EPIDEMIC OF INEQUALITY: THE ENVIRONMENTAL JUSTICE OF AGRICULTURAL ANTIBIOTICS AND ANTIMICROBIAL RESISTANCE

Jonathan E. Hostottle

CONTENTS

INTRODUCTION **1**

I. THE WHAT, WHY, HOW, AND WHO OF AMR **3**

A. ANTIMICROBIAL RESISTANCE – THE WHAT 3
B. A HISTORY OF ANTIBIOTICS IN ANIMAL AGRICULTURE – THE WHY 7
C. A HISTORY OF FEDERAL REGULATION OF ANTIBIOTICS IN ANIMAL AGRICULTURE – THE HOW 9
D. DISPARATE IMPACTS ON HEALTH OF TRADITIONALLY UNDERSERVED COMMUNITIES – THE WHO 15
i. Disparate prescribing practice and comorbidities *17*
ii. Occupational Hazards *19*
E. THE LACK OF DATA ILLUSTRATES THE PROBLEM 20

II. PROPOSED ACTION **21**

A. LEGAL SOLUTIONS 22
i. State and Local Action in the United States *22*
ii. Federal agency action *26*
iii. Medical monitoring requirements *28*
B. SOCIAL SOLUTIONS 29
i. Education for farmers *29*
ii. Rethinking our relationship with food *30*

CONCLUSION **32**

Introduction

The World Health Organization considers antimicrobial-resistant (AMR) infections one of the most significant health threats today.[1] AMR infections are a major cause of sickness and death worldwide.[2] By 2050, AMR's global annual death rate is estimated to grow from 1.2 million to as many as 10 million.[3] Although there is a dearth of scholarship on racial and economic disparities in infection rates and deaths in the United States,[4] available data suggest that these infections disproportionately impact people of color and those experiencing poverty.[5] AMR's disparate impacts demonstrate that this is not just a public health crisis, but an environmental justice concern as well.

The United States agricultural system is a major contributor to AMR through its rampant use of antibiotics in animal production.[6] Although industry and regulators have taken steps to address AMR's causes in recent years,[7] the changes have not gone far enough to ameliorate the

[1] Nathalie Prescott, *Antibiotics: It's What's for Dinner*, 28 GEO. ENV'T L.J. 307, 311 (2016).
[2] *See* David Wallinga et al., *U.S. Livestock Antibiotic Use Is Rising, Medical Use Falls*, NAT'L RES. DEF. COUNCIL (Nov. 18, 2021), https://perma.cc/8H3P-E7PT.
[3] GBD 2021 Antimicrobial Resistance Collaborators, *Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050*, 404 LANCET 1199, 1200, 1209 (2024) [hereinafter GBD 2021]. A major issue that permeates this paper is the dearth of reliable data on which to base the true human and economic costs of AMR infection. To effectively address the threat of AMR, we must solve our reporting and methodological issues so that we truly understand AMR's costs, its causes, and its disparate impacts. *See Strengthening Surveillance, in* COMBATING ANTIMICROBIAL RESISTANCE AND PROTECTING THE MIRACLE OF MODERN MEDICINE 117, 117 (Gillian J. Buckley & Guy H. Palmer eds., 2022); *see also* Chidozie D. Iwu et al., *The incidence of antibiotic resistance within and beyond the agricultural ecosystem: A concern for public health*, 9 MICROBIOLOGYOPEN 1, 17 (2020), https://perma.cc/QL96-TKR3.
[4] Margaret B. Planta, *The role of poverty in antimicrobial resistance*, 20 J. AM. BD. FAM. MED. 533, 537 (2007).
[5] Nicole Gualandi et al., *Racial Disparities in Invasive Methicillin-resistant Staphylococcus aureus Infections, 2005-2014*, 67 CLINICAL INFECTIOUS DISEASES 1175, 1180 (2018); Gillian Smith et al., *Impact of Social Determinants on Racial Differences in Carbapenem-Resistant Enterobacteriaceae Incidence, Atlanta, 2012-2018*, 7 OPEN FOR. INFECTIOUS DISEASES S718, S719 (2020); Isaac See et al., *Socioeconomic Factors Explain Racial Disparities in Invasive Community-Associated Methicillin-Resistant Staphylococcus aureus Disease Rates*, 64 CLINICAL INFECTIOUS DISEASES 597, 603 (2017); Jacinda C. Abdul-Mutakabbir & Brenda Simiyu, *Exploring the intersection of racism, antimicrobial resistance, and vaccine equity*, 2 ANTIMICROBIAL STEWARDSHIP HEALTHCARE EPIDEMIOLOGY 1, 1–3 (2022), https://perma.cc/5BLW-4B9W; Planta, *supra* note 4, at 537.
[6] Christy Manyi-Loh et al., *Antibiotic Use in Agriculture and Its Consequential Resistance in Environmental Sources: Potential Public Health Implications*, 23 MOLECULES 1, 17 (2018), https://perma.cc/W5WE-2T3U.
[7] Claas Kirchhelle, *Pharming animals: a global history of antibiotics in food production (1935–2017)*, 4 PALGRAVE COMMC'N 1, 9 (2018), https://perma.cc/AUQ9-7VDF.

roots of the problem: the continued overuse of antibiotics in human medicine and animal agriculture, as well as insufficient data collection systems.[8] Furthermore, those committed to addressing AMR have failed to even acknowledge the significant racial and socioeconomic disparities when crafting regulations on antibiotic use.[9] If we are to curb this issue, regulators and consumers in the United States must take account of these disparate impacts and use them to frame solutions to AMR as this threat continues to grow through the 21st century.

This article argues that AMR is a significant environmental justice concern, a framing historically ignored by those in power, and that should be addressed by policymakers, regulators, and researchers through an environmental justice lens. This article will examine the issue of AMR from historical and legal lenses, looking at the industry practices and regulatory failures that have contributed to the seriousness of the problem. Part I examines what AMR is, how it develops, and the history of antibiotic use in animal agriculture; discusses the history of agricultural antibiotic regulation in the United States; and explores the disparate impacts of AMR and dive into some of the factors scholars have suggested may contribute to this persistent but understudied problem. In Part II, this article proposes legal and social reforms to curb AMR and promote environmental justice. Although AMR is a significant global threat, this article will primarily explore AMR and the related environmental justice implications as they manifest in the United States.

[8] *See* STACY SNEERINGER ET AL., U.S. DEP'T OF AGRIC., ECON. INFO. BULL. NO. 264, THE U.S. AND EU ANIMAL PHARMACEUTICAL INDUSTRIES IN THE AGE OF ANTIBIOTIC RESISTANCE 19 (2019) [hereinafter AGE OF ANTIBIOTIC RESISTANCE].

[9] Maya L. Nadimpalli et al., *Antibiotic resistance: a call to action to prevent the next epidemic of inequality*, 27 NAT. MED. 187, 187 (2021).

I. The What, Why, How, and Who of AMR

A. Antimicrobial resistance—The What

Antimicrobial resistance occurs when bacteria evolve to the point at which they no longer respond to antibiotic treatment through the evolutionary selection of resistant strains.[10] Antimicrobial agents accelerate this process.[11] Certain bacteria in populations resist and survive the deadly effects of antimicrobial medication. These survivors proliferate, spreading the characteristics that made them resistant to the antibiotics to their genetic successors.[12] As a result, the efficacy of antibiotic treatments drops drastically among the newly resistant bacterial population. This occurs quickly and often, leading some researchers to aver that "[t]oday, antibiotics are regarded as 'endangered species' as they are experiencing fast extinction because of the global occurrence of [antimicrobial resistance]."[13]

In 2019, AMR infections were the attributable cause of 1.2 million deaths globally,[14] two percent of that year's total deaths worldwide.[15] The burden of AMR infection disproportionately impacts those who are elderly,[16] those who are low-income,[17] and those in sub-Saharan Africa and South Asia.[18] These disparate global impacts have many contributors, but one of particular significance is the lack of access to the newer and stronger antibiotics in low and middle income

---

[10] AGE OF ANTIBIOTIC RESISTANCE, *supra* note 8, at 5.
[11] Julian Davies & Dorothy Davies, *Origins and Evolution of Antibiotic Resistance*, 74 MICROBIOLOGY MOLECULAR BIOLOGY REV. 417, 418 (2010).
[12] AGE OF ANTIBIOTIC RESISTANCE, *supra* note 8, at 5.
[13] Iwu et al., *supra* note 3, at 2.
[14] GBD 2021, *supra* note 3, at 1209.
[15] *See Deaths per Year*, OUR WORLD IN DATA, https://perma.cc/LFK8-DMBT.
[16] GBD 2021, *supra* note 3, at 1216.
[17] *Id.* at 1207.
[18] *Id.* at 1200.

countries.[19] Although the global data for AMR shows some positive trends,[20] the global strategy to combat AMR is still insufficient to address its projected harm. Given its current trajectory, some researchers estimate that AMR infections could cause over 90 million deaths worldwide between 2025 and 2050.[21]

In the United States, AMR infections pose major health and economic threats. Nearly two million Americans develop infections due to AMR pathogens each year.[22] Between 35,000 and 162,000 adults[23] die each year from these infections.[24] The burden of AMR goes far beyond its death toll. These infections are costly for individuals who get sick and are hospitalized, the medical industry, and the economy writ large.[25] The exact economic impact of AMR is difficult to calculate, but the Centers for Disease Control and Prevention (the CDC) cited a 2009 study estimating that the annual direct costs of AMR infections are as much as $20 billion and result in

---

[19] Devin Hunt & Olivia S. Kates, *A Brief History of Antimicrobial Resistance*, 26 AMA J. ETHICS 408, 412 (2024). Antibiotics researcher, Claas Kirchhelle, refers to access to "quick fixes" like stronger antibiotics as the root of the global environmental justice problem: it is "risk mitigation . . . available at a price" that only those with resources may access. This quick fix contributes to the antimicrobial "arms race" and only serves to deepen the persistent environmental injustice of AMR as the globally wealthy escape consequences for their overuse of antibiotic medication, but those without resources find no such quarter. Claas Kirchhelle, *The Antibiocene – towards an eco-social analysis of humanity's antimicrobial footprint*, HUMAN. SOC. SCI. COMMC'N 1, 6 (2023), https://perma.cc/3HPD-VUZ7 [Hereinafter *Antibiocene*].

[20] This includes rapidly declining death rates for children under the age of five. GBD 2021, *supra* note 3, at 1199.

[21] *Id.* at 1199.

[22] Iwu et al., *supra* note 3, at 17.

[23] Wallinga et al., *supra* note 2. Here is yet another place where there is a great deal of equivocality in the available research. The reported numbers are subject to methodological problems that create these wide variations. It appears that the largest contributors to this lack of clarity are inconsistency in medical reporting and the sophisticated laboratory equipment needed to report AMR reliably. *See The Health and Economic Burden of Resistance*, *in* COMBATING ANTIMICROBIAL RESISTANCE AND PROTECTING THE MIRACLE OF MODERN MEDICINE 73, 87 (Gillian J. Buckley & Guy H. Palmer eds., 2022) [hereinafter *Health and Economic Burden*]; *see also* Ak Narayan Poudel et al., *The economic burden of antibiotic resistance: A systematic review and meta-analysis*, 18 PLOS ONE 1, 2–3 (2023), https://perma.cc/J69S-CP7E.

[24] Nadimpalli et al., *supra* note 9, at 187. Some scientists have advocated changing the ways in which we calculate deaths attributable to different causes because of insufficient national reporting rates. Once again, the lack of available data presents a barrier for understanding the true scope of the threat presented by AMR and its burden on our populations: especially our most vulnerable. Jason P. Burnham et al., *Re-estimating annual deaths due to multidrug-resistant organism infections*, 40 INFECTION CONTROL HOSP. EPIDEMIOLOGY 112, 112 (2018).

[25] Poudel et al., *supra* note 23, at 2–3.

$35 billion in lost economic productivity.[26] Further studies estimate that the costs of infection to individuals or insurers of certain strains of AMR bacteria ranged from $13,701 and $18,206 per infection, bringing the cost of AMR infection higher than the annual price of chronic diseases such as high blood pressure, asthma, and diabetes.[27]

Due to difficulties in reporting and the studies' susceptibility to methodological error, we don't know the exact human and economic costs of AMR.[28] Measuring this burden is no easy feat, and many of the discrepancies in the data are due to the inadequacy of our current data collection methods as well as AMR's wild variability by country.[29] Even in the United States and other high-income countries, the laboratory infrastructures needed to reliably measure the burden of AMR are difficult to coordinate.[30] To understand and combat this pressing threat effectively, scientists and researchers must conduct more research, especially among those who disproportionately bear the cost of AMR: under-resourced and underserved communities domestically and abroad.[31]

Although AMR has a complex network of causes, antibiotic use in both human and veterinary medicine contributes to the selective evolutionary pressures that lead to resistant pathogens.[32] The widespread use of antibiotics in animal agriculture has led researchers to declare that this source of AMR by itself constitutes a universal health crisis.[33] Sales of medically important antibiotics in the United States for use in animal agriculture are far greater than those

[26] CTR. FOR DISEASE CONTROL & PREVENTION, ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES 11 (2013). Adjusted for inflation from 2008 dollars, in February 2026, those direct costs amount to $30.96 billion, and the lost economic productivity is $54.19 billion. *CPI Inflation Calculator*, U.S. BUREAU OF LABOR STATISTICS, https://perma.cc/PZP2-ZJ5D.
[27] *Health and Economic Burden*, *supra* note 23, at 95–97.
[28] *Id.* at 102–05.
[29] *Id.* at 101–02.
[30] *Id.* at 103.
[31] *See id.*
[32] AGE OF ANTIBIOTIC RESISTANCE, *supra* note 8, at 5–6.
[33] Iwu et al., *supra* note 3, at 17.

for use in human medicine.[34] Antimicrobial agents, antibiotic resistant genes, and the antibiotic resistant bacteria themselves share a complex network of transmission from agricultural sources to humans.[35]

Manure from livestock farming is a major source of antibiotic resistance: from the manure, the AMR agents spread to irrigation water, crops, and the soil itself, thereby increasing the exposure risk of humans to these agents.[36] In fact, most of the antibiotics used in animal agriculture are not metabolized, but are instead discharged into the environment as waste.[37] However, the exact amount of antibiotic agents discharged into the environment from agricultural sources is unknown and understudied.[38] Introducing these antibiotic agents into the environment speeds up the natural evolutionary development of AMR of the bacteria, resulting in pools of AMR agents that eventually spread animal agriculture's AMR burden to human populations.[39] These pools create environmental hazards that create inequitable exposure vectors for already underserved communities.[40]

AMR poses significant domestic and international costs and challenges, but its causes are hard to pinpoint and its costs difficult to fully ascertain. However, antibiotic use in animal agriculture contributes significantly to the problem. The CDC estimates that 75% of dangerous new infections spill over from animal to human populations.[41] If there is to be any hope of curbing

[34] !A major contributor to many of the issues presented throughout this paper are the lack of available data to give us a clear picture of the scope of the problem. The FDA only began reporting annual sales of agricultural antibiotics in 2009. Ten years from when they began reporting, sales of agricultural antibiotics compared to those used in human medicine have varied wildly, ranging from 26% more to over three times the amount of antibiotics sold for use in human medicine. The FDA still does not report on the break down these data further to reflect for which animals these antibiotics are used. Wallinga et al., *supra* note 2.
[35] Iwu et al*., supra* note 3, at 9.
[36] *Id.* at 8–10.
[37] Manyi-Loh et al., *supra* note 6, at 10.
[38] Iwu et al*., supra* note 3, at 18.
[39] Manyi-Loh et al., *supra* note 6, at 10.
[40] *Antibiocene*, *supra* note 19, at 6.
[41] Wallinga et al., *supra* note 2.

the looming threat of AMR and its disproportionate burden, antibiotic use in animal agriculture must be revolutionized.

B. A History of Antibiotics in Animal Agriculture—The Why

Scientists discovered and isolated penicillin in 1929, ushering into the world what seemed an impossible biomedical future: one in which we could effectively fight bacterial infection.[42] Bayer synthesized the first effective human-made antimicrobials, sulphonamides, in 1935,[43] and began marketing them for antibiotic use in animal agriculture as early as 1938.[44] Their use spread rapidly. The Second World War galvanized antibiotics' importance in animal agriculture as the high demand for milk allowed for their efficacy to be battle-tested.[45]

In 1949, researchers discovered that administering antibiotics non-therapeutically could lead to additional weight gains for animals.[46] Catalyzed by the United States' postwar demand for meat, sales of antibiotics for nontherapeutic agricultural use skyrocketed after the announcement of the research findings.[47] All uses of antibiotics in agriculture spread throughout the world as the 20th century dragged on.[48] Concerns about overpopulation and communism led American policymakers and researchers to consider the yield-increasing magic of technologies like antibiotics as a way of defending Western industrial values.[49] The use of antibiotics in the United States grew immensely in the second half of the 20th century. From 1951 to 1970, the country

[42] Hunt & Kates, *supra* note 19, at 409.
[43] Davies & Davies, *supra* note 11, at 417; Kirchhelle, *supra* note 7, at 2.
[44] Kirchhelle, *supra* note 7, at 3.
[45] Furthermore, wartime constraints on Europe's pharmaceutical companies opened the market up for the dominance of U.S. drug manufacturers like Merck, Pfizer, and American Cyanamid. *Id.*
[46] *Id.*
[47] *Id.*
[48] *Id. at* 3–4.
[49] This was a significant part of the messaging when Nikita Khruschev visited US farms in 1959. US commentators stressed that the superior productivity of farms in the country largely relied on post-war technologies like antibiotics. *Id.* at 4–5.

experienced an 11-fold increase in the use of medically important antibiotics and a 30-fold increase of non-medicinal antibiotics.[50] The growth of disease-promoting dense animal agricultural practices, such as concentrated animal feeding operations (CAFOs), in the United States drove a significant part of this expansion. By 1970, calves raised in dense feedlots represented as much as two-thirds of the national calf crop.[51] American demand for meat soared, increasing the need for dense farming practice. Agricultural antibiotics usage in the United States continued to skyrocket along with this need, almost doubling from 1970 to 1978.[52]

Researchers became aware of AMR as early as 1940 when they noticed resistance to antibiotic treatment in certain bacteria cultures.[53] British scientists began warning about the dangers of antibiotic overuse in animal agriculture in the 1950s. These scientists lambasted the unfettered use of antibiotics without veterinary supervision that was common in the United States.[54] Some American commentators joined the British scientists warning about the problem of antibiotic resistance around the same time.[55] As these alarm bells rang louder and the discursive divide deepened in the 1960s and 1970s, actions toward combating AMR remained infrequent and ineffective.[56] Agricultural antibiotic use continued to spread relatively unbounded.[57]

Antibiotic use in American animal agriculture continued to rise until 2015, after which there was a decline in use followed by a subsequent increase.[58] It is unclear whether these trends

[50] *Id.* at 4.
[51] *Id.* at 6.
[52] *Id.* at 5.
[53] Hunt & Kates, *supra* note 19, at 410.
[54] CLAAS KIRCHHELLE, PYRRHIC PROGRESS: THE HISTORY OF ANTIBIOTICS IN ANGLO-AMERICAN FOOD PRODUCTION 107 (2020) [hereinafter PYRRHIC PROGRESS].
[55] Wisconsin, in response, even adopted a labeling requirement for veterinary antibiotics. *Id.* at 44.
[56] *Id.* at 149–50.
[57] Kirchhelle, *supra* note 7, at 8–9.
[58] David Wallinga et al., *A Review of the Effectiveness of Current US Policies on Antimicrobial Use in Meat and Poultry Production*, 9 CURRENT ENV'T HEALTH REP. 339, 342 (2022) [hereinafter *A Review of the Effectiveness*].

are due to voluntary limitations on antibiotic use in the poultry industry[59] or were pushed by Food and Drug Administration (FDA) policies.[60] Simultaneously, as death rates from cancer and heart disease rose to replace deaths from infectious disease, pharmaceutical companies lost their economic incentive to go through the resource-intensive process of developing new and stronger antibiotics that target specific resistant bacteria.[61] Due to its entrenchment in our agricultural practices and economy, the persistent use of antibiotics in animal agriculture continues to exacerbate the threat of AMR.[62]

C. A History of Federal Regulation of Antibiotics in Animal Agriculture—The How

Historically, attempts in the United States to regulate agricultural antibiotic use have been viewed as a failure.[63] The FDA, responding to concerns about antibiotic residue in milk, introduced a national residue monitoring program in 1960, with one for meat following six years later.[64] In 1972, an FDA task force report was released, finding that continuous and subtherapeutic use of antimicrobial drugs in animal agriculture contributed to AMR.[65] The report also suggested that the FDA needed to begin categorizing between antibiotics important for human health and medicine and those that are not.[66] As a result, in 1977, the FDA began to take steps to move away from the residue-focused regulations to those focused on addressing AMR. Donald Kennedy, the FDA Commissioner and former microbiologist, moved to limit the nontherapeutic agricultural use of

[59] *Id.* at 343.
[60] Kirchhelle, *supra* note 7, at 9.
[61] Hunt & Kates, *supra* note 19, at 412.
[62] David Wallinga et al., *Antibiotic Use Remains Far Too Intensive in U.S. Livestock*, NAT. RES. DEF. COUNCIL, (Sep. 11, 2023), https://perma.cc/W7CY-G5Q5.
[63] Kirchhelle, *supra* note 7, at 9.
[64] Kirchhelle, *supra* note 7, at 5. Although direct exposure is undoubtedly a problem, researchers contend that these residue-focused efforts were primarily the result of widespread public ignorance of the other risks, including AMR, associated with rampant antibiotics use. PYRRHIC PROGRESS, *supra* note 54, at 17.
[65] FDA TASK FORCE ON THE USE OF ANTIBIOTICS IN ANIMAL FEEDS, REPORT TO THE COMMISSIONER OF THE FOOD AND DRUG ADMINISTRATION 9 (1972).
[66] *Id.*

antibiotics.[67] However, the industry successfully parried these efforts by funding numerous counter-studies to dispute the report's findings and sow public doubt.[68] The beginning of the anti-regulatory Reagan administration served as the death knell for Commissioner Kennedy's efforts.[69] The public discourse about AMR and the FDA's regulations remained quiet until the late 1980s when public concerns about residue surfaced again.[70]

The current FDA agricultural antibiotic regulatory scheme is structured on the findings of the 1972 report.[71] The current regulatory scheme categorizes antibiotic drugs as "medically important antibiotics" (MIA) and "currently not medically important antibiotics" (NMIA).[72] In 2003, the agency began issuing guidance for industry (GFI) documents pertaining to antibiotic use in animal agriculture.[73] These guidance documents have shown increasing levels of alarm and attempts by the FDA to curb antibiotic use in animal agriculture: GFI 152 issued in 2003 provided a list of MIA ranked in order of importance to human health and medicine; GFI 209 issued in 2012 urged for "judicious use" standards for farmers in the hopes that MIA would not be used for growth promotion and NMIA would only be used in accordance with their labeling requirements; GFI 213 issued in 2013 provided guidance for manufacturers in accordance with GFI 209; and GFI 263,

---

[67] PYRRHIC PROGRESS, *supra* note 54, at 151–52.
[68] *Id.* at 153.
[69] This attack was exceptionally successful and gained much bipartisan support: "Shared concerns about stagnating economic growth and inflation (stagflation) also made more liberal publications like *Harper's* and *Time* join neoconservative attacks on environmentalist 'histrionics.'" *Id.*
[70] *Id.* at 156.
[71] GOV. ACCOUNTABILITY OFF., STATEMENT OF GREGORY J. AHART, DIRECTOR, HUMAN RESOURCES DIVISION, BEFORE THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS HOUSE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE ON FOOD AND DRUG ADMINISTRATION'S REGULATION OF ANTIBIOTICS USED IN ANIMAL FEEDS 3–4 (1977).
[72] AGE OF ANTIBIOTIC RESISTANCE, *supra* note 8, at 5.
[73] Krista D. Gens et al., *Antimicrobials in Animal Agriculture in the United States: A Multidisciplinary Overview of Regulation and Utilization to Foster Collaboration: On Behalf Of the Society of Infectious Diseases Pharmacists*, 9 OPEN F. INFECTIOUS DISEASES 1, 4 (2022), https://perma.cc/YZ8J-KGC2.

issued in 2021, admonished manufacturers to update their recommended conditions for prescription of MIA.[74]

These guidance documents are exactly that: just guidance. The Code of Federal Regulations explicitly states that the GFIs are not legally binding on the public or the FDA.[75] The FDA has publicly defended its approach, calling their push for industry voluntarism "the quickest, most efficient way to reach our collective goal—considerably faster than a mandatory ban."[76] However, the voluntary use approach ignores the fact that industry actors may continue to profit and shift the burden to communities who are disproportionately at risk of bearing the costs of AMR infection.[77] The industry response to the GFI documents has been mixed. On one hand, the "judicious use" guidance from the FDA has coincided with a reduction in antibiotic use in American agriculture,[78] specifically in poultry farming.[79] However, the FDA has no legal enforcement mechanism to urge compliance with the GFI document recommendations, leaving pharmaceutical manufacturers and agribusiness producers free to continue antibiotic overuse.[80]

The GFI documents were not the only actions taken by the FDA. In 2017, the FDA fully implemented their Veterinary Feed Directive (VFD) from a final rule issued in 2015.[81] This rule creates responsibilities for veterinarians, distributors, and clients using antibiotics in animal feed.[82] This regulation requires a VFD from a licensed veterinarian for the distribution of animal feed

[74] *Id.* at 5.
[75] 21 C.F.R. §10.115(d)(1); U.S. FOOD & DRUG ADMIN., *Guidance for Industry*, (Apr. 14, 2023), https://perma.cc/YLN3-FPBX. Along the way, the Obama Administration issued Executive Order 13,676 in 2014 that, among other things, sought to improve antibiotic stewardship with the help of agencies like the FDA, USDA, and EPA. Exec. Order 13676, 79 Fed. Reg. 56931 (Sep. 18, 2014).
[76] PYRRHIC PROGRESS, *supra* note 54, at 211.
[77] *See Antibiocene*, *supra* note 19, at 6.
[78] *Id.*
[79] *A Review of the Effectiveness*, *supra* note 58, at 339.
[80] *See* PYRRHIC PROGRESS, *supra* note 54, at 211.
[81] 21 C.F.R. § 558 (2015).
[82] 21 C.F.R. § 558.6 (2015).

with MIA, creating legal responsibilities for some of the guidance in GFI 209.[83] Importantly, the VFD regulation contains an attempt to close the information gap present in agricultural antimicrobial use, requiring "[a]ll involved parties (the veterinarian, the distributor, and the client) [to] retain a copy of the VFD for 2 years"[84] and maintaining that these parties "must make the VFD and any other records specified in this section available for inspection and copying by FDA upon request."[85] However, in the early years of this regulation, the FDA has rarely exercised its authority to request documents. They only did so once between 2017 and 2018.[86]

Beyond the FDA, the Executive Branch has shown persistent interest in combating AMR. In 2014, the White House released a report, "National Strategy for Combating Antibiotic Resistant Bacteria" (CARB Strategy).[87] The CARB Strategy set out five goals[88] and created national targets to reach by 2020.[89] The document called for the creation of "an interagency task force co-chaired by the Secretaries of Health and Human Services, Agriculture, and Defense [which] will develop a National Action Plan for Combating Antibiotic-Resistant Bacteria."[90] This task force, the

[83] *See id.*
[84] 21 C.F.R. § 558.6(a)(4) (2015).
[85] 21 C.F.R. § 558.6(a)(5) (2015).
[86] *A Review of the Effectiveness*, *supra* note 58, at 342.
[87] *See generally* THE WHITE HOUSE, NATIONAL STRATEGY FOR COMBATING ANTIBIOTIC RESISTANT BACTERIA (2014), https://perma.cc/H5N4-PLUF.
[88] "(1) Slow the Emergence of Resistant Bacteria and Prevent the Spread of Resistant Infections"; "(2) Strengthen National One-Health Surveillance Efforts to Combat Resistance"; "(3) Advance Development and Use of Rapid and Innovative Diagnostic Tests for Identification and Characterization of Resistant Bacteria"; "(4) Accelerate Basic and Applied Research and Development for New Antibiotics, Other Therapeutics, and Vaccines"; and "(5) Improve International Collaboration and Capacities for Antibiotic Resistance Prevention, Surveillance, Control, and Antibiotic Research and Development." *Id.* at 1–2.
[89] "For CDC Recognized Urgent Threats: • Reduce by 50% the incidence of overall *Clostridium difficile* infection compared to estimates from 2011. • Reduce by 60% carbapenem-resistant Enterobacteriaceae infections acquired during hospitalization compared to estimates from 2011. • Maintain the prevalence of ceftriaxone-resistant *Neisseria gonorrhoeae* below 2% compared to estimates from 2013. For CDC Recognized Serious Threats: • Reduce by 35% multidrug-resistant Pseudomonas spp. infections acquired during hospitalization compared to estimates from 2011. • Reduce by at least 50% overall methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infections by 2020 as compared to 2011[.] • Reduce by 25% multidrug-resistant non-typhoidal *Salmonella* infections compared to estimates from 2010—2012. • Reduce by 15% the number of multidrug-resistant TB infections. • Reduce by at least 25% the rate of antibiotic-resistant invasive pneumococcal disease among 5 year olds and 65 year-olds compared to estimates from 2008." *Id.* at 33.
[90] *Id.* at 24.

Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB), was officially created by President Barack Obama's Executive Order 13676.[91] The National Action Plan was released in 2015 and was originally set to expire in 2020.[92] President Donald Trump re-established PACCARB after its expiration in 2020,[93] and the task force is now authorized to operate until August 29, 2026.[94] As a result, in 2020, the task force released a new National Action Plan serving the years 2020–2025.[95]

Some data point to the efficacy of executive measures to combat AMR. From 2013 to 2019, the CDC reported an 18% drop in deaths from AMR, citing strategies that worked in healthcare and the "community" at large.[96] Even though death rates declined, annual infection rates in the United States increased from 2.6 million to 2.8 million during the same period.[97]

The future of AMR in the United States in 2026 appears grim. The FDA recently approved the first new antibiotic for UTI treatment since 1996,[98] potentially contributing to the arms race between antibiotics and AMR bacteria.[99] The first Trump administration seemed to take the threat of AMR seriously by acknowledging the threat of AMR and reestablishing PACCARB.[100]

---

[91] *See* Exec. Order 13676, 79 Fed. Reg. 56,931 (Sep. 18, 2014).
[92] FEDERAL TASK FORCE ON COMBATING ANTIBIOTIC-RESISTANT BACTERIA, NATIONAL ACTION PLAN FOR COMBATING ANTIBIOTIC-RESISTANT BACTERIA 2 (2015), https://perma.cc/7Y7M-TT93.
[93] ADMINISTRATION OF DONALD J. TRUMP, *Message on Antibiotic Awareness Week, 2020* (Nov. 18, 2020). https://perma.cc/DAG8-XAWA.
[94] 89 Fed. Reg. 80574 (Oct. 3, 2024).
[95] FEDERAL TASK FORCE ON COMBATING ANTIBIOTIC-RESISTANT BACTERIA, NATIONAL ACTION PLAN FOR COMBATING ANTIBIOTIC-RESISTANT BACTERIA 2020-2025 (2020), https://perma.cc/2AWX-TTNX.
[96] The CDC's antibiotic use strategies identified revolve around their prevalence in human medicine and not in animal agriculture. Other successes include food hygiene, widespread vaccine use, and safer sex practices. CTR. FOR DISEASE CONTROL & PREVENTION, ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES ix (2019), https://perma.cc/B4UA-F9W7 [hereinafter CDC 2019 REPORT].
[97] These increases in infections included sharp rises in infections from certain bacteria, including a 315% increase in Erythromycin-resistant invasive group A strep, a 124% increase in Drug-resistant Neisseria gonorrhoeae, and a 50% increase in ESBL-producing Enterobacteriaceae. *Id.* at x, 3.
[98] *Blujepa (gepotidacin) approved by US FDA for treatment of uncomplicated urinary tract infections (uUTIs) in female adults and paediatric patients 12 years of age and older*, GSK (Mar. 25, 2025), https://perma.cc/V6UJ-C7SH.
[99] However, some scholars cite the need for new antibiotics as one of the many solutions to AMR. *See* Abdus Salam et al., *Antimicrobial Resistance: A Growing Serious Threat for Global Public Health*, 11 HEALTHCARE 1946, 1958 (July 5, 2023).
[100] *Message on Antibiotic Awareness Week, 2020, supra* note 93.

However, some commentators asserted that the budget cuts from the administration's first term put people in the United States at a heightened risk of AMR infections, potentially signaling that this is not a priority for the administration.[101] Furthermore, the Second Trump Administration canceled PACCARB's meeting scheduled for January 2025 in which the committee was to make their recommendations for 2025–2030.[102]

After pressure from the medical community, the federal government announced that PACCARB would reconvene in June 2026.[103] During the meeting, the Committee planned to "provide input and information to the federal, Inter-Agency Combating Antibiotic-Resistant Bacteria Task Force (Task Force) as they develop the next five-year iteration of the CARB National Action Plan 2026–2031."[104] The Committee will convene again on September 9th and 10th to discuss "how microbiome science can support AMR prevention, drive novel interventions, and build public awareness and understanding of microbiome-focused health promotion measures."[105]

Despite PACCARB's revival, the Second Trump Administration has demonstrated hostility to conversations about structural racism in educational institutions.[106] Given this hostility, it seems unlikely that an environmental justice-framed solution to AMR will prevail during this presidency. Such a framework necessarily involves examining the systemic inadequacies that contribute to this racially disproportionate problem.

[101] Boucher et al., *Proposed U.S. funding cuts threaten progress on antimicrobial resistance*, 167:10 ANNALS INTERNAL MED. 738, 738–39 (2017).
[102] *ASM and IDSA Lead Letter Urging PACCARB to Meet*, AM. SOC'Y FOR MICOBIOLOGY (Jan. 29, 2026), https://perma.cc/4FQH-9N8Q.
[103] AMR Solutions, *PACCARB returns! 16 June 2026 virtual meeting* (May 30, 2026), https://perma.cc/6LCC-8DEK.
[104] 91 Fed. Reg. 29146 (May 19, 2026).
[105] 91 Fed. Reg. 43375 (July 15, 2026).
[106] *See* Dana Goldstein, *How the Trump Administration Might Target D.E.I. in Public Schools*, N.Y. TIMES, Apr. 3, 2025.

Although there has been nominal improvement to the threat of AMR, federal regulators' primarily voluntaristic approach constitutes a failure to sufficiently combat AMR. Notably, none of the regulatory efforts in the United States have ever taken the disparate racial and economic impacts of AMR into account,[107] exacerbating the persistent environmental injustices of AMR.

D. Disparate Impacts on Health of Traditionally Underserved Communities – The Who

"Far from being a global leveller, the biological and social effects of AMR have been felt unevenly."[108] AMR exposure and risk mirror other environmental justice issues: the globally powerful have profited from the rampant and unexamined use of antibiotics and have, thus far, been wealthy enough to buy "quick fixes" such that they do not feel the impacts of AMR as strongly as underserved communities.[109] As discussed above, available data betray the disparate impact that AMR has along economic lines.[110] These effects may be due to lack of access to sufficient healthcare and disproportionate terrestrial, aquatic, and airborne exposure to AMR residues and bacteria.[111] We must approach remediation with "acknowledgement of the significant differences with which [AMR's] fallouts have been distributed."[112] In doing so, we may be able to effectively address the globally-urgent AMR problem without leaving vulnerable communities behind.

Although the disparate racial impacts of AMR are understudied,[113] data point to disproportionate deaths among Black and Hispanic populations in the United States from AMR.[114] Emerging studies show that the disparate racial impact of AMR infections is far from tenuous.

[107] *See* Abdul-Mutakabbir & Simiyu, *supra* note 5, at 2.
[108] *Antibiocene*, *supra* note 19, at 6.
[109] *Id.*
[110] *Health and Economic Burden*, *supra* note 23, at 102–05.
[111] *Antibiocene*, *supra* note 19, at 6.
[112] *Id.*
[113] Planta, *supra* note 4, at 537.
[114] Nadimpalli et al., *supra* note 9, at 187.

However, due to methodological limitations, more research is needed to fully understand the scope of the problem.[115] Nicole Gualandi et al. assert that their 2018 survey study "represents the first description of trends for racial disparities in healthcare-associated infections using data from an entire population area."[116] Their study found that there are persistent racial differences in the rates of Methicillin-resistant Staphylococcus aureus infections (MRSA) between Black and white populations despite rates of MRSA declining overall.[117] Given that we have known about the potential seriousness of AMR for decades, it is alarming that we have only recently begun to examine the racial disparities in AMR exposure and infection.

These nascent studies along with the racially imbalanced impact of the COVID-19 pandemic have led researchers to call for more inquiry into the disparate impacts of AMR infections.[118] The exact reasons why these differentiated outcomes persist are unclear, but researchers have identified three main reasons to explain these inequities: (1) Black and Hispanic patients receive fewer antibiotic prescriptions but are more likely to consume unprescribed antibiotics than white patients;[119] (2) Black and Hispanic populations have more frequent underlying medical comorbidities;[120] and (3) workers in food processing are typically the first affected by animal production-related illness,[121] and about 60% of US meat processing plant

---

[115] Smith et al., *supra* note 5, at S719; *see also* See et al., *supra* note 5, at 603.
[116] Gualandi et al., *supra* note 5, at 1178.
[117] *Id.* at 1180.
[118] Nadimpalli et al., *supra* note 9, at 187.
[119] *Id.*
[120] *Id.* Nadimpalli et al. also assert that Black and Hispanic families are more likely to live in dense, multigenerational family housing, and that puts them at higher risk of AMR infections. *Id.* While the first part of their assertion is certainly true (Black and Hispanic families are 1.75 times as likely as their white counterparts to live in dense, multigenerational housing in the United States), they did not provide support for their second assertion. Although this issue is understudied, in COVID-19 studies, it appeared that those living in dense housing were at no greater risk of infection and hospitalization than those in middle class or wealthy neighborhoods. *See* RAKESH KOCHHAR AND D'VERA COHN, PEW SOC. TRENDS, FIGHTING POVERTY IN A TOUGH ECONOMY, AMERICANS MOVE IN WITH THEIR RELATIVES 28 (2011), https://perma.cc/Z3FQ-X4GR; *see also* Ingrid Gould Ellen et al., *Demons of Density: Do Higher-Density Environments Put People at Greater Risk of Contagious Disease?*, 59 J. HOUS. ECON. 1, 8 (2023).
[121] Courtney G. Lee, *Racist Animal Agriculture*, 25 CUNY L. REV. 200, 227 (2022).

workers are Black or Hispanic.[122] Several of these issues are exacerbated by our structurally racist healthcare system through segregated care, lack of access, and healthcare policy.[123]

The solutions to AMR infection require addressing the complex network of systemic causes of the disparate racial impacts.[124] AMR will not be solved by agricultural policy alone. However, despite the emerging research on this topic, no federal AMR risk reduction plan, including those pertaining to animal agriculture, has taken into account the racial disparities in AMR outcomes.[125] To effectively curb the threat of AMR, regulators must consider the disparate impacts on these populations and meet these challenges where they arise. These challenges are explored below.

i. Disparate prescribing practice and comorbidities

"We must acknowledge that inequities in social determinants of health, as well as provider implicit and explicit biases, heavily influence antimicrobial prescribing patterns and the propagation of AMR."[126] There are large racial disparities in antimicrobial prescription fills, with white persons reporting as many as double the antimicrobial drug prescriptions filled as those who are nonwhite.[127] Some studies suggest that the prescribing practices of individual clinicians are influenced by racial bias.[128]

---

[122] Angela Stuesse and Nathan T. Dollar, *Who are America's meat and poultry workers?*, ECON. POL'Y INST.: WORKING ECON. BLOG (Sep. 24, 2020), https://perma.cc/SP39-5JD6.
[123] *See* Ruqaiijah Yearby et al., *Structural Racism In Historical And Modern US Health Care Policy*, 41 HEALTH AFF. 187, 189–91 (2022).
[124] Nadimpalli et al., *supra* note 9, at 188.
[125] *Id.* at 187; Abdul-Mutakabbir & Simiyu, *supra* note 5, at 2.
[126] Abdul-Mutakabbir & Simiyu, *supra* note 5, at 3.
[127] Scott W. Olesen & Yonatan H. Grad, *Racial/Ethnic Disparities in Antimicrobial Drug Use, United States, 2014–2015*, 24 EMERGING INFECTIOUS DISEASES 2126, 2127 (2018).
[128] Eili Klein et al., *Racial and Socioeconomic Disparities Evident in Inappropriate Antibiotic Prescribing in the Emergency Department*, 84 ANNALS OF EMERGENCY MED. 101, 107 (2024).

Unequal prescribing practices stem partially from ouroboric treatment cycles: patients of color often perceive interactions with clinicians more negatively, leading them to change how they may otherwise describe their symptoms.[129] As a result, minoritized patients receive lower quality treatment for infection than their white counterparts.[130] Antibiotic undertreatment accords with research done in other areas of medicine.[131] Under-utilization of antibiotics increases the risk of repeated infection which necessitates more treatment with stronger antibiotics and promotes further AMR.[132] These disparate practices, although not a primary driver of AMR, put Black and Hispanic individuals at a higher risk of AMR infection.

The disparate medical treatment of Black and Hispanic patients, although not the only cause of disproportionate levels of comorbidities, contributes to a negative health feedback loop. After a study examining racial differences in multi-morbidities across large groups of data, Pankush Kalgotra et al. opined that racial "disparities [in comorbidity rate] are not ONLY due to the sickness differences among races, it is also about diagnoses and treatment of specific groups of people."[133] The COVID-19 pandemic illuminated the significant threat of AMR as a co-infection in hospital settings and helped elucidate, in limited ways, the disparate risks of AMR for patients with comorbidities.[134] Antibiotic treatments too early and too late increase a patient's risk of exposure to AMR. One study found that several patients admitted into intensive care for COVID-19 were given antimicrobial drugs prior to their infection screens coming back, and this

[129] *Id.* at 108.
[130] *Id.*
[131] *Id.* For example, Black patients are much less likely to receive adequate treatment for pain than are white patients. *See* Kelly M. Hoffman, *Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites*, 113 PNAS, 4296, 4296 (2016).
[132] Habtamu Endale et al., *Potential Causes of Spread of Antimicrobial Resistance and Preventive Measures in One Health Perspective-A Review*, 16 INFECTION DRUG RESISTANCE 7515, 7519 (2023).
[133] Pankush Kalgotra et al., *Examining multimorbidity differences across racial groups: a network analysis of electronic medical records*, 10 SCI. REP. 1, 7 (2020).
[134] *See* Basit Zeshan et al., *The Usage of Antibiotics by COVID-19 Patients with Comorbidities: The Risk of Increased Antimicrobial Resistance*, 11 ANTIBIOTICS 1, 1–2 (2022).

early treatment contributed their risk of AMR infection on top of a serious COVID-19 infection.[135] Intensive care units have historically been a hotbed for the spread of AMR, and in them, minoritized patients are significantly less likely to receive timely treatment for their infections and other emergency medical issues.[136] Treatment differences are not the only drivers of this inequity: lack of access to quality healthcare facilities is a major contributor to the disproportionality of AMR as well.[137] The entrenchment of these societal inequities in medical access and treatment exacerbates the threats of AMR and distributes its burdens unequally.

ii. Occupational Hazards

AMR infections also present an occupational hazard for farm and food processing workers.[138] Farm and food production workers are exposed directly to AMR bacteria through their work with animals and animal products.[139] Many health departments don't regulate or consider health conditions for workers in CAFOs.[140] Meatpacking workers are particularly susceptible to the spread of infectious disease, as evidenced by the plants in which they work becoming "hot spots" for COVID-19 infection.[141] Black and Hispanic workers are disproportionately represented in CAFOs and food processing plants,[142] making these populations more susceptible to the frontline risk of infection and the subsequent transmission of AMR bacteria.[143]

---

135 *Id.* at 8–10.
136 Abdul-Mutakabbir & Simiyu, *supra* note 5, at 1–2; Importantly, both over and under-use of antibiotics constitute misuse, and contribute to the problem of AMR. *See generally* CTR. FOR DISEASE CONTROL AND PREVENTION, *Antibiotic Use and Antimicrobial Resistance Facts* (Apr. 22, 2024), https://perma.cc/5AKE-K5WW.
137 Abdul-Mutakabbir & Simiyu, *supra* note 5, at 2.
138 This is just one of many environmental hazards that food workers are subjected to. They also have heightened rates of asthma and other respiratory diseases from exposure to methane and other noxious inhalants while working. Courtney G. Lee, *Racist Animal Agriculture*, 25 CUNY LAW REV. 200, 218–19 (2022).
139 *Id.* at 219.
140 Wendee Nicole, *CAFOs and Environmental Justice: The Case of North Carolina*, 121 ENV'T HEALTH PERSP. A182, A187 (2013).
141 Megan Molteni, *Why Meatpacking Plants Have Become Covid-19 Hot Spots*, WIRED (May 7, 2020), https://perma.cc/7MFV-GYBG.
142 Courtney G. Lee, *Racist Animal Agriculture*, 25 CUNY LAW REV. 200, 215 (2022).
143 Manyi-Loh et al., *supra* note 6, at 21.

Working conditions that increase the risk of negative health outcomes are so bad in some circumstances that they have led researchers to assert "[t]he agencies responsible for regulating CAFOs—their mission is not to protect human health."[144] These exposures put the families and communities of the agribusiness workers at a disproportionately high risk of AMR infection.[145] These risks do not cease when workers' exposure to the bacteria in their work environment ceases, and some research points to the possibility that farm workers may carry these resistant bacteria for as long as 14 days since they were last exposed.[146] However, despite workers' disproportionate exposure, the research in this area is thin and the exact impact needs further study. Moreover, agribusiness workers are less likely to be able to use legal and political processes to protect their interests,[147] and thus can become stuck working in unsafe and dangerous conditions in which they are more likely to be exposed to risks like AMR infection.[148]

E. The Lack of Data Illustrates the Problem

Even though some studies are beginning to explore the socioeconomic causes of disparate impacts of AMR, the data is inadequate.[149] This problem remains understudied partially because "[m]edical treatment studies remain dominated by white males."[150] Fully understanding the drivers

[144] Nicole, *supra* note 139, at A187.
[145] Manyi-Loh et al., *supra* note 6, at 12.
[146] Maya Nadimpalli et al., *Persistence of livestock-associated antibiotic resistant Staphylococcus aureus among industrial hog operation workers in North Carolina over 14 days*, 72 OCCUPATIONAL ENV'T MED. 90, 97 (2015).
[147] The problem of "agricultural exceptionalism" describes the ways in which agricultural workers have been historically excluded from federal and state protections for other types of workers. These exclusions have been motivated by race and show the multifactorial nature of environmental justice issues like AMR. The political and legal powerlessness of farmworkers may exclude them from decision-making processes that seek to ameliorate the AMR problem that disproportionately burdens them. *See* Alexis Guild & Iris Figueroa, *The Neighbors Who Feed Us: Farmworkers and Government Policy—Challenges and Solutions*, 13 HARV. L. POL. REV. 157, 159–60 (2019).
[148] Nicole, *supra* note 139, at A187.
[149] *See generally* See et al., *supra* note 5; Gualandi et al., *supra* note 5, at 1175; "Despite widespread public perception that the federal government and the private sector collect vast amounts of data, the availability of racial and ethnic data in the health care system itself is quite limited . . . With only a few exceptions, private insurers and health plans do not maintain data on the race or ethnicity of their enrollees." NATIONAL RESEARCH COUNCIL PANEL ON DHHS COLLECTION OF RACE AND ETHNIC DATA, ELIMINATING HEALTH DISPARITIES: MEASUREMENT AND DATA NEEDS 206 (Michele Ver Ploeg & Edward Perrin, eds. 2004).
[150] Kalgotra et al., *supra* note 132, at 7.

of the disparate impact of AMR will be a first step to meaningful change.[151] To address AMR effectively, we need to examine the disparate racial and socioeconomic outcomes of the problem and take them into account as we act. As we learn more about the causes of these inequities, we will gain the knowledge to create effective solutions which don't distribute the burdens of AMR and the benefits of continued agricultural antibiotic use unequally.

Before even reaching the data collection point, we must first acknowledge the existence of disparate impacts in AMR infection rates. Only then may we begin to design effective research to help us understand the racial disparities of AMR.[152] This will likely include better data gathering in both the medical and agricultural fields. For example, the FDA's surveillance program for antibiotic use, although expanding, has historically under-collected data to the point where it is not terribly helpful.[153] The lack of available data permeates and exacerbates the problem of AMR so severely that data collection should be one of the first major goals for addressing the threat posed. If we do so with care as we examine the future of antibiotic use in animal agriculture, we may prevent the next "epidemic of inequality."[154]

II. Proposed Action

AMR is an incredibly complex issue that will likely only be solved by global industrial and regulatory cooperation.[155] This paper will only focus on potential legal and social solutions the United States may employ to combat AMR.

---

[151] Abdul-Mutakabbir & Simiyu, *supra* note 5, at 3.
[152] *See id.*
[153] *See A Review of the Effectiveness*, *supra* note 58, at 342.
[154] Nadimpalli et al., *supra* note 9, at 188.
[155] Sagar N. Khadse et al., *Impact of Antimicrobial Stewardship on Reducing Antimicrobial Resistance*, CUREUS, Dec. 2024, at 1, 6; *see* Gens et al., *supra* note 73, at 4–6; Kirchhelle, *supra* note 7, at 10.

A. Legal Solutions

i. State and Local Action in the United States

California and Maryland have recently attempted to address agricultural antibiotics use through localized regulatory schemes.[156] In 2015, California codified in a statute some of the principles laid out in the FDA's GFI *A Review of the Effectiveness* 152 and 209.[157] The law was set to go into effect in 2018 and required that a MIA drug may not be given to livestock without a veterinary prescription.[158] Furthermore, the statute placed restrictions on the circumstances in which prescription of MIA drugs is allowed.[159] The statute requires that MIA be prescribed only when necessary to treat disease or infection, to control the spread of disease or infection, and for surgical operations.[160] However, a crucial loophole remains that may allow for the potential overuse of MIA in animal agriculture: use is allowed when, "in the professional judgment of a licensed veterinarian, it is needed for prophylaxis to address an elevated risk of contraction of a particular disease or infection."[161] Importantly, the California regulations ban use of MIA for growth promotion or for consistent and regular use as a practice.[162] However, MIA usage in dense farming practices may be relatively unchanged by this scheme because a veterinarian could easily deem prophylactic MIA as a necessity in a CAFO because of their density and disease-promotion. The statute also includes a significant surveillance scheme that accords with the 2015 National

---

[156] *A Review of the Effectiveness*, *supra* note 58, at 343-44.
[157] Cal. Food & Agric. Code § 14400–14408 (2015).
[158] *Id.* at § 14401.
[159] *Id.* at § 14402.
[160] *Id.*
[161] *Id.*
[162] Cal. Food & Agric. Code § 14402 (2015).

Action Plan for Combating Antibiotic Resistant Bacteria[163] and a penalty for use and reporting violations.[164]

This law represented an important step forward in addressing AMR and gave meaningful and legally-binding requirements to agribusiness in California, a major agricultural producer.[165] However, the law was not quite as effective as the legislature had hoped. The surveillance and data collection lagged behind the 2018 implementation goal.[166] Additionally, California's Department of Food and Agriculture (CDFA) initially suggested that producers may still be able to use MIA in a regular pattern. This led some commentators to believe that many producers will continue to use the drugs in violation of the statute.[167] Notably, California's law also fails to account for the inequitable burdens of AMR stemming from agricultural antimicrobial use. The law is similarly silent regarding the occupational hazards posed by continued overuse in agriculture, including that which is labeled "judicious."[168]

In 2017, Maryland passed a law, the Keep Antibiotics Effective Act of 2017, which also banned the regular use of MIA (as defined in GFI 152) starting in 2018.[169] This law is similar to California's, but it has some stringencies that give it greater efficacy. First, the law exempts small farm operations from its requirements, tailoring the law to large agricultural actors.[170] The

[163] *Id.* § 14405.
[164] !However, the efficacy of this penalty may be limited. The statute allows for a $250 each day penalty for violations of the requirements for first-time offenders, and $500 each day penalty for second-time offenders. In addition, multiple offenses require that the violators go to a" judicious use" educational program. *Id.* at § 14408.
[165] *A Review of the Effectiveness*, *supra* note 58, at 344.
[166] *Id.*
[167] *Id.*
[168] *See* Cal. Food & Agric. Code § 14400–14408 (2015).
[169] Md. Code Ann., Agric. § 3-1003 (2017).
[170] One interesting element of the threshold requirement to note is just how large a poultry farm must be to trigger the statutory requirements. The statute reads, "[e]xcept as otherwise provided in federal law or regulation, this subtitle does not apply to antimicrobial use in: (1) Cattle on a farm operation that sells fewer than 200 cattle per year; (2) Dairy cattle on a farm operation with a herd size of fewer than 300 dairy cattle; (3) Swine on a farm operation that sells fewer than 200 swine per year; or (4) Poultry on a farm operation that sells fewer than 60,000 birds per year." *Id.* at § 3-1002.

Maryland law also has a reporting standard. Each year, licensed veterinarians must submit data to the Maryland Department of Agriculture, including:

> (1) A copy of the record prescribing the medically important antimicrobial drug or a copy of the veterinary feed directive for each medically important antimicrobial drug . . . administered in feed or water to cattle, swine, or poultry during the previous calendar year; and (2) An accounting, as provided by the owner, of the total number of animals raised during the previous calendar year…[171]

The Maryland law provides a great model for other states with its stringent reporting requirements. Other states have introduced bills for regulating antibiotic use in animal agriculture that mirror those passed in California and Maryland.[172]

Although state laws have begun to address some of the major failures of U.S. federal agricultural antibiotic regulation, there is some equivocality surrounding their efficacy in reducing the usage of agricultural antibiotics. Scarlet Bliss et al. released a study in 2023 suggesting that these laws lacked teeth for four main reasons:

> 1) vague language on antimicrobial use within policies reduces policy effectiveness; 2) the lack of reporting by producers challenges the ability to evaluate the impact of the policies on actual use; 3) diverse stakeholders need to be

[171] *Id.* at § 3-1004.
[172] Bills have been introduced in New York, Oregon, and Illinois. *A Review of the Effectiveness*, *supra* note 58, at 346.

involved in order to develop a more effective policy; and 4) funding should be linked to the policy to provide for reporting and data analysis.[173]

State and local regulatory policy may be an effective way to curb antibiotic use in the absence of meaningful federal action, and current laws in Maryland and California may serve as models for other states. However, these laws still have room for improvement. First, they fail to consider the disparate racial impacts of AMR. As a result, they still omit disproportionately affected communities from the AMR decision-making process.

Legislators could curb the risks of AMR by implementing overuse penalties or a tax on antibiotic manufacturing that fund medical monitoring or treatment of AMR infections.[174] Such a law could very easily mirror the liability structure in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).[175] CERCLA imposes a tax on petrochemical industries which creates a fund for cleaning up hazardous waste sites.[176] Here, lawmakers could impose a tax on antibiotics manufacturers, agribusiness above a certain size which uses antimicrobial drugs in their feed, or both to create a fund. This fund could then be put to use for research into AMR, its disparate impacts, and effective treatment. CERCLA's owes its success to shifting the payment of risky activity to those responsible, and this "antimicrobial CERCLA" could

[173] Scarlet S. Bliss et al., *Weaning U.S. food-animals off antimicrobials: What can we learn from state- and city-level policies?*, 18 PLOS ONE 1, 1 (2023). Importantly, Bliss et al., don't refer to those affected disproportionately by AMR as "diverse stakeholders" in their suggestions, but instead define these actors as "e.g., veterinarians, producers, and the nonprofit sector." *See id.* at 13. This definition, although broad in some positive ways, continues to ignore those who bear the greatest burdens of AMR.
[174] This would require some creative lawmaking, but it would not be completely far-fetched. Perhaps state law could impose a CERCLA-like strict liability on manufacturers or users of MIA in animal agriculture. *See* 42 U.S.C.A. § 9607. Additionally, creating provisions for the statutory penalties to go to fight the problem of AMR would be one step in achieving this procedural justice. Although it is not the norm, these funds could be allocated in ways that advance the environmental justice concerns of AMR; *see also infra* iii. Medical monitoring requirements (describing medical monitoring and how it may be implemented through statutes, regulations, or perhaps even tort law).
[175] 42 U.S.C. 9601 et seq.
[176] RICHARD J. LAZARUS, THE MAKING OF ENVIRONMENTAL LAW 125–26 (2023).

do the same.[177] If lawmakers were to pass such a law, we may begin to ameliorate both the distributive and procedural injustices of AMR.

ii. Federal agency action

Federal regulation of antibiotics use in animal agriculture has been largely unsuccessful.[178] Even though state legislative action may be mobilized to address the threat of AMR, Bliss et al. mention in their study that there is consensus among experts that "federal policy is the most important path forward."[179] In fact, they view state action "mainly as a means to urge stricter antimicrobial use regulation at the federal level."[180] Other researchers agree with the need for a much stronger federal leadership in the fight against AMR.[181] To provide effective guidance, the federal government should, at the very least, adopt regulations and monitoring requirements like those in place in Maryland and California.

The FDA could also look to standards adopted in European countries for reducing antibiotic use in animal agriculture.[182] In Denmark, the regulatory scheme includes well-implemented data collection programs and targets users who exceed the thresholds mandated by these regulations.[183] The Netherlands provides a stricter regulatory approach in which use of growth-promoting antibiotics is simply banned.[184] However, some experts suggest that this outright proscription may be slightly less effective at functionally reducing antibiotic use rates than the comprehensive regulatory framework adopted by Denmark.[185] Although these regulatory

[177] "The single most transformative environmental law of the 1980s was [CERCLA]." *Id.* at 125.
[178] Prescott, *supra* note 1, at 333; Kirchhelle, *supra* note 7, at 9–10.
[179] Bliss et al., *supra* note 172, at 16.
[180] *Id.*
[181] *A Review of the Effectiveness*, *supra* note 58, at 350.
[182] *Id.*; *see generally* AGE OF ANTIBIOTIC RESISTANCE, *supra* note 8.
[183] *A Review of the Effectiveness*, *supra* note 58, at 348–49.
[184] *Id.* at 349.
[185] *Id.*

measures have proven effective at curbing the issue overall, international efforts for curbing AMR still have not effectively addressed the disparate burden that AMR poses on historically underserved populations,[186] and regulators adopting them would likely be insufficient alone for ameliorating the environmental justice concerns of AMR in the United States.

Many effective solutions for combating AMR center around data collection and monitoring of antibiotic usage on factory farms. The closest that the United States has to a reporting requirement is the National Antimicrobial Resistance Monitoring System (NARMS).[187] NARMS is an interagency effort to collect data about the causes of AMR, and the system collects data from CDC, FDA, and the United States Department of Agriculture.[188] NARMS has been active for over two decades, and has undergone significant improvement since its conception.[189] Its efficacy in collecting on-farm antibiotic use data is still critically limited and must be improved if federal agencies hope to effectively combat AMR.[190] While NARMS collects data about the bacteria themselves, their focus is not centered around the question of who gets infected.[191] Data collection and regulatory frameworks must include an acknowledgement of AMR's disparate impacts if they are to effectively promote environmental justice. AMR, as the CDC 2019 report says, is a risk that we all face,[192] but it disproportionately impacts specific groups. Federal regulators must take these inequities into account as they continue to develop an effective schema for combating AMR.

---

[186] *See Antibiocene*, *supra* note 19, at 8.
[187] *About the National Antimicrobial Resistance Monitoring System (NARMS)*, CTR. FOR DISEASE CONTROL & PREVENTION (Sep. 6, 2024), https://perma.cc/V9ER-HF5N [hereinafter *About NARMS*].
[188] *Id.*
[189] Beth E. Karp et al., *National Antimicrobial Resistance Monitoring System: Two Decades of Advancing Public Health Through Integrated Surveillance of Antimicrobial Resistance*, 14 FOODBORNE PATHOGENS & DISEASE 545, 554 (2017).
[190] *See id.* at 552.
[191] *See About NARMS*, *supra* note 187.
[192] *See* CDC 2019 REPORT, *supra* note 96, at 8.

iii. Medical monitoring requirements

The major gaps in research about the exact costs of continued agricultural overuse of antibiotics and the disparate impacts of AMR may necessitate creative solutions from legislatures and regulators. One avenue that could prove fruitful in closing the data gaps is medical monitoring. Medical monitoring grew out of tort law as a common law solution to "compensate plaintiffs who have been exposed to various toxic substances" about which there may be limited medical data.[193] Beginning in 1984, medical monitoring developed as a tort law cause of action and remedy, and was shortly thereafter applied toxic substance exposure claims.[194] Medical monitoring is intended to help plaintiffs pay for diagnostic tests after the defendant has exposed them to a substance known to increase their health risk.[195] These claims have been used somewhat successfully in PFAS class actions, including in litigation against DuPont's Washington Works plant in Parkersburg, West Virginia.[196] There, DuPont settled with the class members to provide, among other things, $235 million toward medical monitoring funding an independent panel to study the connection between PFOA and negative effects on human health.[197] As a result, the 70,000 West Virginians in the class forewent a direct settlement payout in order to fund this gap-closing research.[198] Seven years later, the study's scientists began to deem conclusively that there were probable links between exposure to PFOA and the negative health effects in the community.[199]

---

[193] *In re: Paoli R.R. Yard PCB Litigation*, 916 F.2d 829, 849 (3rd Cir. 1990).
[194] Arvin Maskin et al., *Medical Monitoring: A Viable Remedy for Deserving Plaintiffs or Tort Law's Most Expensive Consolation Prize?*, 27 WILLIAM MITCHELL L. REV. 521, 523–25 (2000).
[195] *Id.* at 522.
[196] *See generally Leach v. E.I. Du Pont de Nemours & Co.*, No. 01-C-608, 2002 WL 1270121, (W. Va. Cir. Ct. 2002).
[197] Michael Janofsky, *Settlement in DuPont Water Suit*, N.Y. TIMES, Sep. 10, 2004, https://perma.cc/ZMT3-C2AJ.
[198] Nathaniel Rich, *The Lawyer Who Became DuPont's Worst Nightmare*, N.Y. TIMES, Jan. 6, 2016, https://perma.cc/2G2T-ZHKV.
[199] *Id.*

Moving away from reliance on the common law, some states have enshrined medical monitoring as a cause of action in various statutes.[200]

The medical monitoring approach could help address AMR and the research gaps about its disparate impacts as well. One plausible way to do this is to compel pharmaceutical manufacturers of agricultural MIA to fund medical monitoring studies. These funds could be distributed evenly to different research causes but may be more equitably and effectively used if they are earmarked for studying AMR resulting from occupational exposures such as work in slaughterhouses, meatpacking, or CAFOs. Although direct causal links between the manufacture of antibiotics for use in animal agriculture and any given infection may not be enough for a tort law claim, it may be enough to convince a legislature or agency to impose this sort of burden on manufacturers.[201] An effective implementation of medical monitoring would represent a step forward in resolving the distributive injustices of AMR: those at risk would be those for whom the testing would provide the greatest potential for relief.

B. Social Solutions

i. Education for farmers

Some experts assert that the best solution is education for farmers.[202] In the United States, farmers are, on average, more knowledgeable about antibiotics and AMR than farmers globally.[203] However, researchers report that American farmers still have major knowledge gaps about the consequences of insufficient antimicrobial stewardship.[204] Some studies suggest that greater

---

[200] Conor Winters, *Bridging the Gap: State Legislative Creation of Medical Monitoring Rights*, GEO. ENV'T L.J. BLOG (Nov. 23, 2023), https://perma.cc/P3UN-HKZN.
[201] In the absence of meaningful data and given the difficulty of data collection, AMR's connection to the manufacture of antibiotics may even have a plausible enough connection to satisfy the low bar of causation that has compelled courts to order this creative remedy in tort suits in the past. *See* Maskin et al., *supra* note 194, at 522.
[202] Iwu et al., *supra* note 3, at 8.
[203] C. McKernan et al., *Antimicrobial use in agriculture: critical review of the factors influencing behaviour*, 3 JAC ANTIMICROBIAL RESISTANCE 1, 3 (2021).
[204] *Id.*

knowledge among farmers increases the chance of positive outcomes regarding AMR, but other studies support the notion that knowledge alone is not sufficient.[205] Some studies have also suggested that more sophisticated and larger farming operations are more likely to showcase knowledge about AMR.[206] This research suggests further that lack of access to adequate educational resources in low-income farming communities have hampered the efficacy of these resources' distributive benefits, and that this inequity itself must be addressed in order to effectively educate farmers.[207] As with most issues that have been addressed in this paper, there remains a paucity of research on this topic, and more studies are needed to examine efficacy of educational programs for farmers in combating AMR.[208]

ii. Rethinking our relationship with food

Beyond statutes and regulations, consumers need to rethink the availability of cheap sources of animal protein and could potentially effect change through widespread behavioral shifts.[209] Likely one of the best methods to curb the threat from AMR is to diminish our reliance on inexpensive products of industrial agriculture.[210] The global wealthy rely on cheap sources of animal products at the cost, among other things, of underserved communities disproportionately bearing the burden of AMR.[211] Even if meat consumption continues at its current high rates, some

[205] *Id.* at 12.
[206] *Id.* at 3.
[207] Rema Shrestha et al., *Beef Cattle Farmers' Knowledge, Attitudes, and Practices Toward On-Farm Biosecurity, Antimicrobial Use, and Antimicrobial Resistance in Illinois, United States of America*, 14 ANTIBIOTICS 1, 7 (2025).
[208] Jessica Craig et al., *Behavior-change interventions to improve antimicrobial stewardship in human health, animal health, and livestock agriculture: A systematic review*, 3 PLOS GLOB. PUB. HEALTH 1, 14 (2023).
[209] Kirchhelle, *supra* note 7, at 10.
[210] *Id.*
[211] *See Antibiocene*, *supra* note 19, at 6.

researchers suggest that American consumers choosing to buy meat raised without the nontherapeutic use of antibiotics could have a significant ameliorating effect on AMR.[212]

Another food-system-focused solution to AMR is to reduce the large amounts of food waste in the United States. Annually, 26% of the meat, poultry, and fish and 30% of the dairy products produced in the United States are wasted.[213] In 2010, the estimated total loss of food products was 132.9 billion pounds, and consumers wasted over double the amount of food wasted at the retail level.[214] Although there may be limits on how much the United States may effectively address the massive problem of food waste,[215] the relatively high percentages of wasted animal products signifies a nontrivial amount of antibiotic usage in animal agriculture providing only detriment without any benefit. Addressing food waste in the United States will have significant environmental justice implications beyond AMR, as there are deeply rooted racial disparities in food access, quality, and security.[216]

However, these market-level consumer solutions seem unlikely to be implemented in the United States given our rising meat consumption and ostensible lack of willingness to regulate in this space.[217] Increasingly, American animal agricultural products are being exported as global demand for meat products rises.[218] However, trends in animal production in the United States may

---

[212] Michael J. Martin & Thomas B. Newman, *Antibiotics Overuse in Animal Agriculture: A Call to Action for Health Care Providers*, 105 AM. J. OF PUB. HEALTH 2409, 2410 (2015). Reducing reliance on antibiotic-raised animal products will have consumer price impacts, but the effects on production will be limited, and farmers' profits may even increase as the cost of meat rises. *See* SNEERINGER ET AL., U.S. DEP'T OF AGRIC., ECON. INFO. BULL. NO 200, ECONOMICS OF ANTIBIOTIC USE IN U.S. LIVESTOCK PRODUCTION 45 (2015).
[213] JEAN C. BUZBY ET AL., U.S. DEP'T OF AGRIC., ECON. INFO. BULL. NO. 121, THE ESTIMATED AMOUNT, VALUE, AND CALORIES OF POSTHARVEST FOOD LOSSES AT THE RETAIL AND CONSUMER LEVELS IN THE UNITED STATES 12 (2014).
[214] *Id.*
[215] *Id.* at 6.
[216] *See* Andrea Collins, *Reducing Food Waste for the Climate, Nature, and People*, NAT. RES. DEF. COUNCIL (Mar. 18, 2024), https://perma.cc/4XT3-97LQ.
[217] *See* Carrie R. Daniel et al., *Trends in meat consumption in the USA*, 14 PUB. HEALTH NUTRITION 575, 575 (2011).
[218] AGE OF ANTIBIOTIC RESISTANCE, *supra* note 8, at 49.

portend the possibility of meeting this demand without increasing the threat of AMR: even as antibiotic use fell in the late 2010s, meat production did not have a similar decline.[219]

Conclusion

Antimicrobial resistance is situated to be one of the most significant health crises of the 21st century. In addition to presenting a pressing medical threat, AMR is an environmental justice issue. Although we have reliable data that AMR infections disproportionately impact those who are low-income globally, there is a paucity of data on the disparate impacts of AMR in the United States. What data are available point to the probability that the burden of AMR is disproportionately borne by low-income people of color in the United States as well. Although there have been several attempts at combating AMR in the United States, none of the regulatory solutions proposed have considered this problem through the lens of environmental justice. If we are going to address AMR effectively in the 21st century, the United States must take into account the inequitable burdens imposed by AMR resulting from the use of antibiotics in animal agriculture. In doing so, the United States may begin to address the threat posed by AMR more effectively than it has yet. The challenges posed by AMR will not be easily solved, but any long-term strategy must take account of those who disproportionately bear the brunt of the costs.

[219] *Id.* at 25–26; Part of changing our relationship with food may also entail rethinking our political lobbying system: federal lobbying on behalf of corporate agribusiness totaled more than half a billion dollars between 2019 and 2023. It is worth noting that one of the biggest reported agribusiness lobbyists was Bayer, the pharmaceutical manufacturer. *See* GOSWAMI, OMANJANA & KAREN PERRY STILLERMAN, CULTIVATING CONTROL: CORPORATE LOBBYING ON THE FOOD AND FARM BILL 6–7, UNION OF CONCERNED SCIENTISTS (2024), https://perma.cc/JCG5-FB4E.