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ISSUE BRIEF

BETTER BURGERS:

WHY IT'S HIGH TIME THE U.S. BEEF INDUSTRY KICKED ITS ANTIBIOTICS HABIT

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OVERVIEW

Antibiotic resistance poses one of the gravest threats to our health.[1] It undermines the efficacy of antibiotics, and therefore the ability to safely perform transplants, joint replacements, C-sections, dialysis, and other procedures requiring reliable drugs to treat the infections that often complicate them. Already, people in the United States experience at least 2.8 million infections caused by antibiotic-resistant bacteria each year, resulting in up to 162,044 deaths.[2]

As resistance worsens, serious infections caused by drug-resistant bacteria are becoming harder and sometimes impossible to treat with antibiotics.[3] Infections caused by these "nightmare" bacteria are on the rise. They include food-borne diseases like those caused by *Salmonella* as well as pneumonia, urinary tract infections, and blood poisoning.

The unnecessary use of medically important antibiotics, both in human medicine and in livestock production, is a critical driver of this crisis, according to leading health authorities such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO).[4] The U.S. beef industry, the world's largest, is a key contributor to antibiotic overuse. Our findings reveal:

- **42 percent of all medically important antibiotics sold for use in U.S. livestock operations are for cattle.** Antibiotic sales for meat and poultry production far outstrip sales for human use.[5]
- **Routine antibiotic use is the norm on U.S. feedlots, where they are added to the feed for entire herds of beef cattle, even when no animals are sick.** The WHO discourages any routine antibiotic use in livestock. It considers this practice unnecessary and hazardous precisely because it contributes to expanding antibiotic resistance.
- **U.S. cattle producers consume antibiotics three to six times more intensively** (on a per-animal-kilogram basis) than many of their European counterparts. And this disparity is likely to widen. By 2022 the European Union—the third-largest beef producer globally—will no longer allow medically important antibiotics to be fed to herds of cattle for disease prevention when no animals are sick.
- **The U.S. beef industry is dominated by giant feedlots in a handful of states, and their largest customers have failed to take meaningful action on antibiotic overuse in beef.** The four primary buyers of cattle from feedlots—Cargill, JBS, Tyson Foods, and National Beef—control more than 80 percent of U.S. beef meatpacking. None of these four companies have established policies or implemented practices that would end routine antibiotic misuse and overuse on the feedlots where the cattle they buy are produced.

As resistance worsens, serious infections caused by drug-resistant bacteria are becoming harder and sometimes impossible to treat with antibiotics.

- **There's little transparency or accountability in the beef industry regarding antibiotic use.** The industry does not directly report on-farm or on-feedlot use of antibiotics, despite repeated recommendations over 15 years from the Government Accountability Office that antibiotic use in livestock production should be tracked more closely.

The public remains mostly in the dark about how the powerful U.S. beef industry contributes to serious public health issues, including unsafe working conditions at meatpacking plants and the crisis in antibiotic resistance, and to climate change. The industry routinely gives antibiotics to entire feedlot herds whether or not cattle are ill, an unnecessary practice that also undermines the effectiveness of these drugs to treat human illness. Behind the practice is an industry trying to offset heightened disease risks created by the crowded, stress-inducing, and often unsanitary conditions typical on many of its feedlots. (Feeding antibiotics to herds with at least some sick cattle is defined as "disease control"; giving antibiotics to herds when no sick animals are present is termed "disease prevention," or prophylaxis.[6]) With any routine antibiotic use, the bacteria best able to withstand the drug will inevitably survive and multiply, spreading antibiotic resistance. These bacteria may share the genes that make them drug-resistant with other dangerous bacteria, even those that may not have been directly exposed to antibiotics.

A culture of secrecy permeates the beef as well as pork industries, hampering progress in reducing their overuse of antibiotics and the growing health threat that it fuels.[7] As noted, the beef industry itself does not report directly to the public on its antibiotic use. Any critical information that exists around antibiotic use on cattle farms or feedlots can be found only by attending talks at the industry's own meetings or buried in the minutiae of government documents. Important details often exist in isolation, absent any analysis to link the pieces together or give them context. When nongovernmental groups like NRDC have made their own calculations of antibiotic use in livestock, the industry has sometimes attacked this scrutiny as junk science "while simultaneously lobbying to block legislation requiring more disclosure of antibiotic use," as reported by the *New York Times*.[8]

Our latest analysis sheds much-needed light on antibiotic overuse in U.S. beef production. (See the Appendix accompanying this report for details on how we calculated all our figures, the underlying data, and their sources).

In recent years, strong consumer demand for meat and poultry raised without the routine use of antibiotics has helped bring about a rapid change in the U.S. chicken industry. Based on data from an industry-funded report, we estimate (with some caveats) that use of medically important antibiotics by the U.S. chicken industry dropped around 73 percent from 2013 to 2017.[9]

By demanding beef produced without routine medically important antibiotics, consumers can help transform the enormous U.S. beef industry as well. To move the U.S. beef marketplace away from routine antibiotic use, commitment from major buyers is critical.

McDonald's, the world's single-largest beef purchaser, released a new antibiotics policy at the end of 2018 that aligns with actions across the European Union to end the routine use of antibiotics in food animal production. It also aligns with the policy recommendations of the WHO.[10] McDonald's new policy has the stated intent of ending the routine use of medically important antibiotics for prevention purposes across its top 10 beef sourcing markets, which represent about 85 percent of the company's global beef supply chain.[11] This is an encouraging start, but there is a long way still to go. For example, McDonald's isn't expected to publicize reduction targets under this commitment until the end of 2020; presumably, McDonald's suppliers may require several additional years to meet those targets.

Apart from McDonald's, however, there have been few if any antibiotics policy changes of significance by other major beef buyers. This stands in stark contrast to the recent and impressive changes across the chicken industry.

Given the degree of consolidation in the U.S. beef industry, action by only a few additional companies to reshape the use of antibiotics in feedlots could spur long-overdue changes across beef supply chains. With combined annual revenue of more than $200 billion, Cargill, JBS, Tyson Foods, and National Beef have the power to catalyze those changes; collectively they buy and slaughter 17 of every 20 head of cattle processed into beef in the United States.[12] Large beef buyers have little choice but to purchase directly or indirectly from one or more of these meatpackers.

Change is desperately needed to help curb antibiotic overuse and the rapid spread of resistance to which this practice contributes. But change will come only if cattle producers, cattle processors, beef buyers, the U.S. Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA) all commit to reforming the system and begin to do their part.

THE U.S. BEEF INDUSTRY AT A GLANCE

The United States produced 26.9 billion pounds of beef in 2018, more than any other country in the world.[13]

Raising beef cattle in the United States is a very intensive industrial process. Cattle are born on small farms where they forage on range or pasture. Calves from these operations are typically sold after weaning, mixed with calves from other farms, and ultimately shipped long distances to crowded feedlots. On the feedlots, cattle are quickly fattened to market weight over a span of six to nine months, after which they are sold and shipped to slaughterhouses to be processed into beef products.[14] In 2018, 33 million head of cattle were slaughtered in the United States, of which 25 million were partially fattened or "finished" on feedlots (with the rest coming from dairies or elsewhere).[15]

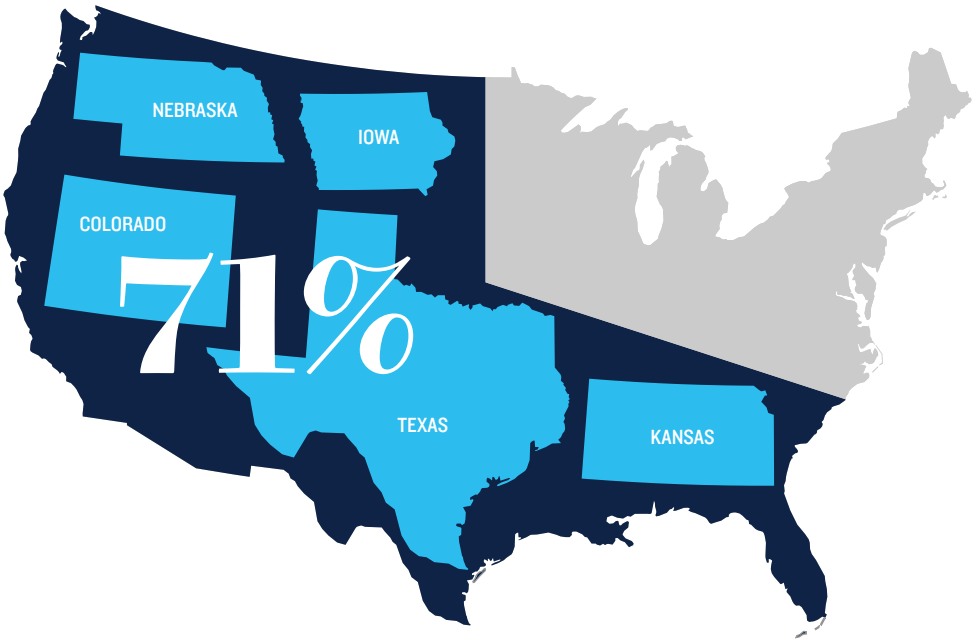
The U.S. beef industry has dramatically consolidated in recent decades, following in the footsteps of the pork and chicken industries. Nearly a third of all feedlot operators left the business between 1980 and 2010, and the remaining feedlots grew much larger.[16] Of more than 30,000 feedlots operating today, the 571 largest ones—those with more than 5,000 animals—produce three-quarters of all feedlot-finished cattle (almost 19 million animals). In 2017 these few mega feedlots sold an average of 32,000 head of cattle each, and the very largest of them have capacity for three times as many.[17]

More than 70 percent of feedlot cattle are concentrated in just five central states—Nebraska, Texas, Kansas, Iowa, and Colorado—near abundant, low-cost corn supplies.[18] The concentration of so many cattle and their manure in so few states increases air, soil, and water pollution; it also heightens the health risks for people living nearby and for the communities downwind and downstream of these feedlots.[19] Antibiotic use and the resulting increase in antibiotic resistance add to the already elevated risks.

The beef industry has consolidated in slaughtering and meatpacking as well as in feedlot cattle production. Meatpackers buy finished cattle off the feedlot and send the animals to slaughterhouses for processing. The number of slaughter plants dropped 81 percent between 1980 and 2010.[20] Just four companies, Cargill, Tyson, JBS, and National Beef, now control more than 80 percent of all U.S. beef meatpacking.[21]

Consolidation across the beef industry influences how well regulated it is, the health and safety of workers, and exactly who suffers or profits most from the industry's structure and practices. Consolidation also means that improved antibiotics policies by only a few companies can have an outsize impact on antibiotic use across the entire industry.

FIGURE 1: FIVE STATES CONTAIN MORE THAN 70 PERCENT OF FEEDLOT BEEF CATTLE



CURRENT FEEDLOT PRACTICES MAKE CATTLE SICK

Typical beef feedlot conditions include increasingly large herds, crowding, frequent movement of cattle, and diets high in grains and other concentrated sources of energy.[22] These conditions can lead to illness, primarily liver abscesses and so-called shipping fever.

Cattle are ruminants, with stomachs adapted to convert foraged grasses into energy. After weaning, when calves are shipped from many points to mega feedlots, they transition from grasses to a diet that is 70 to 90 percent grains and other high-energy ingredients, such as the dried by-products of corn that has been distilled into ethanol.[23]

When cows eat the typical grain-rich feedlot diet, the carbohydrate overload can lower the pH of the rumen (basically the cow's stomach) and change its bacterial population. A more acidic rumen can in turn lead to lesions in the stomach wall that allow bacteria to invade the bloodstream and lodge in the liver, forming abscesses.[24]

Cattle living with liver abscesses often eat less and gain less weight, and when discovered at slaughter the abscessed livers themselves cannot be sold. Both impact feedlot profits; a 2015 audit estimated the cattle industry's annual abscess-related losses at $30 million.[25] Tylosin is the antibiotic most commonly used on feedlots; in fact, USDA surveys indicate that at least half of feedlot cattle receive feed rations with added tylosin, whose sole FDA-approved indication is to "reduce the severity of liver abscesses in beef cattle."[26]

Reducing the severity of abscesses isn't the same as preventing their occurrence; only changing the grain-rich feedlot diet is likely to accomplish the latter. That helps to explain why, even despite the routine use of tylosin, up to one-third of North American feedlot cattle are still found to have liver abscesses at the time of slaughter.[27] Ultimately, feedlot owners ought to take measures to actually prevent these health problems in cattle in the first place, rather than mistakenly assume that feeding them antibiotics will serve that purpose.

The stress of moving calves to feedlots and mixing them with cattle from many different places increases the risk of developing shipping fever, or bovine respiratory disease (BRD).[28] Cattle imported from Mexico, Canada, and elsewhere—estimated at around two million head in 2019—lead to further mixing of animals in U.S. herds, increasing the risk of infections spreading among them.[29] BRD accounts for about half of all feedlot cattle deaths and 70–80 percent of illnesses.[30]

Feedlots' problems with BRD appear to be on the rise. Bovine veterinarian, John Maday, points to results from past USDA surveys indicating that the percentage of feedlot calves treated for BRD with antibiotics rose from 10 percent in 1994 to 16 percent in 2011.[31] One of the nation's largest operators presented its own data in 2014 showing a steady, 13-year increase in cattle deaths from BRD on its feedlots; meanwhile, the mortality rate among groups of cattle that feedlots themselves consider to be at high-risk for BRD is reported to have roughly doubled in the five years prior to 2015, from a long-term average of 1–2 percent to 3–4 percent.[32]

While better management of calves before they are shipped to the feedlot, called pre-conditioning, can help reduce instances of BRD, much of the increase in feedlot mortality is among cattle that have already been on the feedlot for more than 100 days. Climate change, bringing higher temperatures, drought, and dust to the Great Plains, is certainly playing a role—it adds to the other stressors experienced by feedlot cattle, further reducing their immunity and increasing the risk of illness or death.[33]

The U.S. beef industry therefore faces a conundrum. Antibiotic use on feedlots remains high, as operators continue to feed them routinely to herds, often when no cattle are sick. And yet these antibiotics appear to be failing as an approach to preventing disease: Cattle illnesses and deaths, including from liver abscesses and shipping fever, have increased. Some cattle veterinarians have begun writing about the need for U.S. feedlots to return to basics, with more focus on cattle health and the primary prevention of disease.[34]

For their part, Europe's policymakers have long been explicit in their resolve to promote a suite of livestock production practices to improve animal health in the first place and therefore avoid the need for and use of medically important antibiotics.[35] Europe trails only the United States and Brazil in the quantity of beef produced. Many European countries, however, use antibiotics in cattle at an intensity (measured on a milligram-per-animal-kilogram basis) that is only a fraction of what it is in the United States, as discussed later in greater detail.[36] (In fact, the European Parliament recently passed legislation that bans the routine use of antibiotics for disease prevention in food animal production by 2022.[37])

As an approach to preventing disease, routine feedlot use of antibiotics doesn't seem to work. Antibiotic use remains high, even as cattle illnesses and deaths have increased.

The suite of nonantibiotic best practices to keep animals healthier are uncomplicated. On U.S. feedlots, for example, they could include the following:

- Vaccinating cattle and utilizing other approved, nonantibiotic veterinary practices to prevent disease.[38]
- Increasing the amount of roughage in feedlot diets to reduce the risk and incidence of liver abscesses.[39]
- Buying only calves certified as pre-conditioned before entering the feedlot, and therefore known to be at lower risk of disease.
- Avoiding the purchase of calves from farms whose animals have a track record of experiencing more health problems in the feedlot setting.
- Making sure young cattle below a specified weight are not brought onto the feedlot. Younger, lower-weight animals are at much higher risk of BRD and other diseases.[40]
- Changing protocols to avoid mixing groups of cattle on the way to the feedlot.[41]

Within the U.S. cattle industry, voices calling for a change—away from routine antibiotics to a greater focus on better animal conditions and health—remain rare, and largely confined to the industry's trade publications or conferences. The rise in cattle disease and death on feedlots supports the conclusion that the conventional U.S. beef industry has been slow to adopt or invest in these nonantibiotic best practices—or at least that it has been doing so ineffectively.

BEEF FEEDLOTS OVERUSE ANTIBIOTICS

More medically important antibiotics are sold for U.S. cattle production than for any other livestock sector, according to the FDA. Some are given as injections to individual animals that are sick with a diagnosed disease, but most are given to herds via their feed or drinking water.[42]

Injectable antibiotics represent less than 1 percent of the medically important antibiotics sold in the United States for use in all food animals; conversely, medically important antibiotics that are delivered en masse to entire groups of animals in their feed or drinking water account for 92 percent of the total.[43]

The FDA does not report sales of injectables for cattle alone, but that proportion must necessarily be small.[44] On the other hand, as the *New York Times* reported in 2018, it is routine feedlot practice to add important antibiotics to the feed for entire cattle herds whether sick animals are present or not.[45]

In 2017 the WHO issued its official "Guidelines on Use of Medically Important Antimicrobials in Food-Producing Animals."[46] The guidelines specifically allow for the use of these drugs for disease treatment. But they recommend against using these antibiotics in livestock herds when there is no confirmed disease, saying that the drugs should never be used for growth promotion and should be administered only under very limited circumstances for disease prevention. These recommendations are based on two separate WHO-commissioned reviews of the scientific literature, summarizing hundreds of individual studies.[47] In each review, investigators found support for ending the routine use of medically important antibiotics on livestock farms for disease prevention. The body of science suggests that taking this particular step would decrease the presence of antibiotic-resistant in animals and on farms significantly, with likely benefits to public health as well.

It is worrisome that U.S. feedlots disregard these guidelines and consume medically important antibiotics in significant amounts and at a far higher intensity than do many European cattle producers. Perhaps the greatest fuel for public health concerns is how routinely these precious medicines are being given to entire cattle herds on feedlots that hold thousands of animals. That practice heightens the risk that antibiotic resistance will develop and spread because in general, the greater the number of individuals (animals or people) that receive antibiotics, the more bacteria that will be exposed to those drugs, and the more likely that drug-resistant strains of bacteria will emerge and spread.[48] There's also evidence that antibiotics ingested by mouth, relative to those given via injection, will expose more gut bacteria to those drugs, thereby increasing the odds that drug-resistant bacteria will develop and flourish.[49] In contrast, injected antibiotics circulate in the bloodstream before being metabolized and excreted, bypassing the gut where billions of bacteria are present.

More details follow about feedlot practices with respect to antibiotics and the public health concerns they create:

FEEDLOTS GIVE MEDICALLY IMPORTANT ANTIBIOTICS ROUTINELY TO ENTIRE HERDS

The United States lacks a system to collect comprehensive data from farms and feedlots on their actual use of antibiotics (e.g., quantities of each drug used, their dosages and formulations, and their intended purpose), so existing FDA sales data are the best available proxy.[50]

According to the FDA, 13.3 million pounds of medically important antibiotics were sold for use in animal agriculture in 2018, vastly outstripping sales of the same drugs for use in human medicine.[51] Cattle production accounted for 42 percent of such sales, roughly as much as were sold for pork and chicken production combined; after initially dropping from 2016 to 2017, sales of cattle antibiotics rose by more than 8 percent from 2017 to 2018.[52] The top two antibiotics used on cattle feedlots, tetracyclines and macrolides, account for about 74 percent of all antibiotics sold for use in the entirety of animal agriculture.[53]

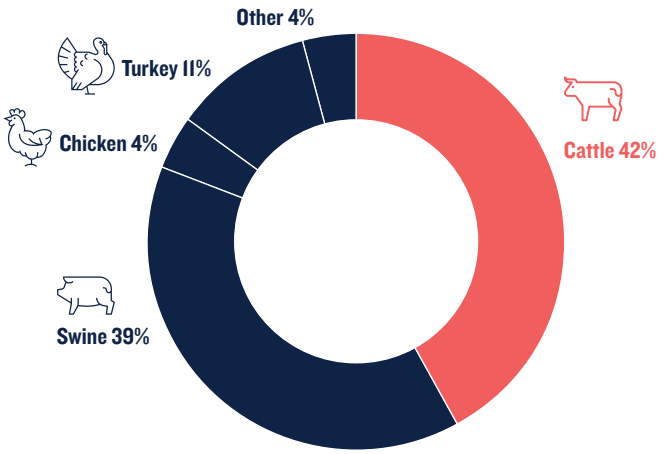
Periodically the USDA completes comprehensive surveys of operators about their feedlot practices, most recently in 1999 and 2011; USDA will begin conducting the next survey later in 2020, with results to be published at least two years later.[54] In addition to being infrequent, the USDA's surveys are voluntary and the questions can vary over time, and both of these factors can diminish their usefulness and credibility.[55] A smaller, 2017 survey published recently focused specifically on antibiotic use on feedlots, but it too was voluntary.[56]

Imperfect as they are, these surveys paint a picture of feedlot antibiotic use that is consistent with that described in the aforementioned *New York Times* article. That is, feedlots are adding medically important antibiotics routinely to cattle feed regardless of whether sick cattle are present.[57] At the time of the most recent survey, 77.8 percent of large feedlots and 53.8 percent of small feedlots indicated that they were using medically important antibiotics in feed.[58] More than half of feedlot cattle overall (and 61 percent of the cattle on large feedlots) were fed tylosin, a macrolide antibiotic, while 27 percent were given a tetracycline (chlortetracycline or oxytetracycline) in their feed, either alone or in combination with other drugs.[59] Feedlot operators indicated as part of the 2011 survey that macrolides and tetracycline antibiotics were added to cattle feed mainly for disease prevention rather than to treat sick cattle.[60] USDA's most recent survey, however, failed to report on the purpose behind a feedlot's employment of these drugs.

Both macrolides and tetracycline antibiotics are important to human medicine. Their overuse in cattle production has profound public health implications. In fact, macrolides such as tylosin are considered "critically important" to humans, according to the FDA and WHO. They are medicines of choice for treating certain pneumonias (including Legionnaire's disease), some strains of MRSA, and sexually transmitted diseases.[61] Macrolides also are used, especially in pregnant women and children, to treat serious *Campylobacter* infections, typically contracted from eating contaminated meat or poultry.[62]

The CDC considers tetracyclines to be among the most important antibiotics for treating potentially life-threatening infections due to gram-negative bacteria, which can cause urinary tract infections, meningitis, and sepsis.[63] Particular strains of gram-negative bacteria are responsible for an increasing number of deaths every year in U.S. hospitals and nursing homes because they are resistant to almost every available antibiotic. These strains cause infections that are dangerously close to being completely untreatable.

FIGURE 2: PERCENTAGE OF MEDICALLY IMPORTANT ANTIBIOTICS SOLD TO U.S. LIVESTOCK SECTOR, 2018



BEEF FEEDLOTS AND MEATPACKERS KEEP SILENT ON ROUTINE ANTIBIOTIC USE

We need specific information about how and why producers routinely add antibiotics to animal feed to more fully understand the contribution this practice makes to antibiotic resistance. Those crucial details remain elusive—a situation that the FDA, along with most major beef and cattle buyers, appears disinclined to change.

In at least 11 European countries, these data are already being collected online, efficiently and cost effectively.[64] This should be done in the United States as well, with information coming directly from farms, feedlots, and veterinarians. Since 2004 the Government Accountability Office (formerly the General Accounting Office) has repeatedly urged the USDA and FDA to work together to create a comprehensive U.S. system for collecting these data, which many experts believe to be critical to the success of any national effort to combat antibiotic resistance; to date, no such effort has been undertaken.[65]

Single-antibiotic feed additives are often FDA-approved for multiple uses. Complicating the situation is the fact that a single feed additive can contain multiple drugs, further obscuring the actual purpose behind any particular use of that additive. The inconsistency with which the USDA conducts and reports its feedlot surveys also hampers any effort to tease out the actual reason why a specific antibiotic is being added to cattle feed. NAHMS' 2017 surveys, for example, collected some information on the reason for use of specific antibiotics, but then failed to distinguish between use for treatment, control, or disease prevention. That's important because compared to antibiotics for treatment, antibiotics for prevention are typically given to groups of animals for longer durations and at lower doses.[66]

While the large French cattle industry slaughters as many animals each year as Texas and California, combined, the U.S. industry consumes antibiotics at a rate about 4 times higher than in France.

It is possible to build a fuller (albeit still incomplete) picture for why antibiotics are used in cattle feed by drawing on data from the 2017 survey, plus information from the Code of Federal Regulations (Title 21, Part 558), which lists the indications, or reasons for use, for all FDA-approved drugs and drug combinations used in cattle feed. Our colleagues at Food Animal Concerns Trust (FACT) used that information, plus additional insights described in this report's appendix, to create Figure 3, which we reproduce below by permission.

FACT's analysis gives a more comprehensive understanding than ever before of how and why feed antibiotics are routinely fed to cattle herds on feedlots.[67] Figure 3's take-home message is that the large majority of medically important antibiotics are fed to feedlot herds to "prevent" liver abscesses or to address the risks from respiratory disease. Both problems, however, could be effectively lessened or prevented altogether through improved diet and better cattle management practices—practices that could at the same time reduce the need for antibiotics. Figure 3 underscores the disturbing likelihood that many, if not most, of the medically important antibiotics being added to cattle feed are unnecessary and could be replaced with clear, nonantibiotic alternatives.

U.S. PRODUCERS USE ANTIBIOTICS MORE INTENSIVELY THAN MANY INTERNATIONAL COUNTERPARTS

It is difficult to draw conclusions about long-term trends in antibiotic use in U.S. cattle production, since the FDA has reported antibiotic sales by animal species only for 2016, 2017 and 2018.

Comparing the *intensity* of antibiotic use in the U.S. cattle industry with that of cattle producers in other countries tells a clearer story.[68] Using a metric first developed and employed by the European Medicines Agency in 2011, our analysis looks at milligrams of antibiotics sold for cattle use in the U.S. per kilogram of livestock. It reveals that the U.S. cattle industry continues to use medically important antibiotics three to six times more intensively than cattle industries in four of the top European livestock-producing countries where cattle-specific information is available.

Figure 4 summarizes our findings. (See the appendix for a more detailed explanation of the calculations.) While France, for example, slaughters as many cattle each year as Texas and California, combined, the U.S. cattle industry consumes antibiotics at a rate about 4 times higher than in France. Two recent reports examine the experiences of EU member countries implementing a range of policies and strategies to more prudently use antibiotics in livestock

FIGURE 3: ANTIBIOTICS IN CATTLE FEED (2016) AND REASONS FOR THEIR USE

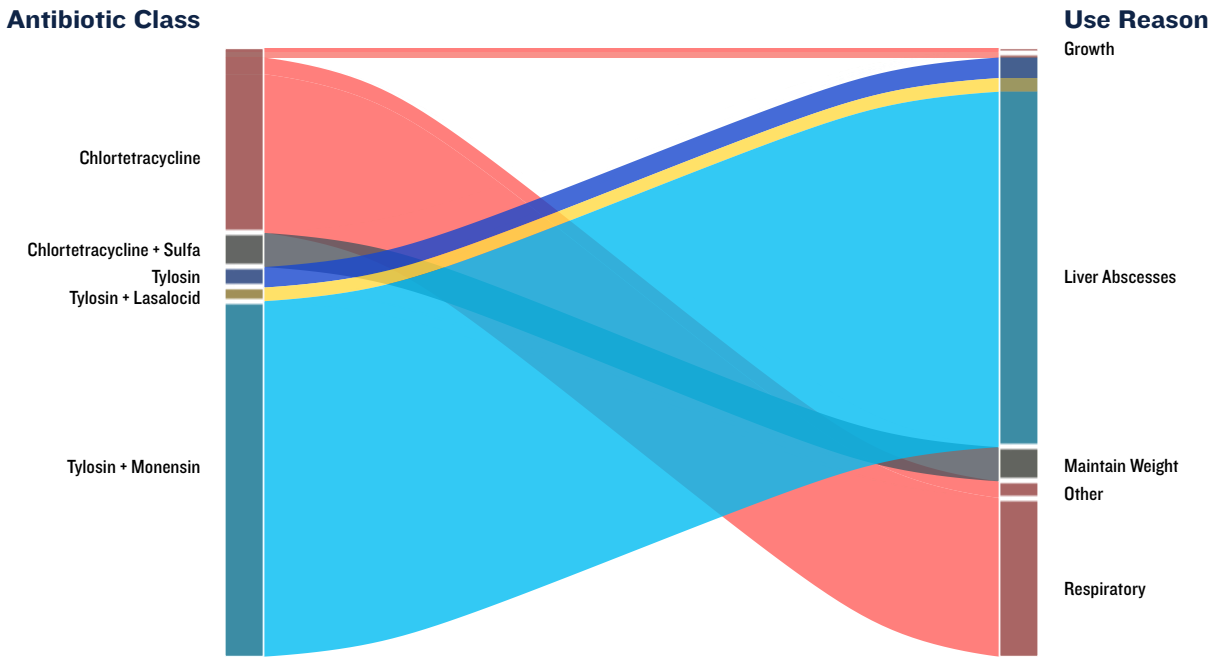
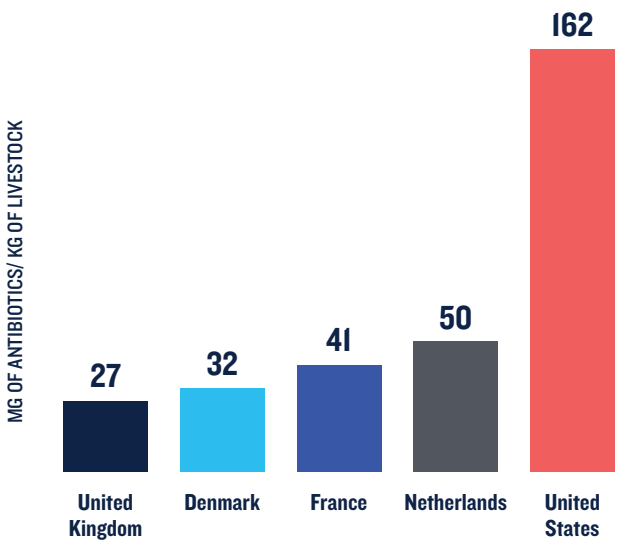


FIGURE 4: INTENSITY OF ANTIBIOTIC CONSUMPTION IN CATTLE PRODUCTION IN THE UNITED STATES (2018) VERSUS THE UNITED KINGDOM, DENMARK, FRANCE, AND THE NETHERLANDS (2017)



production, an approach described as "as little as possible, as much as necessary."[69] Their conclusion: Countries that choose to implement this package of policies at all levels can reduce their use of antibiotics in livestock production by more than 50 percent.[70] Case studies of several individual EU member countries further demonstrate that instituting these policies can successfully reduce antibiotic use without adversely affecting animal welfare, productivity, or profitability in the long term.[71]

ANTIBIOTIC-RESISTANT BACTERIA CAN SPREAD EASILY TO HUMANS

The routine use of medically important antibiotics on feedlots exacts a steep public health toll because the antibiotic-resistant bacteria that can develop and thrive in feedlots are not confined there. Feedlots become "reservoirs" from which drug-resistant bacteria can spread to humans in a variety of ways: People can be exposed to bacteria carrying antibiotic-resistance genes when they handle raw beef or eat undercooked meat that is contaminated with them; farmers and farmworkers are exposed when they handle cattle harboring these same drug-resistant bacteria; and people living downstream or downwind of feedlots can be impacted because both resistant bacteria and their genes can travel via contaminated air, water, and soil.[72]

RESISTANT BACTERIA ARE FOUND IN GROCERY STORE BEEF

Properly cooked meat should no longer harbor resistant bacteria. However, people can and do acquire resistance from beef that has been handled or cooked improperly. Government meat surveys conducted as part of the National Antimicrobial Resistance Monitoring System (NARMS) show that antibiotic-resistant bacteria are found routinely on supermarket beef products. In 2017, for example, NARMS reported that 20 percent of the *Salmonella* and about 22 percent of both *Enterococcus* and *E. coli* bacteria found on supermarket ground beef were tetracycline resistant.[73]

Among these three kinds of bacteria contaminating ground beef, however, only drug-resistant *Salmonella* are considered a conventional cause of food poisoning. An outbreak of 255 *Salmonella* Newport infections in 32 states from June 2018 to March 2019 left 2 people dead and 60 hospitalized, and the CDC has linked the infections to U.S.-purchased beef as well as cheese bought in Mexico.[74] The specific strain of bacteria causing the outbreak showed resistance to multiple antibiotics, including macrolides. Investigators isolated an identical strain of *Salmonella* from a Texas steer at slaughter in September 2018 and in two beef samples from Texas beef packing plants in November 2018 and March 2019.[75] CDC investigators concluded that the microbiological evidence "strongly suggests" the deadly outbreak strain is present in cattle herds in both countries. They posited that a 41 percent rise in sales of macrolides for use in U.S. cattle from 2016 to 2017 could have created conditions ripe for U.S. cattle to end up carrying this specific, sometimes lethal *Salmonella* strain.

Even though the CDC considers only *Salmonella* to be a conventional cause of food poisoning, drug-resistant strains of *Enterococcus* and *E. coli* found on supermarket beef are very real health threats. After eating contaminated meat, a person can unknowingly seed her gut with these bacteria and/or the genes that confer drug resistance. A healthy person can walk around unaffected by their presence. Later in life, however, when her immune system becomes compromised through age or illness, the same drug-resistant bacteria can cause grave illness in that person, due to her inability to mount an effective immune response. She can also spread these bacteria to others. In hospitals today, drug-resistant *E. coli* and *Enterococcus* are causing many deaths.

RESISTANT BACTERIA COLONIZE LIVESTOCK AND MEAT INDUSTRY WORKERS

While antibiotic overuse in livestock creates health risks for all of us, the people working in the meat industry face higher risks. Workers in frequent contact with food animals during slaughter or with the meat products derived from them, which the NARMS surveys revealed to be routinely contaminated with antibiotic-resistant bacteria, are

A 2015 study of feedlot air quality found drug-resistance genes were up to 4,000 percent more prevalent in air samples collected downwind of Texas feedlots than those collected upwind.

themselves at risk for becoming colonized and/or infected with these bacteria.[76] These workers also may unwittingly carry antibiotic-resistant bacteria home to their families. Drug-resistant infections are especially risky in children, since fewer antibiotics are safe for use in their age group.

RESISTANT BACTERIA CONTAMINATE AIR, WATER, AND SOIL

Each year, U.S. factory farms generate about 40 times more waste than all the human waste treated by the nation's municipal wastewater plants.[77] Antibiotics fed routinely to livestock are mostly excreted, unchanged, in manure, along with resistance genes and resistant bacteria. Manure runoff and blowing manure dust carry these dangerous by-products from animal feedlots into nearby soil, groundwater, lakes, and streams.[78] A 2015 study of feedlot air quality found drug-resistance genes were up to 4,000 percent more prevalent in air samples collected downwind of Texas feedlots than those collected upwind.[79]

This means that people living, playing, or swimming downstream or downwind of feedlots are exposed to heightened health risks.[80] Coming into contact with air, water, or soil contaminated with manure can directly cause a bacterial infection that makes a person sick with a hard-to-treat disease. More subtly, this contact can lead to drug-resistance genes independently being transferred to more benign bacteria already living within a person's body, making the latter bacteria potentially more dangerous—that is, capable of causing disease in the future.

The fact that cattle feedlots operate outdoors complicates efforts to limit the manure-related spread of antibiotic resistance. So does the feedlot industry's increasing interest in turning its abundant manure into an additional revenue stream by selling it as fertilizer.[81] We now know that spreading animal manure onto fields where crops are grown can and often does contaminate those crops with disease-causing bacteria. In fact, the practice has contributed to outbreaks of food poisoning, as the CDC has acknowledged.

Moreover, thanks to climate change, we are experiencing more-frequent flooding, which carries manure-related hazards downstream and into communities. For example, the historic flooding of the Missouri River and its tributaries in March 2019 hit several livestock producers.[82] And in August 2018, the record-breaking flooding in North Carolina due to Hurricane Florence inundated livestock and poultry operations.[83] The flooding of intensive livestock operations is increasingly likely given the rise in frequency of extreme weather events.

THE PATH FORWARD: COMMIT TO BEEF FROM CATTLE RAISED WITHOUT ROUTINE ANTIBIOTIC USE

Time is running out. Virtually everyone benefits from having a pool of antibiotics that dependably work, but that supply is disappearing, a victim of the global spread of drug resistance driven largely by rampant misuse and overuse.

There's strong consensus that broader, more urgent action is needed to reduce such use in both human and animal settings.[84] Better leadership is urgently needed as well. A future in which antibiotics remain effective cannot be ensured by focusing today solely on using them more wisely in human medicine, since only around 35 percent of all medically important antibiotics are sold for human use.

There is no good defense for cattle production that continues to use antibiotics routinely to compensate for the stress, respiratory disease, liver abscesses, and other health issues that are characteristic of industrial feedlots. These problems are not inherent in raising cattle per se but are created or exacerbated by the feedlot industry's own practices. Those practices can and must change. Both feedlot operators and their largest buyers, meatpackers such as Cargill, Tyson Foods, JBS, and National Beef, must act together to reduce the use of medically important antibiotics. The groceries and restaurant chains that buy beef from these companies to sell at retail also can play a pivotal role.

That said, private sector action alone is likely not sufficient to solve this problem. We must also demand leadership from policymakers at all levels: federal, state, and local. Despite consensus on the imperative to reduce antibiotic use overall, the U.S. National Action Plan for Combating Antibiotic-Resistant Bacteria (NAP) has been far less forceful in its recommendations for more responsible antibiotic use in livestock production than in its guidance for human medicine.[85] The NAP establishes national targets for reducing antibiotic overuse in both hospital and community medical settings, for example, but not in animal agriculture.

This isn't surprising. The FDA and USDA have never supported setting targets to reduce the use of antibiotics in food animal production. While in 2017 the FDA finally took action to end the feeding of medically important antibiotics to herds or groups of animals to promote faster growth, its policies allow continued use of many of these same feed additives, at equivalent dose levels, for disease prevention—whether or not any animals are sick.

As NRDC has often pointed out, this FDA loophole effectively undercuts other efforts within the NAP to combat antibiotic resistance.[86] By contrast, WHO guidelines recommend that member states, including the United States, not allow the routine use of medically important antibiotics on livestock farms, for either disease prevention or growth promotion.[87]

States and cities are just beginning to fill the leadership void left by the FDA and USDA. For example, Maryland and California passed laws in recent years to help end the routine use of medically important antibiotics, to begin collection of on-farm antibiotic use data, and to have these data shared with the public. And San Francisco has stepped up to require large grocery chains to report on the antibiotic footprint of the meat and poultry they sell.

MAJOR BEEF BUYERS NEED TO ACT ON ANTIBIOTICS

As one of the largest beef buyers globally, McDonald's has taken a significant step forward with its new antibiotics policy, although the impact in reducing antibiotic use across the company's supply chains won't be known for several years. BurgerFi and Shake Shack are two additional burger chains that only serve beef produced without routine antibiotic use. Several other restaurant chains are sourcing responsibly raised beef (Chipotle and Panera) or have pledged to soon do so (Subway).[88]

Mainstream grocery stores often sell beef products from cattle produced without routine antibiotic use, including from companies such as Niman Ranch, Applegate, Organic Valley, and Meyers Natural Foods, as well as beef products from animals that are 100 percent grass fed. Unfortunately, these are niche offerings, far smaller than the conventionally produced beef that dominates most grocery shelves.

Apart from these modest leadership examples, most major buyers have done little or nothing to reduce the overuse of medically important antibiotics in their beef supplies. For example, the most recent *Chain Reaction* scorecard gave failing grades to 17 of the nation's top 21 restaurant chains that buy and serve beef because those companies lacked meaningful policies to restrict routine use of medically important antibiotics in their beef supplies.[89] Wendy's, the third-largest such chain, barely avoided a failing score, earning a D+. Wendy's landed the report's "Biggest Wannabe" award for publicly painting itself as a leader on antibiotics when in fact the minimal steps it has taken do very little to address the problem in its beef supply.

We should expect more from the companies that sell us our beef. Specifically,

- Mainstream beef buyers should follow McDonald's lead and make a comprehensive, timebound commitment to only buy beef that is raised without the routine use of medically important antibiotics.
- Their progress in meeting these commitments should be tracked by independent, third-party auditors.
- Consumers deserve and should expect grocery stores and restaurants to be fully transparent about how intensively antibiotics have been used in their beef supply chains. Grocery chains in the United Kingdom, and certain U.S. chains such as Whole Foods, have shown that this is possible.

BEEF PRODUCERS AND PACKERS NEED TO ACT ON ANTIBIOTICS

In the U.S. beef industry, conventional feedlots must quickly and effectively transition to the suite of best cattle management practices described earlier, practices proven effective at reducing stress and promoting animal health, thereby reducing the need for medically important antibiotics in the first place. European authorities observe that when livestock industries implement this approach, reductions in antibiotic use of more than 50 percent can be expected, without negative long-term impacts on animal health, farm productivity, or profitability.[90]

Recently the Antibiotic Resistance Action Center at George Washington University's Milken School of Public Health announced an expansion of its Certified Responsible Antibiotic Use (CRAU) program to include a new standard written for feedlot beef production.[91] To sell beef under a CRAU label, a producer will be required to meet certain criteria consistent with responsible antibiotic use and have its practices verified by third-party auditors.

As of now, however, no large U.S. beef producer or packer has committed to a policy that ends the routine feeding of medically important antibiotics to cattle herds when animals are not sick. Because these companies wield enormous control over production practices at the feedlot level, such a commitment would reorient the course of the conventional U.S. beef industry when it comes to antibiotic use.

The good news is that many smaller U.S. producers already raise cattle under one of several third-party certifications requiring that antibiotics not be used routinely (or at all). These programs include (but are not limited to) Organic, American Grassfed, Certified Grassfed Beef, and Certified Humane. Raising beef cattle from birth to slaughter on well-managed range or pasture (i.e., "100 percent grass fed") can prevent many of the health problems common on feedlots. Grass-fed cattle, for example, avoid much of the stress related to feedlot crowding as well as the moving and mixing of animals. Their grass diet also avoids liver abscesses and other problems associated with raising ruminants on diets too low in roughage and too high in grains and ethanol distillation by-products.

We urge conventional beef producers in the United States to:

- Commit to responsible antibiotic use by ending the routine use of medically important antibiotics in animal feed for herds when no animals are sick, instead reserving these drugs only to treat disease in specific animals or to control a disease outbreak confirmed by a licensed veterinarian.
- Work with third-party certification programs like those described above to verify responsible antibiotic use practices.
- Support the creation of national antibiotic use reduction targets and a comprehensive national system for tracking antibiotic use at the farm level.

THE FDA AND USDA MUST DO MORE

Leadership at the broader, more national level is needed; actions by a few states or by the private sector alone are insufficient. The FDA and USDA, as well as policymakers in additional states, must stop caving in to industry pressure and do more to combat the health threat from increasing antibiotic resistance.

A panel of independent experts issued a road map in 2017 with 11 specific and achievable steps forward; some members of the European Union have successfully implemented all or nearly all of the steps.[92] Among them, the following are perhaps the most important for immediate implementation in the United States:

- Set concrete, time-limited national goals for reducing the use of medically important antibiotics in food animal production overall and by animal species, especially including the beef sector. These goals should be reflected in any updates to the previously mentioned National Action Plan.[93]
- Acknowledge the need to end all routine uses of medically important antibiotics—including for disease prevention—in food animal production generally, and specifically in beef production. As the lead U.S. regulator, this falls to the FDA, which must also announce a timeline-bound plan to make it happen. As previously noted, the FDA's current policy allows and endorses use for disease prevention, even as it prohibits the use of many of the same drugs at identical or nearly identical dosages for growth promotion.
- Prioritize the establishment of a comprehensive data collection system for tracking antibiotic use on farms and feedlots.

Effective action to prevent the unnecessary use of antibiotics will happen only if producers, packers, grocery stores, and the FDA all become leaders in reforming the beef production system.

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