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Security Council Update I: International Health Implications of Antibiotic-Resistant Bacteria

Introduction

Antibiotic resistance occurs when bacteria evolve mechanisms to resist the effects of drugs that once killed them or inhibited their growth. The overuse and misuse of antibiotics in humans, animals, and agriculture have accelerated the rise of antibiotic-resistant strains. Antibiotic resistance has emerged as one of the most pressing public health challenges in the 21st century. The World Health Organization (WHO) has declared it a global crisis and emphasizes that it has the potential to reverse decades of medical progress.[1] Bacteria such as *Methicillin-resistant Staphylococcus aureus* (MRSA), *Vancomycin-resistant Enterococcus* (VRE), and multidrug-resistant *Mycobacterium tuberculosis* (MDR-TB) are already posing significant challenges.[2] In 2019, a singular strain of MRSA caused over 100,000 deaths worldwide, and those strains continue to mutate into several variations.[3] This specific strand was also found to disproportionately impact high-income Member States, including but not limited to the North American and European regions.[4] Antimicrobial Resistance (AMR) threatens not only individual health but also the efficacy of medical procedures, from surgeries to cancer treatments.[5] As resistance rates continue to rise, the need for coordinated international action has never been more urgent.[6]

The Escalating Spread of AMR

According to WHO estimates, at least 700,000 deaths annually can be attributed to antibiotic-resistant infections, a number projected to rise to 10 million by 2050 if no action is taken.[7] The overuse and misuse of antibiotics in humans and livestock, compounded by insufficient infection control measures, have accelerated the emergence and spread of resistant strains.[8] Common infections are becoming harder to treat, leading to prolonged illness, higher healthcare costs, and increased mortality.[9] The costs of treating AMR adds an estimated EUR 9 billion and USD 20 billion to the European and American healthcare costs.[10]

There are a few key challenges to consider when discussing AMR. Many Member States lack robust surveillance systems to monitor antibiotic resistance.[11] Without comprehensive data and security systems in place, tracking the spread of AMR, and thus, implementing effective responses and mitigating damage becomes exceedingly difficult.[12]

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[1] World Health Organization. “Antimicrobial Resistance.” Last modified October 2023. https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance.

[2] Centers for Disease Control and Prevention. "Antimicrobial Resistance and Veterinary Practices." Last reviewed March 10, 2023. https://www.cdc.gov/antimicrobial-resistance/prevention/veterinarians.html.

[3] National Center for Biotechnology Information. “Using mRNA to Fight COVID-19: A Team Effort with BioNTech and Pfizer.” National Library of Medicine, 2021. https://www.ncbi.nlm.nih.gov/books/NBK577288/.

[4] National Center for Biotechnology Information. “Using mRNA to Fight COVID-19: A Team Effort with BioNTech and Pfizer.”

[5] National Center for Biotechnology Information. “Using mRNA to Fight COVID-19: A Team Effort with BioNTech and Pfizer.”

[6] Centers for Disease Control and Prevention. "About Antimicrobial Resistance." Last reviewed September 8, 2023. https://www.cdc.gov/antimicrobial-resistance/about/index.html.

[7] Naddaf, Miryam, "The Report Estimates That, by 2050, Antimicrobial Resistance Will Cause 10 Million Deaths Per Year Worldwide." *Nature*, October 30, 2024. https://www.nature.com/articles/d41586-024-03033-w.

[8] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats." *Pharmacy and Therapeutics* 40, no. 4 (2015): 277-283. https://pmc.ncbi.nlm.nih.gov/articles/PMC4378521/.

[9] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[10] Dadgostar, Porooshat. 2019. “Antimicrobial Resistance: Implications and Costs.” *Infection and Drug Resistance* 12 (December): 3903–10. doi:10.2147/IDR.S234610.

[11] Eleonora Cella, et al. "Joining Forces against Antibiotic Resistance: The One Health Solution." *Pathogens* 12, no. 9 (2023): 1074. https://doi.org/10.3390/pathogens12091074.

[12] Eleonora Cella, et al. "Joining Forces against Antibiotic Resistance: The One Health Solution."

The United States of America is an example of a Member State that has government agencies, such as the Centers for Disease Control (CDC), that gather data on AMR infections.[13] Members of the European Union pool their AMR data into the European Centre for Disease Prevention and Control (ECDC).[14] More specifically, the CDC and ECDC collect data on infections and use it to identify certain "risk factors" that make infection more likely so they can be mitigated.[15][16] Public understanding of antibiotic resistance remains too low, leading to misuse of antibiotics through self-medication and incomplete courses. Patients failing to complete a course of antibiotics can allow the bacteria to survive and develop resistance to the antibiotic, similar to how a vaccine uses a weakened virus to help humans develop viral resistance. This process can occur when there is improper prescription and application from doctors.[17] Studies show that even in developed Member States antibiotics are incorrectly prescribed in 30-50% of cases and improperly applied in intensive care units 30-60% of the time.[18] Increasing awareness among the general population and medical professionals is paramount to tackling AMR.[19] There is also an ever-growing disparity between developed and developing Member States where healthcare systems may be under-resourced.[20] For developing Member States, there are even more considerable barriers to hurdle to provide safe access to antibiotics and other life saving measures.[21] The main factors that fuel this disparity for lower to middle income Member States are rising incomes, low-cost antimicrobials, poor hospital oversight, and lack of controls on over the counter medications.[22] With incomes for individuals rising in these developing Member States their access to cheap antimicrobials and lack of oversight makes it far more likely that the drugs are improperly and irregularly administered.[23]

Many Member States, regardless of their level of development, utilize antibiotics to stimulate growth in livestock.[24] This works because antibiotics ward off infections allowing animals to grow larger than they would when fending off these infections themselves.[25] In fact the practice is so widely adopted that in some western Member States such as the United States approximately 80% of antibiotics sold are used for animals.[26] This is extremely consequential as eating these types of animals can affect the human gut biome and even transfer AMR.[27] Animals administered antibiotics in this manner can act as breeding grounds and systems of AMR delivery for human populations.[28]

Regional Implications of AMR

Antibiotic resistant bacteria and infections do not end at Member State borders. The international community is so interconnected that trade and travel via land, air, and water are constant. This increased international mobility facilitates the rapid transfer of resistant bacteria between borders and vulnerable populations. This was clearly

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[13] Centers for Disease Control and Prevention. *Antibiotic Resistance Threats in the United States, 2013*. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2013. https://www.cdc.gov/antimicrobial-resistance/media/pdfs/ar-threats-2013-508.pdf.

[14] European Centre for Disease Prevention and Control. "Antimicrobial resistance in the EU/EEA (EARS-Net) - Annual Epidemiological Report 2022," November 17, 2023, https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-resistance-europe-2022

[15] Centers for Disease Control and Prevention. *Antibiotic Resistance Threats in the United States*

[16] European Centre for Disease Prevention and Control. "Antimicrobial resistance in the EU/EEA (EARS-Net) - Annual Epidemiological Report 2022."

[17] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats." *Pharmacy and Therapeutics* 40, no. 4 (2015): 277-283. https://pmc.ncbi.nlm.nih.gov/articles/PMC4378521/.

[18] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[19] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[20] University of Oxford. "An Estimated 1.2 Million People Died in 2019 from Antibiotic-Resistant Bacterial Infections." Last modified January 20, 2022. https://www.ox.ac.uk/news/2022-01-20-estimated-12-million-people-died-2019-antibiotic-resistant-bacterial-infections.

[21]University of Oxford. "An Estimated 1.2 Million People Died in 2019 from Antibiotic-Resistant Bacterial Infections."

[22] Lim, C., Takahashi, E., Hongsuwan, M., Wuthiekanun, V., Thamlikitkul, V., Hinjoy, S., Day, N. P., Peacock, S. J., & Limmathurotsakul, D. "Epidemiology and burden of multidrug-resistant bacterial infection in a developing country," eLife, September 2016, https://doi.org/10.7554/eLife.18082

[23] Lim, C. et al., "Epidemiology and burden of multidrug-resistant bacterial infection in a developing country"

[24] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[25] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[26] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[27] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

[28] Ventola, C. Lee. "The Antibiotic Resistance Crisis: Part 1: Causes and Threats."

observed during the COVID-19 pandemic making it a collective challenge.[29] Any contaminated food, water, or medical supplies only continue to exacerbate the issue.[30] Member States with high rates of antibiotic misuse, particularly in agriculture via pesticides, such as tetracyclines and streptomycin used in the western and southern United States.[31] These antibiotic pesticides are sprayed on agricultural products consumed by humans which contributes to a cycle of resistance that affects global health security.[32]

This can be seen to have a disproportionate effect on different regions of the world, especially in regions with lower access to healthcare services. Of the regions identified in an analysis of the global impact of AMR, published in the Lancet, Australasia had the lowest death impact from AMR, while Western Sub-Saharan Africa had the highest death impact from AMR.[33] The type of infectious pathogens also varied by region.[34] High income regions attributed half of their fatalities to Escherichia coli (E-coli) and Staphylococcus aureus (staph), while the Sub-Saharan African region had their fatalities more evenly distributed amongst different pathogens such as, E-coli, Staphylococcus aureus, and Klebsiella pneumoniae.[35] Many of these disparities can be explained by the difference in level of medical care as well as access to sanitary necessities such as food and water.[36] A wider proliferation of vaccines would also curb disparities in the types of diseases that generate AMR deaths.[37]

A Focused Global Response to AMR

In 2015, the WHO sought to address the major existential threat of AMR by their Member State's unified approval of a Global Action Plan to tackle AMR (GAP-AMR).[38] This plan's stated goal being, "to ensure, for as long as possible, continuity of successful treatment and prevention of infectious diseases with effective and safe medicines that are quality-assured, used in a responsible way, and accessible to all who need them."[39] The GAP-AMR identified information gathering through surveillance of AMR as an effective tool to prevent further infections.[40] To properly plan policy positions and future responses the WHO created the Global Antimicrobial Resistance and Use Surveillance System (GLASS) on October 22 2015.[41] GLASS was an effort to standardize the data collection and transformation process by monitoring and supporting individual Member State's own surveillance systems.[42] GLASS has continued to issue reports and operate in 135 Member States, territories, and areas.[43]

In 2022, the United Nations General Assembly held a high-level meeting on antimicrobial resistance, emphasizing the need for a multisectoral approach.[44] Resolutions called for increased funding for research, the establishment of

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[29] Eleonora Cella, et al. "Joining Forces against Antibiotic Resistance: The One Health Solution." *Pathogens* 12, no. 9 (2023): 1074. https://doi.org/10.3390/pathogens12091074.
[30] Eleonora Cella, et al. "Joining Forces against Antibiotic Resistance: The One Health Solution."
[31] Eleonora Cella, et al. "Joining Forces against Antibiotic Resistance: The One Health Solution."
[32] Eleonora Cella, et al. "Joining Forces against Antibiotic Resistance: The One Health Solution."
[33] Murray, Christopher J. L., et al. "Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis." *The Lancet* 399, no. 10325 (2022): 629–655. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)02724-0/fulltext
[34] Murray, Christopher J. L., et al. "Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis."
[35] Murray, Christopher J. L., et al. "Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis."
[36] Murray, Christopher J. L., et al. "Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis."
[37] Murray, Christopher J. L., et al. "Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis."
[38] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS)." Accessed November 4, 2024. https://www.who.int/initiatives/glass.
[39] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS)."
[40] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS)."
[41] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS)."
[42] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS)."
[43] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS)."
[44] United Nations. "General Assembly Ensures Countries Will Take National Targets by 2030, as it Adopts Resolution on Sustainable Development Goals, Amid Member States' Calls for Financing, Technological Support." United Nations Press, October 23, 2024. https://press.un.org/en/2024/ga12642.doc.htm#:~:text=The%20Assembly%20ensured%20that%2C%20by%202030%2C%20all%20countries,national%20targets%20informed%20by%20existing%20capacities%20and%20priorities.

global surveillance networks, and the promotion of responsible antibiotic use across all sectors.[45] Assemblies such as these highlight the necessity of GLASS and its role in ameliorating these stated issues. The GLASS 2022 report is one recent example of the international effort to combat AMR through surveillance and education.[46] Antibiotic resistance represents a multifaceted crisis requiring immediate and sustained international action. Collaborative efforts among governments, healthcare providers, researchers, and the public are essential to combat this threat. Strengthening surveillance systems, incentivizing research and development, and fostering public awareness will be critical to ensuring the effectiveness of antibiotics for future generations.

Without sufficient efforts we could very well reach the WHO's estimated 10 million deaths annually by 2050.[47] Many of those in the scientific community believe that the cost of inaction in the face of antimicrobial resistance will reverse innovation and send us back to a pre-antibiotic era.[48] This would be an era that would see many of our innovations in the medical field fall apart as they stand upon the foundation of these medicines.[49] All of our developments in the fight against cancer will amount to nothing as we watch patients die from untreatable bacterial and fungal infections.[50] Organ transplants would be almost unthinkable as patients are required to take immunosuppression medications, making them defenseless.[51] Without a concerted international effort on this issue we could very easily find ourselves at the mercy of all manners of pestilence.

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[45] United Nations. "General Assembly Ensures Countries Will Take National Targets by 2030, as it Adopts Resolution on Sustainable Development Goals, Amid Member States' Calls for Financing, Technological Support."

[46] World Health Organization. "Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report 2022". https://iris.who.int/bitstream/handle/10665/364996/9789240062702-eng.pdf?sequence=1.

[47] Naddaf, Miryam, "The Report Estimates That, by 2050, Antimicrobial Resistance Will Cause 10 Million Deaths Per Year Worldwide." *Nature*, October 30, 2024. https://www.nature.com/articles/d41586-024-03033-w.

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[49] Infectious Diseases Society of America. "Experts in Infectious Diseases to House Leaders: Address Antimicrobial Resistance."

[50] Infectious Diseases Society of America. "Experts in Infectious Diseases to House Leaders: Address Antimicrobial Resistance."

[51] Infectious Diseases Society of America. "Experts in Infectious Diseases to House Leaders: Address Antimicrobial Resistance."