U.S. pork and the superbug crisis:

how higher-welfare farming is better for pigs and people

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Introduction

Antibiotic-resistant bacteria, also known as "superbugs," pose an extinction-level threat to all human life. Recently, the World Health Organization called antimicrobial resistance "an increasingly serious threat to global public health that requires action across all government sectors and society." Yet not enough is being done to address the overuse of antibiotics, which is leading to ever less-effective antibiotic medicines.

One of the biggest factors behind the growing problem of resistance is that antibiotics are vastly overused in farming. Globally, by far most of the antibiotic use is for animals. While use of the drugs as growth promoters in feed and water has been increasingly phased out in the United States, approximately 70% of all medically important antibiotics in the country are sold for use in animals.

In December 2018, World Animal Protection released a global report on the results of pork samples tested for the presence of bacteria resistant to specific antibiotics. The project was prompted by current research suggesting a link between low-welfare farming systems and overuse of antibiotics. Bacteria resistant to antibiotics considered most critically important to human health by the World Health Organization were found in samples sold by major supermarkets in Brazil, Spain and Thailand, including samples sold in Walmart stores in Brazil.

This report turns its attention to the presence of antibiotic-resistant bacteria found in pork sold in supermarkets in the United States—the country with one of the highest per capita rates of meat consumption in the world—and two well-known national retail chains.

The results of these tests have widespread implications for all retailers, as well as pig producers, governments and consumers of pork.

Above: As one of the most intensively farmed animals on the planet pigs suffer from the moment they are born. Their lives in the wild are in stark contrast to the life they face on a factory farms.

Executive summary

Testing conducted by World Animal Protection in 2019 of pork from Walmart stores found significant presence of bacteria resistant to multiple antibiotics important to human medicine. The spread of antibiotic-resistant bacteria is a global public health crisis, leading to longer durations of illness, higher hospitalization rates, and greater mortality. The United Kingdom's Review on Antimicrobial Resistance estimated that by 2050, 10 million lives each year will be "at risk due to the rise of drug-resistant infections if we do not find proactive solutions now."[i]

Eighty percent of the bacteria isolated from Walmart's pork products were resistant to at least one antibiotic, with significant resistance to classes of antibiotics considered highly important or critically important by the World Health Organization (WHO). Thirty-seven percent of the bacteria found on Walmart samples were multidrug-resistant meaning they were resistant to three or more classes of antibiotics, and nearly10% were resistant to a total of six classes of medically important antibiotics.

Further, roughly 27% of the resistant bacteria found on Walmart's pork were resistant to classes categorized as Highest Priority Critically Important Antibiotics (HPCIA). HPCIAs are antibiotics where there are few or no alternatives to treat people with serious infections. The Food and Agriculture Organization of the United Nations (FAO) recommends that these classes should never be used in animal agriculture.[ii]

World Animal Protection tested pork from a second national competitor chain for comparison. While samples from both chains had similar overall presence of bacteria detected in their batches, more than half of the antibiotic-resistant strains (60%) were from Walmart's pork samples. Further, all of the bacteria resistant to four or more classes of antibiotics and all bacteria resistant to HPCIAs were found in Walmart's samples.

Additionally, half of Walmart's sample batches had two or more resistant strains present in the same batch, with two batches containing multidrug-resistant strains of both Enterococcus and E. coli.

No batches of samples from the second retailer contained two strains of multidrug-resistant bacteria in a single batch, and none of the bacteria from that retailer's samples were resistant to antibiotics considered critically important or HPCIA. The second retailer has committed to strengthen its animal welfare policies for its pork suppliers, including working towards a commitment to complete elimination of gestation crates for breeding sows. The company has responded positively to engagement by World Animal Protection and working collaboratively as it moves forward.

Moving the world for farm animals

During 2018 we contributed to giving 3.6 billion animals better lives through our advocacy efforts and initiatives that focus on animals in farming; animals in disasters, animals in communities and animals in the wild.

Our Raise Pigs Right campaign, launched in April 2018, is moving consumers, the food industry, governments and supermarkets to help transform the lives of pigs suffering in intensive factory farms around the world.

Together we have the power to end their suffering. Getting pigs out of cages and into social groups, giving them materials like straw to manipulate, and stopping painful mutilations will give farmed pigs a better life. With better conditions pigs can be pigs–live pain-free, move around, play, forage, explore, socialize and experience natural behavior.

Antibiotics overuse in farmed animals is a leading cause of resistant bacteria

Routine and continuous use of drugs in farmed animals poses potential risks for animals, people, and the environment. Many of the bacteria commonly carried by animals can also cause disease in people. When regularly exposed to low doses of antibiotics, the bacteria that survive are better able to reproduce and spread. In September 2016, the United Nations (UN) General Assembly formally recognized the inappropriate use of antimicrobials in animals as a leading cause of rising antimicrobial resistance (AMR).

Use of important antimicrobials in livestock feed has been linked to the transference of resistant bacteria to humans since 1969,[iii] and use of drugs that are important to medicine represents a major public health concern worldwide. These include antibiotics commonly used in pig production in the United States, namely macrolides, lincosamides, tetracyclines, and aminoglycosides.[iv]

WHO has also acknowledged that the widespread use of antibiotics to promote growth and prevent disease in food-producing animals drives the emergence and spread of resistant bacteria in both animal and human populations.[v] WHO further states that this relationship is particularly associated with intensive animal production in which antibiotics are used for productivity purposes, not to treat sick animals.[vi]

Factory farms confine animals indoors with minimal or no access to outdoor space and natural light. They often further confine animals in cages, with no room to turn around or lie down with their limbs fully extended. This highly stressful environment can lead to severe behavior issues such as aggression and violence or stereotypies like cage-biting or sham chewing. These practices have become standard in the industry alongside the routine use of antibiotics given either via daily feed and water or by injection at specific life stages.

Antibiotic use and resistance in the United States

Until January 2017, antibiotics were widely used in low doses in the United States to promote rapid weight gain. Antibiotics may still be used routinely for purposes of disease prevention, essentially keeping mortality and illness rates lower in cruel, harsh conditions. Data from 2016 show that 95% of U.S. swine operations used antimicrobials in their production, and 90% of sites administered medically-important antibiotics via feed or water.[vii]

Antibiotics are commonly used in piglets that are subjected to tail docking or surgical castration. They are also often administered to piglets following early weaning from their mothers. Mother pigs (sows) are routinely given antibiotics to prevent them from succumbing to urinary, hoof, vaginal, and shoulder infections as a result of the stress and injury caused by close confinement and poor living conditions. Pigs raised for meat are often given feed-based antibiotics to deal with acute stress caused by overcrowding, barren environments and changes in group composition which may trigger existing or latent infection.

This ubiquitous use has helped drive the development and spread of AMR. Resistant bacteria that develop on farms and in farm animals can reach humans through several pathways. They can remain in animals through slaughtering and processing, and resistant bacteria have been detected on retail meat tested in the United States in several studies.[viii]

Between April and September 2015, 192 people across five western U.S. states were sickened by two species of multidrug-resistant Salmonella, an outbreak that the CDC attributed to pork products.[ix] The company, Kapowsin Meats, recalled more than 500,000 pounds of pork that may have been contaminated by the superbugs. Between November 2018 and July 2019, 45 people across 13 states were infected by a multidrug-resistant strain of Salmonella attributed to contaminated pig ear dog treats.[x] An outbreak of Listeria in the summer of 2018 that hospitalized four people, killing one, was linked to deli ham products from Johnston County Hams, Inc.[xi] Another Listeria strain hospitalized eight people in April 2019, one of whom died, was connected to similar bacteria found in samples of sliced deli meats.[xii]

Left: Pregnant pig in enriched group housing. Straw is offered on the ground as an enrichment material. Mother pigs in group housing are more motivated to explore when they have access to manipulable material like straw. This keeps them calm and minimises stress and fights.

Summary of World Animal Protection's U.S. pork testing

A total of 160 samples of pork were purchased from several stores of Walmart and a competing national retailer over a period of several days in the mid-Atlantic region of the United States. The samples, 80 from each retailer, were analyzed by researchers at Texas Tech University (TTU) in 32 batches of five samples each for the presence of bacteria that cause illness in humans: E. coli, Salmonella, Enterococcus, and Listeria. Bacteria isolated from the batches were then tested for susceptibility to antibiotics.

According to the data provided to World Animal Protection by TTU, a total of 51 bacteria were isolated from 30 batches including:

- Enterococcus in 27 batches;
- E. coli in 14 batches;
- Salmonella in six batches, and;
- Listeria in four batches.

Batches of samples from Walmart were far more likely to contain a detectable presence of two or more of the bacteria in a single batch than the other chain, and all batches that tested positive for three or more bacteria were obtained at Walmart.

Antibiotic susceptibility testing conducted by TTU revealed that 41of the 51 bacteria isolated from the pork samples were resistant to at least one class of medically important antibiotic. Twenty-one of the bacteria were multidrug-resistant, meaning they were resistant to three or more classes, with three being resistant to six classes of medically important antibiotics.

The majority of multidrug-resistant strains were isolated from Walmart sample batches, including all strains resistant to four or more drug classes. All seven strains resistant to Highest Priority Critically Important Antimicrobials (HPCIA) were in Walmart samples.

Specifically, the pork testing project revealed that:

- Bacteria present in the pork samples were most commonly resistant to lincosamide, streptogramin, and/or tetracycline classes of antibiotics. All three are highly important.
- All Salmonella isolates were found in Walmart batches, and two of the six Salmonella found were resistant to quinolones, a class of HPCIA.
- All four Listeria isolates were antibiotic-resistant, and one Listeria isolate from a Walmart sample was resistant to six total classes including two different classes of HPCIA.
- Three E. coli isolates were multidrug-resistant, including resistance to critically important and highly important drugs. All three were from Walmart samples.
- Of the 27 Enterococcus present, only one was not resistant to any antibiotic classes tested.

Conclusion

The data provided by the lab at TTU from testing of the submitted retail pork samples illustrate the significant presence of antibiotic-resistant bacteria in the United States that pose a risk to humans. The findings complement strong existing research on how excessive antibiotics use on farms is creating the conditions for superbugs to thrive, and the opportunities for transmission to the food chain.

Consumers are highly concerned for both their own health and the welfare of pigs. Retailers play an important role in protecting both the animals in their supply chains and the health of their customers. Surveys conducted by World Animal Protection in 2017 demonstrated that the majority of shoppers believe that retailers have a responsibility to ensure pigs are treated right, and 88 percent of Walmart's customers believe this is true.[xiii]

World Animal Protection's Raise Pigs Right campaign is calling for pigs to be spared painful mutilations and to be spared from cages, and not to suffer in barren environments. Instead, these highly intelligent animals should be allowed to live in groups, with room to move, and be given opportunities to express their instinctive natural behaviors.

Purpose of the report

This report covers the results of retail pork product testing conducted for World Animal Protection U.S. in 2019 by Texas Tech University (TTU). It illustrates the need for the pig industry to shift to higher-welfare practices to curb the overuse of antimicrobial drugs and protect pigs, people, and the planet. The testing was commissioned to identify the presence of bacteria in fresh pork meat on U.S. grocery shelves, and to test for strains resistant to antibiotics.

Previous studies have found so-called "superbugs" in retail poultry and pork products in the U.S.[xiv] This report builds on previous investigations by focusing on large retail chains that can make a significant impact by using their purchasing power to hold their suppliers to higher standards of production. This report follows a December 2018 report from World Animal Protection, which provided the first global snapshot of the presence of superbugs in retail pork products.

Superbugs are bacteria that have developed resistance to one or more classes of antibiotics, rendering those antibiotics less effective in treating infections. Superbugs are also known as antimicrobial resistant bacteria (ARB). They represent a significant threat to human health, killing an estimated 700,000 people worldwide annually.[xv] This is projected to rise to 10 million deaths annually by 2050.[xvi] The U.S. Centers for Disease Control and Prevention (CDC) most recent analysis estimates that resistant infections sicken more than 2 million people in the United States each year, and kill at least 23,000.[xvii]

Recent research by World Animal Protection demonstrates that U.S. consumers are looking for change and seeking out higher-welfare animal products. Eighty-nine percent of people surveyed think that supermarkets have a responsibility to ensure that pigs are treated well, and 78% would be more likely to shop at a supermarket that committed to end the confinement of pigs in its supply chain.[xviii] Research also shows that consumers are increasingly attracted to brands they feel are transparent about the practices and standards that underlie their products.[xix]

It is essential that supermarkets, as major buyers of pork, work closely with their suppliers to address the issue of low animal welfare as part of the move towards responsible antibiotic use to tackle the superbug crisis.

By getting pigs out of cages and into group housing with room to move and providing enrichment materials like straw, the animals are less stressed and more resilient. By giving piglets longer time with their mothers before weaning and by ending painful mutilations like surgical castration, tail cutting, and teeth clipping, the pigs are more robust as they grow and develop, requiring fewer antibiotics to stay healthy.

Higher-welfare farming methods already practiced by responsible producers in the U.S. must be rolled out nationwide. This report shows how such action will reduce the need for routine overuse of antibiotics and protect public health from the superbug crisis.

World Animal Protection's global superbugs report

In December 2018, World Animal Protection released a global report focused on retail pork product testing conducted in four countries: Australia, Brazil, Spain, and Thailand. The testing was commissioned to identify bacteria present in pork meat and to test for strains resistant to specific antibiotics. The project was prompted by current research suggesting a link between low-welfare farming systems and overuse of antibiotics. This report was the first global snapshot of the presence of superbugs in retail pork products and further exposed the global nature of the problem.

Superbugs resistant to antibiotics considered most critically important to human health by the WHO were found in samples sold by major supermarkets in Brazil, Spain and Thailand, including samples sold in Walmart stores in Brazil.

U.S. intensive farms, excessive antibiotics use and superbugs

As the production of animals raised for food has intensified and become industrialized, the amount of antibiotics sold for use in animal agriculture increased significantly until only very recently. As a result, the public health crisis of antibiotic-resistant infections has worsened.

Factory farms confine animals indoors with minimal or no access to outdoor space and natural light. They often further confine animals in cages, with no room to turn around or lie down with their limbs fully extended. These industrial operations seek to maximize the number of animals they can raise in a space, stocking animals to the point where they cannot move without touching another animal. This highly stressful environment can lead to severe behavior issues such as aggression and violence or stereotypies like cage-biting or sham chewing.

These intensive farming practices have become standard in the industry alongside the routine use of antibiotics given by injection at specific life stages and via the animals' daily feed and water. Until January 2017, antibiotics were widely used in low doses in the United States to promote rapid weight gain. Antibiotics may still be used routinely for purposes of disease prevention, essentially keeping mortality and illness rates lower in cruel, harsh conditions.

Data from 2016 show that 95% of U.S. swine operations used antimicrobials in their production, and 90% of sites administered medically-important antibiotics via feed or water.[xx] Producers were also likely to administer several different antibiotics to their pigs. For example, 62.7% of sites gave nursery-age pigs three or more individual antimicrobials via feed.[xxi] The pig industry continues to use antimicrobials in feed for growth-promotion purposes as well. Antimicrobials not important to human medicine are still approved at growth promotion doses, and 26% of operations indicated they feed antimicrobials to grower/finisher pigs for this purpose. Further, despite efforts by the U.S. Food and Drug Administration (FDA) to phase out growth promotion uses of medically important drugs, research by Pew Charitable Trusts demonstrates loopholes in the regulations that allow several products to be used for their growth promotion benefits.[xxii]

In addition to growth promotion, operators indicated respiratory diseases and diarrhea as common reasons for administering antibiotics. Swine disease is exacerbated by low-welfare conditions and practices and higher-welfare strategies can play a role in preventing disease and the need for antibiotic treatments. Among U.S. operators surveyed, 31.3% indicated that weaning pigs at older ages (21 or more days old) as a "very important" practice for reducing the need to use antimicrobials in pigs.[xxiii] Higher importance was given to adjusting diets to meet pigs' nutritional needs and making facility management adjustments with 97.8 and 81.9% of operators, respectively, citing these strategies as "very important" for reducing antimicrobials. The types of facility management adjustments operators' value were not indicated.

World Health Organization's (WHO) medically important antibiotics list

The WHO convened workshops in 2003 and 2004 to address the public health consequences associated with the use of antimicrobials in farmed animals. The global health body recognized that there was clear evidence of adverse human health consequences arising from non-human usage of antimicrobial medicines, and that the consequences were especially severe when pathogens developed resistance to antimicrobials that are important for treating illness in human health settings. From this, WHO recommended and appointed an expert medical group to define and develop a list of antimicrobials considered critically important in humans and advise on their proper use.

The Critically Important Antimicrobials for Human Medicine list has to date been revised six times, updating regularly to reflect current knowledge of resistance patterns. It is intended to assist stakeholders and national governments with prioritizing risk assessment, risk management strategies, and resourcing for addressing antimicrobial resistance. The list is organized in tiers, identifying listed antimicrobials as "important," "highly important," or "critically important" to assist with prioritization, allowing for adaptation to specific national and regional contexts. Additionally, WHO has released a separate list of "highest priority critically important antimicrobials" (HPCIA) identifying the drug classes that are of highest risk and should be used most prudently.

Our global testing project found:

Country

Spain

- E. coli in 155/200 samples: 77.5%
- Bacterial resistance was found across these 155 E. coli-positive samples, including resistance to antibiotics of 'highest critical importance to human health' from Carrefour: ofloxacin (29% of E. coli found was resistant to ofloxacin), ciprofloxacin (18.7% of E. coli found was resistant), colistin (3.2% of E. coli found was resistant).
- 64.5 % of all E. coli found were MDR.

Thailand

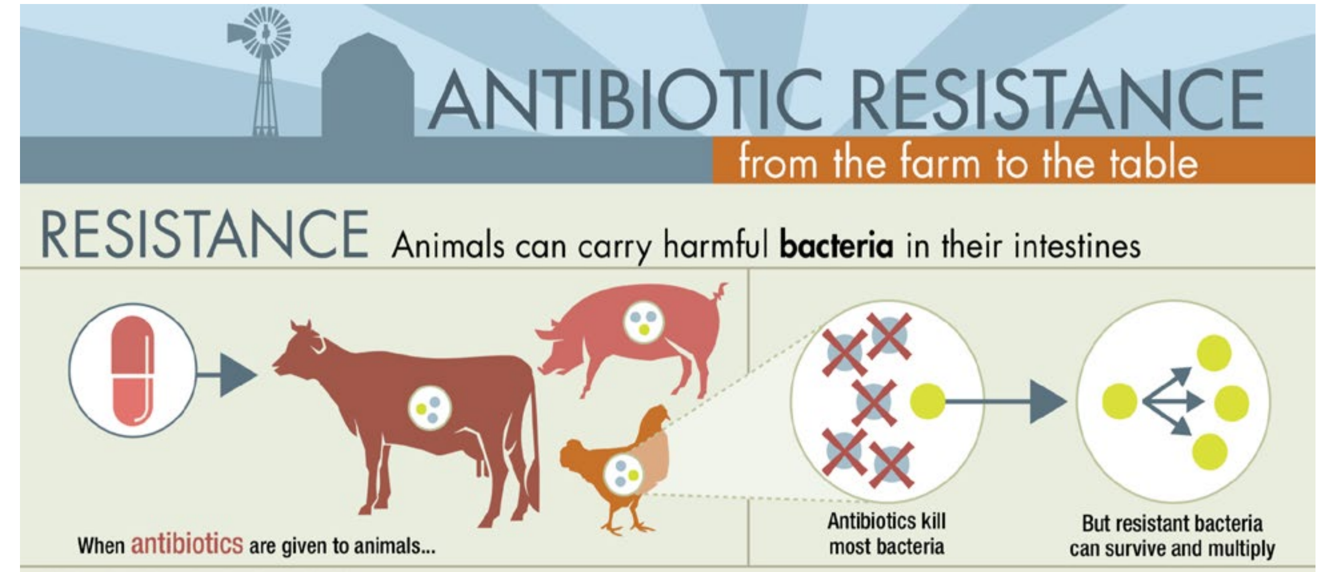
- E. coli was present in 97% of the 150 samples; Salmonella was present in 50% of samples.
- 97% of all E. coli and 93% of all Salmonella were MDR.
- ESBL positive E. coli were prevalent (10% of all E. coli found). Such E. coli are inherently resistant to cephalosporin and ampicillin. Third-generation and later cephalosporin antibiotics are of 'highest critical importance' to human health.
- Bacterial resistance to antibiotics of 'highest and high critical importance to human health' was found. Across E. coli found in Tesco Lotus samples, resistance was found to; cefotaxium (15% of samples containing E. coli), cefpodoxium (15%). Across E. coli and Salmonella found in Tesco Lotus samples, resistance was found to gentamicin (19%), streptomycin (96.8%), ampicillin (100%).
- Bacterial resistance to antibiotics 'highly important' to human health was also found: Across E. coli and Salmonella found in Tesco Lotus samples; resistance was found to tetracycline (96.7% of samples containing E. coli or Salmonella) and chloramphenicol (61%).

Brazil

- E. coli was present in 92/100 samples from four supermarkets (Carrefour, Walmart, Extra (Casino Group) and Pao de Acucar (Casino Group)), and 33.6% were MDR.
- Bacterial resistance to fluoroquinolones was found in samples from three of the four supermarkets. Fluoroquinolones are of 'highest critical importance' to human health.
- E. coli resistance to amikacin and to Salmonella resistance to sulphonamides was found in samples from Extra (Casino Group) and Pao de Acucar (Casino Group). Amikacin is of 'high critical importance to human health'; Sulphonamides are 'highly important to human health'.
- One Carrefour sample contained E. coli ESBL positive bacteria. Such E. coli have inherent cephalosporin and ampicillin resistance. Third-generation and later cephalosporin antibiotics are 'highest critical importance' to human health.
- Walmart samples were also found to have E. coli resistant to ceftiofur and colistin. These are antibiotics of 'high importance and highest critical importance' to human health. Colistin was banned for use in farm animals in Brazil in 2016.

Australia

- Of 300 samples across three supermarkets (Coles, Woolworths, Aldi), E. coli was found ranging from 36% to 70% of samples from each supermarket and Enterococcus was found ranging from 36% to 90% of samples from each supermarket.
- Moderate to high levels of resistance were found to ampicillin/tetracycline in E. coli and to tetracycline/streptogramins in Enterococcus.
- MDR was found in Woolworths (E. coli) and Coles (Enterococcus) samples only.
- No resistance to drugs of 'highest critical importance to human health' was found.



Routine antibiotic use drives resistance among harmful bacteria

Routine and continuous use of drugs to promote rapid weight gain or prevent disease poses potential risks for animals, people, and the environment. The use of antibiotics considered by the World Health Organization (WHO) to be important to medicine represents a major health concern for people worldwide. These include antibiotics used in pig production in the United States: macrolides, lincosamides, tetracyclines, and aminoglycosides.[xxiv] Use of important antimicrobials in livestock feed as growth promoters and to prevent disease has been linked to the transference of resistant bacteria to humans since the Swann Committee report in 1969.[xxv]

WHO has acknowledged that the widespread use of antibiotics to promote growth and prevent disease in food-producing animals nurtures the emergence and propagation of resistant bacteria in both animal and human populations.[xxvi] WHO further states that this relationship is particularly associated with intensive animal production in which antibiotics are used for productivity purposes, not to treat sick animals.[xxvii] In September 2016, the United Nations (UN) General Assembly formally recognized the inappropriate use of antimicrobials in animals as a leading cause of rising antimicrobial resistance (AMR).

Many of the bacteria commonly carried by animals can also cause disease in people. When exposed to routine, low doses of antibiotics, the bacteria that survive are better able to reproduce and spread. Bacteria can also transfer genes to one another – a process called horizontal gene transfer – meaning a Salmonella bacterium with resistant genes can pass them on to other bacteria that were not previously exposed to antibiotics. In-feed use of antibiotics has been shown to significantly increase the risk of E. coli resistant to important medicines.[xxviii] Even short-term doses of in-feed antibiotics increases the prevalence and diversity of antibiotic resistance, including resistance to antibiotics not directly fed to the animals.[xxix] A 2011 study investigating resistant bacteria in 11 European countries found strong correlation between multidrug-resistant E. coli isolates from pigs and poultry and isolates found in humans.[xxx] It has also been shown that farms that transition to organic practices, which restrict antibiotics use, have lower prevalence of resistant bacteria and lower prevalence of multidrug-resistance.[xxxi]

Highest Priority Critically Important Antimicrobials (HPCIA) are classes of antibiotics where there are few or no alternatives to treat people with serious infections. The Food and Agriculture Organization of the United Nations (FAO) recommends that these classes should never be used in animal agriculture.[xxxii] This is to help preserve their effectiveness when needed to treat infections in people. A 2019 study in the United States demonstrated that eliminating routine, feed-based antibiotics throughout the lives of growing pigs had no significant difference for mortality or daily weight gain with conventional, continuous administration, and resulted in similar net revenue per pig.[xxxiii]

Antibiotic resistance and foodborne pathogens in the U.S.

Despite all of this, important antibiotics remain widely used in factory farming in the United States. In U.S. pig production antibiotics are commonly used in piglets that are subjected to tail docking or surgical castration. They are also often administered to piglets following early weaning from their mothers. Mother pigs (sows) are routinely given antibiotics to prevent them from succumbing to urinary, hoof, vaginal, and shoulder infections as a result of the stress and injury caused by close confinement and poor living conditions. Pigs raised for meat are often given feed-based antibiotics to deal with acute stress caused by overcrowding, barren environments and changes in group composition which may trigger existing or latent infection.

This ubiquitous use has helped drive the development and spread of AMR. Resistant bacteria that develop on farms and in farm animals can reach humans through several pathways. They can remain in animals through slaughtering and processing, and resistant bacteria have been detected on retail meat tested in the United States in several studies.[xxxiv] Fruits and vegetables may also be contaminated by resistant bacteria through cross-contamination or due to the use of manure from factory farms in crop production.[xxxv] They can also be carried off-farm by livestock workers, wildlife, and vermin, as well as through the air, soil, and water near factory farms.[xxxvi]

DNA fingerprinting technology has improved our ability to make direct links between resistant bacteria isolated from sick people to an agricultural source.[xxxvii] Whole Genome Sequencing (WGS) has enabled researchers to develop a better understanding of pathogen movements between host populations. For example, providing quantitative evidence that a strain of Staphylococcus aureus frequently jumps from livestock to humans rather than vice versa.[xxxviii] WGS improves our understanding of the factors that influence the gain or loss of resistance in bacteria.[xxxix]

Between April and September 2015, 192 people across five western U.S. states were sickened by two species of Salmonella, an outbreak that the CDC attributed to pork products. CDC's National Antimicrobial Resistance Monitoring Service (NARMS) laboratory conducted antibiotic resistance testing on isolates collected from 10 infected people. All 10 isolates were multidrug-resistant, with resistance to ampicillin, streptomycin, sulfisoxazole, and tetracycline.[xl] Streptomycin (an aminoglycoside) and ampicillin (a penicillin) are categorized as critically important to human medicine by WHO.[xli] Sulfisoxazole (a sulfonamide) is categorized as highly important.[xlii] The company, Kapowsin Meats, recalled more than 500,000 pounds of pork that may have been contaminated by the superbugs.

Between November 2018 and July 2019, 45 people across 13 states were infected by a multi-drug resistant strain of Salmonella attributed to contaminated pig ear dog treats.[xliii] Whole genome sequencing of isolates from 30 infected people illustrated antibiotic resistance to ampicillin (a penicillin), ciprofloxacin (a quinolone/fluoroquinolone), gentamicin (an aminoglycoside), nalidixic acid (a quinolone/fluoroquinolone), streptomycin (an aminoglycoside), sulfisoxazole (a sulfonamide), tetracycline, and trimethoprim-sulfamethoxazole (a sulfonamide). Quinolones and fluoroquinolones are categorized as HCPIAs.[xliv]

Whole genome sequencing enabled the CDC to connect an outbreak of Listeria in July – August 2018 that hospitalized four people, one of whom died, to deli ham products from Johnston County Hams, Inc.[xlv] In April 2019, WGS identified a Listeria strain that hospitalized eight people, killing one, as genetically similar to Listeria taken from samples of sliced deli meats from retail locations in New York and Rhode Island.[xlvi]

U.S. antibiotics policies and regulations

The U.S. government has taken some steps to address the overuse of antibiotics and curb the spread of antibiotic-resistant bacteria. However, the emphasis of U.S. policy initiatives has been on antibiotics in human health settings and advancing research into new and effective medicines for human infections. Addressing routine overuse of antibiotics in animal agriculture has been a low priority to date, with policies focusing on data collection and voluntary reductions rather than mandatory restrictions on the frequency and amount of use.

Beginning in 2003, the U.S. Food and Drug Administration (FDA) incorporated concerns about antibiotic resistance into its assessments of new drugs intended for use in farm animals. It was not until almost a decade later, in 2012, that the agency issued a guidance for industry outlining its perspective on the use of antibiotics in farm animals. Guidance 209 acknowledged that "[m]isuse and overuse of antimicrobial drugs creates selective evolutionary pressure that enables antimicrobial resistant bacteria to increase in numbers more rapidly than antimicrobial susceptible bacteria and thus increases the opportunity for individuals to become infected by resistant bacteria," and for this reason "unnecessary or inappropriate use should be avoided."[xlvii]

The agency asserted that the use of medically important drugs in farmed animals should be limited to uses considered necessary for assuring animal health and should only be used under veterinary oversight or consultation.[xlviii] Despite this step, the guidance stipulated that routine administration of antibiotics to healthy animals for purposes of preventing future disease was in line with "assuring animal health."

In 2013, the agency issued further instructions to industry, Guidance 213, which recommended that manufacturers of antibiotics for farmed animals remove all indications on their labels that the drugs can be used to promote growth or improve feed efficiency.[xlix] It established a voluntary compliance deadline of January 1, 2017. Although not mandatory, all drug companies complied by the set deadline. However, as disease prevention uses are still permissible, it is possible for producers to administer medically important antibiotics routinely at low doses via feed and water, and benefit from the growth-promoting effects as well. The Pew Charitable Trusts has outlined various loopholes in the regulations that allow several products to continue to be used for their growth promotion benefits.[l]

In 2015, the FDA shifted key aspects of its voluntary Guidance 209 into law, passing a regulation requiring that all uses of medically important antibiotics in farmed animals may only occur under veterinary oversight.[li] That same year, U.S. President Barack Obama issued a National Action Plan for Combatting Antimicrobial Resistant Bacteria (The Plan).[lii] The Plan included few concrete strategies for addressing antibiotics use in farmed animals, and instead sanctioned the FDA's existing approach. The Plan did not expressly call for reductions in on-farm antibiotics usage nationally and made only minimal mention of requiring improved living conditions and animal health strategies.

Some facts about pigs. They're amazing!

Pigs have strong maternal instincts. They build strong connections with their piglets and are extremely protective of them. They perform suckle grunting to indicate when milk is available, using rhythmic changes to send specific signals to their young. At just 36 hours old piglets can recognize their mother's unique voice.

Pigs are very intelligent, curious, and insightful. In some ways they're as smart as a three-year-old child.

Pigs are intelligent, social, curious, and playful. They are highly sensitive, emotional, and compassionate, forming strong family bonds. Pigs kept as pets even mourn the loss of or separation from human family members.

They enjoy listening to music, and this encourages them to play.

Antibiotics for U.S. pig production

Since 2009, the FDA has collected data on antimicrobial drug sales to the food animal industry. These data show that roughly 3 million kilograms (kg) of medically important antimicrobial drug sales in 2016 were intended for use in swine. That amount, nearly 7 million pounds, is almost equivalent to that used by humans in the U.S.[liii] Comparatively, this is also seven times the rate used in pigs in Denmark and Netherlands. This amount decreased significantly in 2017 to just over 2 million kg, but the swine industry continues to account for 36% of important antimicrobials sold to farmed animals.

The 2017 data show that products intended for use in pigs accounted for:[liv]

- eight-four percent of the domestic sales and distribution of lincosamides[1], 128,642 total kg.
- forty percent of macrolides[2], 189,503 total kg.
- forty-five percent of tetracyclines[3], 1,579,145 total kg.
- twenty-five percent of aminoglycocides[4], 63,602 total kg.
- eleven percent of sulfas[5], 31,024 total kg.

Based on these data, World Animal Protection ensured that TTU's testing included susceptibility to lincosamides, macrolides, and tetracyclines, in particular. Macrolides are categorized as HPCIAs, and lincosamides and tetracyclines are categorized as "highly important" antimicrobials.[lv] Of note, while sales of most classes of antimicrobials decreased between 2016 and 2017, sales of lincosamides intended for swine increased by eight percent over the same period.[lvi] From 2016 to 2017, total sales of macrolides and tetracylcines for swine decreased by 44% and 37%, respectively.[lvii]

Despite overall decreases in sales, the swine industry is more likely to use medically important antimicrobials as opposed to not medically important antimicrobials than the other animal industries. The 2017 data show that 84% of the antimicrobials sold for use in pigs are considered medically important. In comparison, only 43% of the drugs sold for use in cattle are medically important, and only 15% for chickens.[lviii]

In lieu of strong, mandatory federal regulations requiring producers to phase out routine uses of antibiotics and restricting use to treating sick animals, major food companies have established policies for their supply chains. Large restaurant chains, retailers, and some large commodity producers have made public commitments to restrict and reduce the use of medically important antibiotics in the animals that produce their meat, eggs and dairy.

Methodology

World Animal Protection worked with researchers at Texas Tech University (TTU). The Department of Animal and Food Sciences at TTU is well recognized and housed in a state-of-the-art teaching and research facility.

The pork samples were purchased from several locations of two major retailers on two separate days several days apart in Washington D.C., Maryland, and Virginia. Each product was given a batch and sample number by World Animal Protection and the specific retail source was not indicated. In total, 160 pork products were purchased from nine different retail locations on April 15 and 18, 2019 and all samples underwent the testing protocols at TTU.

The researchers at TTU tested the 160 samples in batches of five, for a total of 32 batches. Batches contained only samples purchased from the same retailer on the same day, though certain batches consisted of a combination of cuts of pork, store locations, or in-house and third-party brands. Batches were tested for the presence of Salmonella, E. coli, Enterococcus faecium and faecalis, and Listeria monocytogenes and isolated the bacteria when identified. Isolates were then run through Antibiotic Susceptibility Testing based on the FDA's National Antimicrobial Resistance Monitoring Service (NARMS) protocols to determine isolates with resistance to one or more antibiotics. Resistant isolates were sent to a separate lab at TTU, which ran Whole Genome Sequencing on the isolates to determine the presence of genetic elements that confer resistance to antibiotics and identify any correlations to genetically similar bacteria isolated by other institutions. The sequence mapping was in progress at the time of this report's publication and will enable World Animal Protection or other researchers to compare the bacteria found in these samples to clinical isolates from patients.

Key findings

Across the 32 batches of samples there were 51 positive bacterial isolates: E. coli was detected: E. coli was detected in 14 (43.75%) batches; Enterococcus in 27 (84.38%) batches; Listeria in four (12.5%) batches; and Salmonella in six (18.75%) batches.

Bacteria	n	% (Based on 32 tested batches
E.coli	14	43.75
Enterococcus	27	84.38
Listeria	4	12.50
Salmonella	6	18.75
Total # isolates	51	

Of the 32 batches tested, 30 (94%) had positive bacterial findings for at least one of the four bacteria:

- Twelve (37.5%) batches were positive for Enterococcus only;
- one (3%) batch was positive for Listeria only; and,
- one (3%) batch was positive for Salmonella only.

16 (50%) batches had positive bacterial findings for at least two bacteria:

- eight (25%) were positive for both E. coli and Enterococcus;
- two (6%) were positive for Enterococcus and Salmonella;
- one (3%) was positive for E. coli and Listeria;
- two (6%) were positive for E. coli, Enterococcus, and Salmonella;
- one (3%) was positive for E. coli, Enterococcus, and Listeria; and,
- one (3%) was positive for all four bacteria.

Although each retailer had an equal number of batches (15 each) that had positive positive bacterial findings for at least one of the four bacteria, 12 of the 16 batches that had positive findings of two or more bacteria were from Walmart stores compared to four from the second retailer's stores. Moreover, all six batches positive for Salmonella and all batches with three or more strains present were from Walmart stores.

Antibiotic susceptibility results

Of the 51 isolates tested for susceptibility or resistance to antibiotics, only 10 were pan-susceptible.

Forty-one (80.39%) were resistant to at least one class of medically important antibiotic

- Thirty-nine total isolates were resistant to at least one class considered highly important to human medicine by WHO.
- Eleven total isolates were resistant to at least one class considered critically important to human medicine by WHO.
- Seven total isolates were resistant to at least one class listed in WHO's Highest Priority Critically Important Antibiotics (HPCIA) list.

Further, 21 (41.18%) were multidrug-resistant (MDR), meaning the isolate was resistant to at least three classes of antibiotics. In other words, nearly half of the resistant bacteria were resistant to multiple antibiotic classes. Further, all 21 MDR isolates were resistant to at least three antibiotics considered medically important, and three isolates (one each of Enterococcus, E. coli, and Listeria) were resistant to six classes of important antibiotics.

Antibiotic resistance results by species

Enterococcus:

Twenty-six (96.3%) of the Enterococcus isolates were resistant to at least one class of medically important antibiotics. The most common resistance was to lincosamides (lincomycin), streptogramins (quinupristin/dalfoprisitin), and/or tetracyclines (tetracycline). All three classes are categorized as highly important.

Seventeen of those isolates (65.38%) were multi-drug resistant:

- Thirteen isolates were resistant to lincosamides, streptogramins, and tetracyclines.
- One isolate was resistant to lincosamides, streptogramins, and oxazolidinones.
  - o Oxazolidinones are categorized as critically important.
- One isolate was resistant to lincosamides, streptogramins, tetracyclines, and macrolides.
  - o Macrolides are among the classes categorized as HPCIAs.
- One isolate was resistant to lincosamides, quinolones, and nitrofuran derivates.
  - o Quinolones are categorized as HPCIAs.
- One isolate was resistant to lincosamides, streptogramins, tetracyclines, amphenicols, macrolides, and aminoglycosides.
  - o Aminoglycosides are categorized as critically important; amphenicols are considered highly important.

Listeria:

All four (100%) Listeria isolates present in the sample batches were resistant to lincosamides, which are listed as highly important.

One isolate (25%) was resistant to six total classes of antibiotics: lipopeptides, penicillins, streptogramins, macrolides, lincosamides, and glycopeptides.

- Macrolides and glycopeptides are listed as HPCIAs.
- Penicillins and lipopeptides are categorized as critically important.
- Lincosamides and streptogramins are highly important.

Salmonella:

Two of the Salmonella isolates (33.33%) were resistant to one antibiotic class, while the rest of the isolates were pan-susceptible.

The two resistant isolates were resistant to quinolones, which are categorized as HPCIAs.

E. coli:

Nine E. coli isolates (64.29%) were resistant to at least one class of medically important antibiotic.

- Four (28.57%) were resistant to tetracyclines alone, and one (7.14%) was resistant to tetracyclines and sulfanomides.
  - o Tetracyclines and sulfanomides are considered highly important.
- Another isolate (7.14%) was resistant to both tetracyclines and aminoglycosides.
  - o Aminoglycosides are considered critically important.

Three E. coli isolates were multi-drug resistant:

- One (7.14%) was resistant to tetracyclines, aminoglycosides, and penicillins.
  - o Penicillins are categorized as critically important.
- One (7.14%) was resistant to tetracyclines, sulfanomides, aminogylcosides, and amphenicols.
  - o Amphenicols are categorized as highly important.
- One (7.14%) was resistant to tetracyclines, sulfanomides, aminoglycosides, penicillins, macrolides, and cephalosporins (1st/2nd generation).
  - o First and second generation cephalosporins are categorized as highly important.

Implications for consumers

Routine antibiotics overuse is closely associated with low-welfare practices, including early weaning, painful mutilations and caging of mother pigs.

The limited product sampling for this report aligns with wider research pointing to the need for responsible reduction in antibiotic use across the pig industry. Our interest is in pointing to the evidence that higher-welfare practices can allow responsible antibiotics use.

We cannot comment on the specific health implications for consumers relating to the products sampled. However, the European Medicines Agency confirms that resistant bacteria can be transmitted to people via the food chain and be carried in the human intestines. This can carry a risk of infection for the young, the elderly, or those with compromised immunity.[lix]

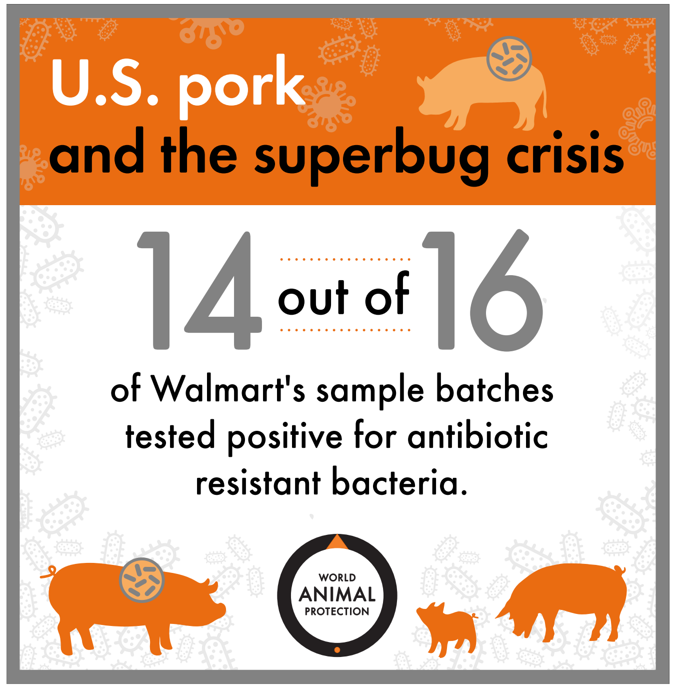
Illnesses can include food poisoning, diarrhea, urinary tract infections and kidney failure.

Retailers and superbugs

The 41 isolates with resistance to at least one medically important antibiotic were predominantly from Walmart stores. In total, 13 antibiotic-resistant Enterococcus, three antibiotic-resistant Listeria, eight antibiotic-resistant E. coli, and the only two antibiotic-resistant Salmonella were found in Walmart sample batches. In contrast, while 13 antibiotic-resistant Enterococcus were found in the second retailer's sample batches, only one antibiotic-resistant Listeria and one E. coli were found in its samples.

Despite the greater number of resistant isolates detected in the Walmart samples, the two retailers had comparable results in terms of the number of multi-drug resistant bacteria detected. Of the 21 isolates found to be resistant to three or more classes of antibiotics, 12 (57.14%) were from Walmart pork samples and 9 (42.86%) from the second retailer.

However, all five isolates with resistance to four or more classes were found in Walmart samples, as were all seven isolates with resistance to at least one HPCIA. Bacteria in Walmart's samples were resistant to a wide range of highly important, critically important, and HPCIA classes of antibiotics, including penicillins, macrolides, and quinolones. In contrast, bacterial resistance in the second retailer's samples was limited to just a few classes of highly important antibiotics with resistance to one or a combination of lincosamides, tetracyclines, or streptogramins.



Walmart competitor animal welfare commitments

While Walmart has not yet made a time-bound commitment to phase out sow stalls in its supply chain, several of its national grocery competitors have. Target and Costco have committed to only partner with suppliers who do not use gestation crates by 2022 and Kroger by 2025. Walmart is lagging behind the times. It needs to move forward by making animal welfare a priority, as it is for its customers, and ensuring that its commitment to animal welfare is expressed as an enforceable policy.

Target is committed to working with vendors on the elimination of sow gestation crates by 2022. Target recognizes this task will involve a large undertaking from pork product vendors and will partner closely with vendors as they work through this transition.[lx]

Costco has a Gestation Crate Policy that asks suppliers to phase out gestation crates for pregnant sows in favor of group housing. The goal is a complete transition by 2022. Approximately 80% of Costco suppliers have completed this process, and many more will finish ahead of this target date.[lxi]

Kroger has begun asking suppliers to transition away from gestation stalls to group housing or free-range environments. Many of its pork suppliers are already making this transition or have time-bound commitments to make this transition. By 2025, Kroger will source 100% of fresh pork from suppliers and farms that have transitioned away from gestation stalls.[lxii]

Moving forward to raise pigs right

Conclusion

Pork is big business, with supermarkets spending millions each year to source pork from producers around the world. This gives them significant influence over the way pigs are raised. Supermarkets have a responsibility to use that influence to improve production practices, to benefit pigs and people.

This retail pork testing conducted for World Animal Protection by Texas Tech University shows the significant presence of antibiotic resistant bacteria. The findings complement strong existing research on how excessive antibiotics use on farms is creating the conditions for superbugs to thrive, and the opportunities for transmission to the food chain.

Consumers are highly concerned for both their own health and the welfare of pigs.

World Animal Protection's Raise Pigs Right campaign is calling for pigs to be spared painful mutilations, freed from cages, and not left to suffer in barren environments. Instead, these highly intelligent animals should be allowed to live in groups, with room to move, and be given opportunities to express their instinctive natural behaviors.

Our work with leading global pig producers shows that change is possible and higher-welfare systems are good for animals, good for people, and good for business too. See our global business case studies on sows and pigs raised for meat.

Regarding antibiotics, recent data document that antibiotic reductions in conjunction with welfare improvements can maintain the economic viability of swine production. Researchers in The Netherlands concluded that "implementation of measures to improve animal welfare, can also contribute to the decrease of antibiotic usage, while maintaining the economic performance of the farms."[lxiii] Additionally, a recent study in the United States indicates that reduced antibiotic treatment had no significant differences in mortality or daily weight gain and similar net revenue per pig as conventional antibiotic usage.[lxix]

Raise pigs right

The evidence is clear that raising pigs right is the only way to address the industry's contribution to the superbug crisis – and the time to change is now. We are calling for the following urgent actions.

Supermarkets must...

- **Strengthen** their pork procurement policies to stop pigs being kept in cages, barren environments and subjected to cruel and painful mutilations. Supermarkets should only use suppliers who keep pigs in groups, on comfortable flooring and allow the animals opportunities to express natural behavior.
- **Publish** annual reports on their progress towards implementing higher pig welfare commitments.
- **Require** suppliers to commit to using antibiotics responsibly in pig farming; ending the use of antibiotics to promote growth and to prevent disease across herds. They should not, however, pursue 'no antibiotics ever' or 'raised without antibiotics' policies or product lines; this can create a disincentive for producers to treat sick animals and does not address underlying welfare issues.

Pig producers must...

- **Plan** to stop using cages, barren environments and performing painful mutilations. Their plans should show how they will keep pigs in groups, with comfortable flooring and give them opportunities to express natural behavior.
- **Use** systems that allow for better welfare, as outlined in World Animal Protection's global pig welfare framework, and publicly commit to doing so.
- **Commit** to using antibiotics responsibly in pig farming. This means not using antibiotics to promote growth or to prevent disease across herds. They must not adopt 'no antibiotics ever' or 'raised without antibiotics' policies. Antibiotics should be available to treat sick animals.

Governments must...

- **Strengthen** policy, surveillance and regulatory frameworks to support the development of pig farming systems, allowing for better animal welfare and responsible antibiotics use. This includes ensuring subsidies support higher-welfare practices.

Consumers should...

- **Choose** higher-welfare options where available. If higher-welfare products are not available, consumers should pressure retailers to sell them.
- **Not** equate 'no antibiotics ever' or 'raised without antibiotics' labeling with higher animal welfare. Antibiotics use for promoting growth and to prevent disease across herds must end, however antibiotics are needed to treat sick animals. Higher-welfare systems allow for responsible reduction of antibiotics.
- **Write** letters to Walmart CEO Doug McMillon demanding the company do better to protect pigs, people, and the planet by committing to higher welfare practices, starting with requiring open housing for breeding sows. Visit www.WorldAnimalProtection.us/writeforwelfare.
- **Urge** supermarkets to commit to improve pig welfare by joining our Raise Pigs Right campaign.

▶ Visit www.WorldAnimalProtection.us/raise-pigs-right.

References

i J. O'Neill. 2016. Tackling Drug-Resistant Infections Globally. Final report and recommendations of The Review on Antimicrobial Resistance (May). Jim O'Neill, Chair, https://amr-review.org/sites/default/files/160525_Final%20paper_with%20cover.pdf.

ii Food and Agriculture Organisation of the United Nations, (2018) Antimicrobial resistance policy review and development framework, http://www.fao.org/3/CA1486EN/ca1486en.pdf

iii Pig Progress, Finding Alternatives to Antibiotics, May 2 2016, http://www.worldpoultry.net/Health/Articles/2016/5/Finding-alternatives-to-antibiotics-2779551W/?cmpid=NLC|worldpoultry|2016-05-06|Finding_alternatives_to_antibiotics.

iv United States Food and Drug Administration (FDA). 2018. 2017 Annual Report, https://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM628538.pdf.

v World Health Organisation (WHO). 2011, Policy package to combat antimicrobial resistance / 4D Reduce use of antibiotics in food-producing animals, http://www.who.int/world-health-day/2011/presskit/whd2011_fs4d_subanimal.pdf?ua=1.

vi http://www.who.int/foodsafety/areas_work/antimicrobial-resistance/amrfoodchain/en/

vii US Department of Agriculture. 2019. Antimicrobial Use and Stewardship on US Swine Operations, 2017. USDA Animal and Plant Health Inspection Service, National Animal Health Monitoring System (May), https://www.aphis.usda.gov/animal_health/nahms/amr/downloads/amu-swine-operations.pdf

viii JR Johnson, et al. 2017. Extraintestinal pathogenic and antimicrobial-resistant Escherichia coli, including sequence type 131 (ST131), from retail chicken breasts in the United States in 2013," Appl. Environ. Microbiol., 83. https://doi.org/10/1128/AEM.02956-16; GH Tyson, et al. 2018. Prevalence of antimicrobial resistance of enterococci isolated from retail meats in the United States, 2002 to 2014, Appl. Environ. Microbiol., 84. https://doi.org/10/1128/AEM.01902-17; AC Brown, et al. 2018. CTX-M-65 Extended-Spectrum β-Lactamase-Producing Salmonella enterica Serotype Infantis, United States, Emerging Infectious Diseases, 24(12). https://doi.org/10.3201/eid2412.180500; GH Tyson, et al. 2017. Identification of plasmid-mediated quinolone resistance in Salmonella isolated from swine ceca and retail pork chops in the United States, Antimicrob. Agents Chemother, 61. https://doi.org/10.1128/AAC.01318-17.

ix https://www.cdc.gov/salmonella/pork-08-15/index.html

x https://www.cdc.gov/salmonella/pet-treats-07-19/index.html

xi https://www.cdc.gov/listeria/outbreaks/countryham-10-18/index.html

xii https://www.cdc.gov/listeria/outbreaks/deliproducts-04-19/index.html

xiii Survey conducted for World Animal Protection by Voodoo Research, 2017.

xiv JR Johnson, et al. 2017. Extraintestinal pathogenic and antimicrobial-resistant Escherichia coli, including sequence type 131 (ST131), from retail chicken breasts in the United States in 2013," Appl. Environ. Microbiol., 83. https://doi.org/10/1128/AEM.02956-16; GH Tyson, et al. 2018. Prevalence of antimicrobial resistance of enterococci isolated from retail meats in the United States, 2002 to 2014, Appl. Environ. Microbiol., 84. https://doi.org/10/1128/AEM.01902-17; AC Brown, et al. 2018. CTX-M-65 Extended-Spectrum β-Lactamase-Producing Salmonella enterica Serotype Infantis, United States, Emerging Infectious Diseases, 24(12). https://doi.org/10.3201/eid2412.180500; GH Tyson, et al. 2017. Identification of plasmid-mediated quinolone resistance in Salmonella isolated from swine ceca and retail pork chops in the United States, Antimicrob. Agents Chemother, 61. https://doi.org/10.1128/AAC.01318-17.

xv J O'Neill. 2016. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations, UK Review on Antimicrobial Resistance (May), https://amr-review.org/.

xvi J O'Neill. 2016. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations, UK Review on Antimicrobial Resistance (May), https://amr-review.org/.

xvii US Centers for Disease Control and Prevention. 2013. Biggest Threats and Data, https://www.cdc.gov/drugresistance/biggest_threats.html.

xviii Voodoo Brand Research & Consultancy. 2017. Pigs, pork, consumers and retailers: exploring attitudes and behavior, Research conducted for World Animal Protection US, October 2017.

xix J. Kang & G. Hustvedt. 2013. Building Trust Between Consumers and Corporations: The Role of Consumer Perceptions of Transparency and Social Responsibility, J. Bus. Ethics. https://doi.org/10.1007/s10551-013-1916-7; O Merlo, et al. 2017. The benefits and implementation of performance transparency: The why and how of letting your customers 'see through' your business, Business Horizons; M. Dundon. 2016. Transparency in the Fast-Food Industry: Utilizing Mobile to Capture New Audiences, California Polytechnic State University Senior Project, Journalism Department, https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1116&context=joursp; GC Kane. 2015. How McDonalds Cooked up More Transparency, MITSloan Management Review (Web, published 12 Nov, 2015), https://sloanreview.mit.edu/article/how-mcdonalds-cooked-up-more-transparency/.

xx US Department of Agriculture. 2019. Antimicrobial Use and Stewardship on US Swine Operations, 2017. USDA Animal and Plant Health Inspection Service, National Animal Health Monitoring System (May), https://www.aphis.usda.gov/animal_health/nahms/amr/downloads/amu-swine-operations.pdf

xxi US Department of Agriculture. 2019. Antimicrobial Use and Stewardship on US Swine Operations, 2017. USDA Animal and Plant Health Inspection Service, National Animal Health Monitoring System (May), https://www.aphis.usda.gov/animal_health/nahms/amr/downloads/amu-swine-operations.pdf

xxii Pew Charitable Trusts. 2014. "Many drugs may still be available for food animals at growth-promotion levels," PEW Issue Brief (November 30), https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2014/11/gaps-in-fdas-antibiotics-policy.

xxiii US Department of Agriculture. 2019. Antimicrobial Use and Stewardship on US Swine Operations, 2017. USDA Animal and Plant Health Inspection Service, National Animal Health Monitoring System (May), https://www.aphis.usda.gov/animal_health/nahms/amr/downloads/amu-swine-operations.pdf

xxiv United States Food and Drug Administration (FDA). 2018. 2017 Annual Report, https://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM628538.pdf.

xxv Pig Progress, Finding Alternatives to Antibiotics, May 2 2016, http://www.worldpoultry.net/Health/Articles/2016/5/Finding-alternatives-to-antibiotics-2779551W/?cmpid=NLC|worldpoultry|2016-05-06|Finding_alternatives_to_antibiotics.

xxvi World Health Organisation (WHO). 2011, Policy package to combat antimicrobial resistance / 4D Reduce use of antibiotics in food-producing animals, http://www.who.int/world-health-day/2011/presskit/whd2011_fs4d_subanimal.pdf?ua=1.

xxvii http://www.who.int/foodsafety/areas_work/antimicrobial-resistance/amrfoodchain/en/

xxviii 2009. Preventive Veterinary Medicine. Associations between reported on-farm antimicrobial use practices and observed antimicrobial resistance in generic fecal Escherichia coli isolated from Alberta finishing swine farms. Varga et al. https://www.ncbi.nlm.nih.gov/pubmed/19041147.

xxix 2012. Proceedings of the National Academy of Sciences. In-feed antibiotic effects on the swine intestinal microbiome. Looft et al. https://www.pnas.org/content/109/5/1691.

xxx 2011. Foodborne Pathogens and Disease. Association between antimicrobial resistance in Escherichia coli isolates from food animals and blood stream isolates from humans in Europe: an ecological study. Vieira et al. https://www.ncbi.nlm.nih.gov/pubmed/21883007.

xxxi 2011. Environmental Health Perspectives. Lower prevalence of antibiotic-resistant Enterococci on US conventional poultry farms that transitioned to organic practices. Sapkota et al. https://www.ncbi.nlm.nih.gov/pubmed/21827979; 2015. Antibiotic Resistance in Escherichia coli from Pigs in Organic and Conventional Farming in Four European Countries. J. Osterberg, et al. PLoS ONE 11(6).

xxxii Food and Agriculture Organisation of the United Nations, (2018) Antimicrobial resistance policy review and development framework, http://www.fao.org/3/CA1486EN/ca1486en.pdf xxxiii 2018. PLoS ONE 13(12). S. Dee, et al. A randomized controlled trial to evaluate performance of pigs raised in antibiotic-free or conventional production systems following challenge with porcine reproductive and respiratory syndrome virus

xxxiv JR Johnson, et al. 2017. Extraintestinal pathogenic and antimicrobial-resistant Escherichia coli, including sequence type 131 (ST131), from retail chicken breasts in the United States in 2013," Appl. Environ. Microbiol., 83. https://doi.org/10/1128/AEM.02956-16; GH Tyson, et al. 2018. Prevalence of antimicrobial resistance of enterococci isolated from retail meats in the United States, 2002 to 2014, Appl. Environ. Microbiol., 84. https://doi.org/10/1128/AEM.01902-17; AC Brown, et al. 2018. CTX-M-65 Extended-Spectrum β-Lactamase-Producing Salmonella enterica Serotype Infantis, United States, Emerging Infectious Diseases, 24(12). https://doi.org/10.3201/eid2412.180500; GH Tyson, et al. 2017. Identification of plasmid-mediated quinolone resistance in Salmonella isolated from swine ceca and retail pork chops in the United States, Antimicrob. Agents Chemother, 61. https://doi.org/10.1128/AAC.01318-17.

xxxv http://www.who.int/foodsafety/areas_work/antimicrobial-resistance/amrfoodchain/en/

xxxvi JR Barrett. 2005. Airborne Bacteria in CAFOs: Transfer of Resistance from Animals to Humans, Environ. Health. Prespect., 113(2): A116-A117, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1277892/; X Ye, et al. 2015. Livestock-associated methicillin and multidrug resistant S. aureus in humans is associated with occupational pig contact, not pet contact, Scientific Reports. Doi: 10.1038/srep19184; J O'Neill. 2016. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations, UK Review on Antimicrobial Resistance (May), https://amr-review.org/.

xxxvii http://www.who.int/foodsafety/areas_work/antimicrobial-resistance/amrfoodchain/en/

xxxviii M. Woolhouse, M. Ward, B. van Bunnik, & J. Farrar (2015). Antimicrobial resistance in humans, livestock and the wider environment, Phil. Trans. R. Soc. B, 370. http://dx.doi.org/10/1098/rstb.2014/0083.

xxxix M. Woolhouse, M. Ward, B. van Bunnik, & J. Farrar (2015). Antimicrobial resistance in humans, livestock and the wider environment, Phil. Trans. R. Soc. B, 370. http://dx.doi.org/10/1098/rstb.2014/0083.

xl https://www.cdc.gov/salmonella/pork-08-15/index.html

xli World Health Organization. 2016. Critically Important Antimicrobials for Human Medicine, 5th Revision.

xlii World Health Organization. 2016. Critically Important Antimicrobials for Human Medicine, 5th Revision.

xliii https://www.cdc.gov/salmonella/pet-treats-07-19/index.html

xliv World Health Organization. 2016. Critically Important Antimicrobials for Human Medicine, 5th Revision.

xlv https://www.cdc.gov/listeria/outbreaks/countryham-10-18/index.html

xlvi https://www.cdc.gov/listeria/outbreaks/deliproducts-04-19/index.html

xlvii FDA Guidance 209, https://www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM216936.pdf.

xlviii Guidance 209.

49 FDA Guidance 213. https://www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM299624.pdf.

xlix Pew Charitable Trusts. 2014. "Many drugs may still be available for food animals at growth-promotion levels," PEW Issue Brief (November 30), https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2014/11/gaps-in-fdas-antibiotics-policy.

l https://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm071807.htm

li https://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm071807.htm

lii https://www.cdc.gov/drugresistance/us-activities/national-action-plan.html

liii http://www.cidrap.umn.edu/news-perspective/2018/06/report-us-pigs-consume-nearly-many-antibiotics-people-do

liv FDA (2018) 2017 Annual Report, https://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM628538.pdf.

lv lincomycin, pirlimycin

lvi erythromycin, gamithromycin, tildipirosin, tilmicosin, tulathromycin, tylosin, tylvalosin

lvii tetracycline, chlortetracycline, oxytetracycline

lviii gentamicin, spectinomycin

lix Sulfadimethozine, sulfamethazine

lx Target food animal welfare & antibiotics policies,https://corporate.target.com/_media/TargetCorp/csr/pdf/TGT_Food-Animal-Welfare-and-Antibiotics-Policies.pdf.

lxi Costco gestation crate statement to suppliers,https://www.costco.com/wcsstore/CostcoUSBCCatalogAssetStore/feature-pages/19w0237-Merchandising-Animal-Welfare-Gestation.pdf.

lxii The Kroger family of companies animal welfare policy,https://www.thekrogerco.com/wp-content/uploads/2018/07/The-Kroger-Co_AnimalWelfarePolicy_2018-July.pdf

lxiii FDA (2018) 2017 Annual Report, https://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM628538.pdf.

lxiv FDA (2018) 2017 Annual Report, https://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM628538.pdf.

lxv The European Agency for the Evaluation of Medicinal Products Veterinary Medicines Evaluation Unit, (1999) Antibiotic resistance in the European Union associated with therapeutic use of veterinary medicines / Report and qualitative risk assessment by the Committee for Veterinary Medicinal Products, https://www.ema.europa.eu/documents/report/antibiotic-resistance-european-union-associated-therapeutic-use-veterinary-medicines-report_en-0.pdf

lxvi https://corporate.walmart.com/policies

lxvii https://corporate.walmart.com/policies

lxviii R. Bergevoet, M. van Asseldonk, N. Bondt, P. van Horne, R. Hoste, C. de Lauwere, & L. Puister-Jansen. 2019. Economics of antibiotic usage on Dutch farms, Wageningen Economic Research Policy Paper, Wageningen University, Den Haag, Netherlands.

lxix 2018. PLoS ONE 13(12). S. Dee, et al. A randomized controlled trial to evaluate performance of pigs raised in antibiotic-free or conventional production systems following challenge with porcine reproductive and respiratory syndrome virus

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90 Eglinton Avenue East, Suite 960
Toronto, ON M4P 2Y3

Phone: (416) 369 0044
Fax: (416) 369 0147
Email: info@worldanimalprotection.ca

World Animal Protection Canada
@MoveTheWorldCA
WorldAnimalProtectionCanada