotic use on farms. By 2050, an estimated 10 million deaths per year globally will be attributable to antimicrobial resistance.

Many of these are predicted to be caused by common bacteria such as salmonella and e. coli. Standard infections that we take for granted like food poisoning or UTIs will prove increasingly untreatable through antibiotics. 2,000 deaths are shocking loss of life, but this is predicted to rise even further if we don't act now. This report highlights, that due to increasing numbers of livestock, even with the current trend of reductions in antibiotic use, we will still see an increase in the number of deaths associated with antibiotic use on farms by 2050. Add to this, the current overuse is impacting our economy by over £1.3 billion a year already.

The UK has an opportunity to lead the way on this, to improve our animal and human health by moving the UK to a humane and sustainable farming system. Put simply there is no future for factory farming.

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By 2050, an estimated 10 million deaths per year globally will be caused by superbugs (bacteria that are resistant to the antibiotics normally used to treat infections), with an overall economic cost of US$100 trillion. The overuse of antimicrobials in animal farming contributes to the spread of superbugs and reduces the effectiveness of antibiotics for treating the infections these superbugs cause in both humans and animals.

Superbugs are already a deadly threat to people, killing an estimated 1.27 million people a year worldwide, but how does overuse of antibiotics on factory farms impact the health of humans in the UK? This study calculates the human health and economic burden of the use of antibiotics on farms.

What are superbugs?

Antibiotics are medicines used to treat infections caused by bacteria. When they work, they kill or prevent the growth of the bacteria.

Achievements in modern medicine, such as major surgery, organ transplantation, treatment of preterm babies, and cancer chemotherapy, which we today take for granted, would not be possible without access to effective treatment for bacterial infections. But some bacteria can develop resistance to antibiotics, making the drugs ineffective. The growth of antibiotic resistance is accelerated by the overuse of antibiotics in human medicine and farming and threatens to undermine much of modern medicine(1).

Resistant bacteria generally have one or more antibiotic-resistance genes (ARGs), which enable them to resist the antibiotics. Copies of ARGs can pass between bacteria, through a process called "horizontal gene transfer", and the bacteria receiving the genes then become resistant. The presence of ARGs in some bacteria therefore increases the chance that others will become resistant, particularly when antibiotics are overused.

Overuse of antibiotics in farming

Factory farms squash billions of genetically uniform animals into stressful, barren environments, with no access to outdoor space or natural light.

Animals may have little or no room to turn around or lie down with their limbs, head or wings fully extended. This highly stressful and often barren environment can lead to illness and severe behavioural issues. These can include aggression or repetitive behaviour like tail biting in pigs, cage biting or chewing continuously on nothing until frothing at the mouth, feather pecking or even sometimes cannibalism. Stress depresses the immune system and makes animals more prone to infections.

Very densely packed sheds also provide good conditions for disease to spread from animal to animal. Poor hygiene and air quality are also a cause of disease. Antibiotics are used across groups to prevent stressed animals getting sick; they prop up a system of suffering for food production.

Worldwide approximately 65% of antibiotic consumption occurs in animal farming(2), the figure is lower in the UK at 30%(3). Despite intensive farming remaining widespread in the UK, the British livestock industry has achieved a welcome 55% reduction in antibiotic use since 2014(4). Use in the pig industry has been reduced by about 60%, but despite this, the pig industry is still the largest farm user of medically important antibiotics in the UK. This is because pigs are one of the most intensively farmed species on the planet. Up to 90% of all antibiotics they receive are administered in the first 10 weeks of pigs' lives. They are used to avoid infection after routine painful mutilations (tail docking and teeth clipping), and due to stress from early separation from mothers, barren and overcrowded environments and related gut and respiratory infections(5).

Early weaning is a particularly important cause of antibiotic use in the pig industry, and delaying weaning is one of the most important husbandry improvements which can reduce the need for excessive use(6)(7).

Chicken farms have seen the biggest reduction in antibiotic use overall in the UK. Use per bird fell by 80% between 2014 and 2017, but subsequently increased again by 63%, so that in 2020 use was only down by 67% compared with 2014(8). In 2016, the British Poultry Council committed to no longer using antibiotics preventatively, which has contributed to the reductions, as has improved antibiotic-use data collection. However, the highly intensive production methods used in chicken farming means that bird health is often badly impacted. In intensive production systems, chickens are genetically selected for fast growth in order to achieve the target live

Overuse of antibiotics in farming

weight of 2-2.5 kg in 35 to 40 days. Whereas in free-range production, birds live at least 56 days and in organic production they usually live 70–81 days(9)(10). The very rapid growth rate has large impacts on bird health and welfare, and consequently on antibiotic use. Data collected from every chicken farm in the Netherlands show that fast-growing breeds use on average of 6 times more antibiotics per bird than slower-growing breeds(11). Intensively farmed birds are also kept in cramped conditions in very large numbers in small spaces: industry Red Tractor standards allow for a "stocking density" (number of animals per area) of up to 38kg of bird per square meter, which means that each bird has a space allowance of less than an A4 sheet of paper. Excessively high stocking densities badly impact chicken health and welfare(10) and have been associated with higher antibiotic use(12).

Intensive dairy production, where animals may be kept in overcrowded conditions and are bred for maximum production, can compromise animals' immune responses, and enable disease to develop and spread.

The main health problems requiring antibiotic treatment are mastitis (inflammation of the mammary gland and udder tissue, usually due to bacterial infection), foot problems and uterine problems. According to a European Food Safety Authority (EFSA) review, these health problems are greater in "zero-grazing" dairy systems where the cows are kept indoors all year round(13).

In the UK, most dairy cows have access to pasture during the summer months, but increasingly cows are being kept indoors and large, zero-grazing herds are becoming more common in the UK and worldwide.

What does this mean for humans?

The use of antibiotics on farms leads to losses in productivity because of illnesses, disability or early deaths caused by antibiotic resistance.

In 2023 nearly 2,000 deaths in the UK are predicted to occur due to infection with resistant E. coli and Salmonella associated with antibiotic use in factory farms, bacteria commonly found in farmed animals and animal products we consume. The economic losses in the UK due to this will amount to over £1.3 billion in 2023, and that amount is set to rise if we continue to use the current level of antibiotics on farms.

We calculated two different scenarios, the first where antibiotic use continued to reduce in line with recent trends. The second scenario calculated based on antibiotic use per kilogram of live animal stays at current levels. Due to livestock numbers continuing to increase in the UK we see the health and economic burden increase year on year.

Even if we continue to reduce antibiotic use on farms, public health impacts and economic losses will continue to increase. This is because due to predicted increases in the production and consumption of animal products, livestock numbers will also increase. This will still result in an increase in the total amount of antibiotics used by 2050. To reduce the burden on human health and our economy we need to reduce livestock numbers, which means reducing consumption of animal products.

Year	Productivity losses scenario 1 (million £)	Productivity losses scenario 2 (million £)
2023	1,323.57	1,342.30
2024	1,324.95	1,364.20
2025	1,320.39	1,381.10
2030	1,315.81	1,460.50
2035	1,326.68	1,535.30
2040	1,345.10	1,608.10
2045	1,368.55	1,680.80
2050	1,392.89	1,750.50
Accumulated losses 2023-2050	37,552.43	43,531.40

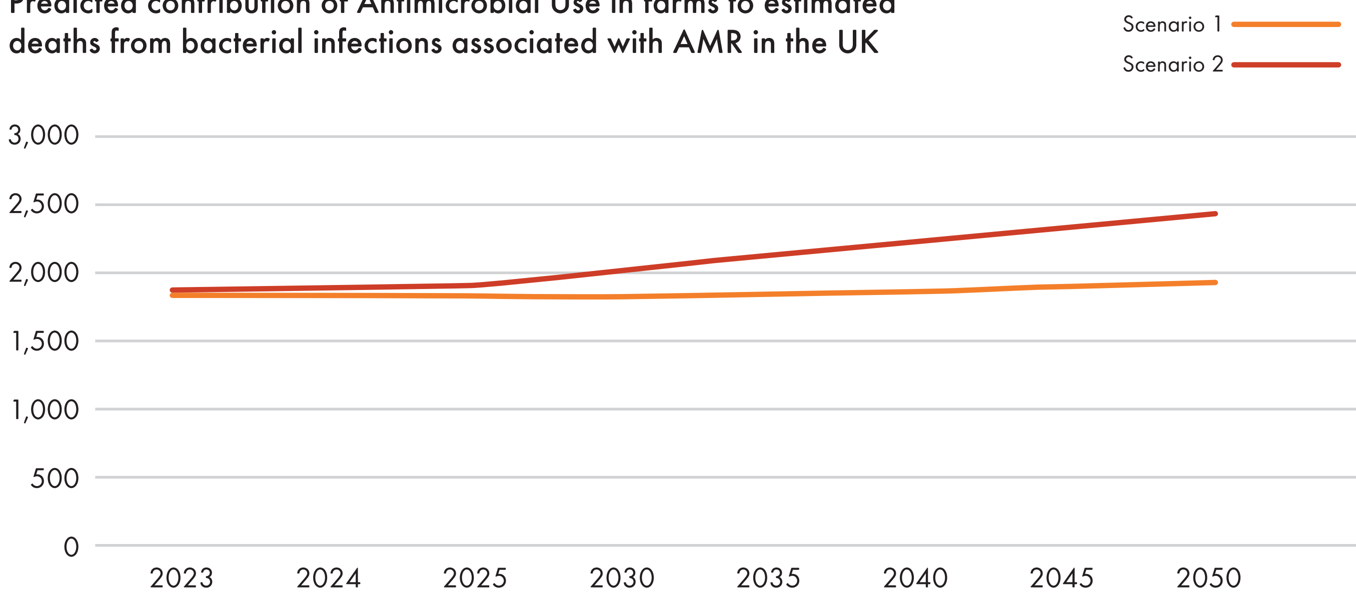
Table 1: Monetary evaluation of productivity losses resulting from bacterial infections associated with AMU in farms – 2023 to 2050

Year	Estimated number of deaths scenario 1	Estimated number of deaths scenario 2
2023	1,835	1,861
2024	1,837	1,891
2025	1,831	1,915
2030	1,824	2,025
2035	1,840	2,129
2040	1,865	2,230
2045	1,898	2,331
2050	1,931	2,427
Accumulated 2023-2050	52,069	60,359

Table 2: Predicted contribution of AMU in farms to estimated deaths from bacterial infections associated with AMR in the UK

How did we calculate these numbers?

Predicted contribution of Antimicrobial Use in farms to estimated deaths from bacterial infections associated with AMR in the UK



1. Scenario 1 – Continuing the ongoing trends in reducing AMU

2. Scenario 2 – No additional incentives for further AMU reduction

1.1 This study used published data from UK and EU government departments and health trusts on livestock numbers, antibiotic sales, antibiotic use, bacterial infections in humans and AMR in humans to model the burden on human health and the economy resulting from AMU on farms.

1.2 Research steps

1. The first step established livestock production data, including imports, exports, and veterinarian antibiotic sales and use. This was done to identify the most produced farmed animals with antibiotic data for inclusion in the study.
2. The second step estimated the standard amount of antimicrobial used per kilogram of live animal in the UK. This allowed for an estimation of the total amount of antibiotics used.
3. In the third step, zoonotic bacteria (bacteria that infect both humans and animals) of food-producing animals that were under surveillance and monitoring for antimicrobial resistance (AMR) in the UK were identified. A scientific literature search was conducted to assess the relevance of these surveyed bacteria as agents of resistant zoonoses. Additionally, available data on the human AMR burden caused by these bacteria, measured as the total time lost due to disability or premature death, were collected.
4. The fourth step estimated how much antimicrobial use on farms had contributed to the human AMR burden using a cross-sectional analysis.
5. The fifth step used estimates of the human burden of AMR in the UK for 2019, expressed as the number of healthy years lost due to illness or death caused by AMR, to calculate economic losses resulting from AMR.
6. Finally, a projection was made regarding the future impact of antimicrobial use in farming and its link with the human AMR burden in the year 2050 based on two scenarios, the first where antimicrobial use stays at current levels and the second where it continues a trend of reduction.

1.3 Cross-sectional analysis

A cross-sectional analysis was conducted to assess how antimicrobial use (AMU) in farms contributes to the human burden Escherichia coli and Non-Typhoidal Salmonella infections associated with antimicrobial resistance (AMR) in the UK. This type of analysis provides a snapshot of the population at a

How did we calculate these numbers?

specific moment, unlike longitudinal studies that track individuals over time. To do this we used data from 31 EU countries with similar farming systems and data collection methods to measure the connection between the use of ABs on farms and AMR in humans.

1.4 Economic evaluation

The economic assessment in 2019 was performed through the human capital approach (Weisbrod, 1961). This approach evaluates the economic impact of a disease by considering the value of lost productivity from people who are affected, either due to illness, disability or premature death (DALYs). This method has been discussed in previous studies (Dalal and Svanström, 2004; Jiang et al., 2022; Krol et al., 2013; WHO, 2009). The economic analysis is centred on productivity losses linked to antimicrobial-resistant infections of Escherichia coli and NT Salmonella spp. in the UK.

In this study, it has been assumed that the average cost of one year lost by one person for disability or premature death equals the average GDP per capita of the country where the person lives (Borghi and Guest, 2000; Brown et al., 1999; Dalal and Svanström, 2004; Musango et al., 2021; Nuijten, 2001; Oggioni et al., 2015). Based on this assumption we adopted the UK GDP per capita (£33,510 in 2019) as the cost of one DALY.

1.5 Projection of AMR cost in 2050

To project the future impact of AMU in farming and its relationship with the human AMR burden, meat consumption has been used, driven by population growth, as an indirect measure for antibiotic use. The population variations in the UK from 2023 to 2050 were based on projections from the UK Office for National Statistics. The changes in the consumption of animal-derived food products, particularly the type and quantity of meat consumed, was determined by considering consumption patterns and variations in meat production, imports, and exports across different farmed species over the last ten years.

Two distinct scenarios regarding farming practices related to AMU were considered, guided by AMR policies:

1. **Scenario 1 – Continuing the ongoing trends in reducing AMU**

2. **Scenario 2 – No additional incentives for further AMU reduction**

1.6 Calculation of deaths

Using the same data sources and the same cross-sectional approach already used for the assessment of the contribution of AMU in farms to the estimated DALYs from Escherichia coli and NT Salmonella infections associated with AMR, we have also developed a model to estimate the deaths from resistant infections of these two types of bacteria, which could be related to AMU in UK farms

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[1]There are two ways to measures the human health AMR burden which provide a sliding scale linking AMR to human health impact "associated" and "attributable". In the case of livestock is normally used AMR "associated" because, in factory farm system preventive measures are not easy to be implemented.

AMR Associated: Associated is most inclusive estimate of burden. Measures people with drug-resistant infection that contributed to their death or disability. The infection was implicated in their death or disability, but resistance may or may not have been a factor. For example, if someone gets sick because the antibiotics, they were prescribed don't work due to AMR, that illness is AMR-associated.

AMR Attributable: This goes a step further. It means that AMR is directly responsible for a health problem. Measures people who would not have suffered death or disability of infection if it was treatable (i.e. if there was no AMR) for whom resistance can be said to have caused their death or disability.

In a nutshell, "associated" is a link, while "attributable" means AMR is the clear cause.

What needs to be done?

The problem must be tackled at the source and farm antibiotic use must be reduced to more sustainable levels. Doing this will require a ban on all forms of routine farm antibiotic use, including preventative group treatments. It will also require major improvements to animal husbandry so that practices known to be associated with higher levels of disease and antibiotic use are phased out.

The UK agriculture industry has reduced antibiotic use per kilo of live animal by 55% since 2014 (as of October 2023) through voluntary measures focusing primarily on broiler and pig antibiotic use(14). While this has shown that voluntary measures can effectively reduce excess AB use to a point, the targets set by the industry body RUMA (Responsible Use of Medicines in Agriculture Alliance) has allowed for the continued routine and preventative use of antibiotics on farms which is still overuse. This study shows that the current targets would not reduce the impact on human health and the UK economy over the next 27 years up to 2050. One of the flaws of the industry measures to date is that a responsible level of AB use was not established as a base line to work towards. Instead targets were set by species and levels of reduction deemed achievable within the current farming systems used in the UK.

Many farming systems currently used in the UK allow for responsible AB use targeting individuals or groups with diagnosed illness needing treatment. However, many of the intensive systems, which form the majority of UK farming at present, necessitate the routine and preventative use of antibiotics to maintain animal health despite the conditions they are kept in. This means there are vast difference in AB between farms across the UK.

The UK and the EU banned the use of antibiotics for growth promotion on 1 January 2006. Antiobiotics used for growth promotion are routinely added to animal feed in order to increase the absoption and metabolism of nutrients from feed. However, ending the use of antibiotics for growth promotion did not lead to the reduction in antibiotic use that some had been hoping for since it remained legal to use antibiotics for routine disease prevention.

Because of this, on 28 January 2022, the EU introduced new laws banning all forms of routine antibiotics use in farming, and all preventative antibiotic treatments of groups of animals(15). Furthermore, under the new EU legislation, antibiotics can no longer be used to "to compensate for poor hygiene, inadequate animal husbandry or lack of care or to compensate for poor farm management." The UK was still a member of the EU when the new farm-antibiotic legislation was agreed in 2018, and the government claimed to support it, and said that it would align with the legislation and implement the new provisions subject to a public consultation(16). In particular, in 2018 the then Secretary of State for Defra said in Parliament that it would apply the restrictions on preventative antibiotic use. At present proposed regulations made by the Veterinary Medicines Directorate fall short of those introduced in the EU and have yet to implemented.

This study shows that the current industry led measures do not go far enough to mitigate the risks to human health and that strong regulations would be needed to progress reduction to levels that would not increase future deaths, DALYs and economic costs by 2050. What is clear is that if we want to reverse the trend of deaths, DALYs and economic cost we need to go further than simply reducing AB use per kilo of animal but also reduce rather than continue to increase livestock numbers.

World Animal Protection recommends

- introducing regulations that match those of the EU
- ban the building of new or expansion of existing intensive farms
- adopt the recommendations outlined in the government commissioned National Food Strategy including a reduction of meat consumption of 30% by 2032(17)
- reducing consumption of animal products

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