

Committee: World Health Organisation

Issue: The rise of superbugs

Student Officer: Noha El-Hajj

Position: Deputy President

PERSONAL INTRODUCTION

Dear Delegates,

My name is Noha El-Hajj and I will be serving as the deputy president of the World Health Organisation during the 4th American College of Greece Model United Nations conference. This will be my 6th conference overall and my second time acting as a Student and I'm really looking forward to the debate and discussion of our topics.

MUN is an activity that I highly encourage you to pursue. It enables you to grow as an individual, interconnect and deepen your knowledge of the world. To me, it is the epitome of a platform that enables you to thrive, and hence I'm anticipating our soon-to-come fruitful debates in WHO.

In this study guide I'm aiming to provide you with information that will hopefully mark a starting point for your in-depth research, regarding this issue. If you have any inquiries after reading this study guide, or need any clarification please don't hesitate to email me at Noha2450@hotmail.com prior to the conference, and I will be more than glad to respond. I look forward to meeting you all.

Best Regards,

Noha El-Hajj

TOPIC INTRODUCTION

Superbugs that have antimicrobial resistance have been reported to kill ¹700,000 people worldwide. They pose one of the biggest threats to our global community by hindering our health, economic development and food security.

Firstly, the rise of superbugs has been predicted to cause detrimental economic losses worldwide. In fact, research teams from RAND Europe and KPMG (Klynveld Peat Marwick Goerdeler) proved this solely by assessing and observing a single part of the impact of antimicrobial resistance which is indicative that superbugs will steadily rise in resistance. To the extent that, ²by 2050 it would lead to 10 million people dying annually and a reduction of 2% -3.5% in Gross Domestic Product (GDP). Subsequently, it would cost the world up to 100 trillion dollars. Moreover, accounting for the economy's labour force it will progressively decline due to mortality and morbidity and overall reduce economic production.

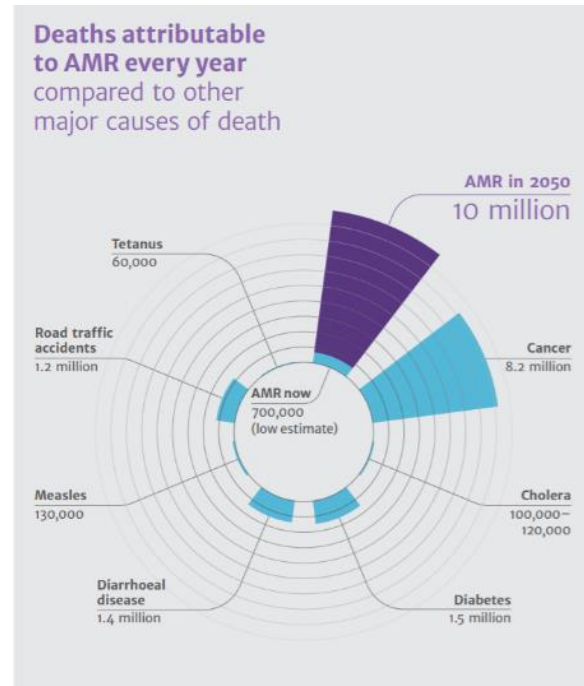


Figure 1 AMR deaths annually

Global risk factors that contribute to the surge of superbugs

In an ever-globalized world, travelling breeds new opportunities for antimicrobial-resistant pathogens to be distributed globally. This occurs due to the interactions of different microbes and especially bacteria, that provide them with opportunities to share their genetic material with each other, giving rise to new resistant strains at an extraordinary rate.

Even animals spread superbugs amongst their population, which amplifies the risk of them being transmitted to us people. This issue is one prominent in the USA where ³80% of antibiotics sold every year are fed to animals.

¹ Tagliabue, Aldo, and Rino Rappuoli. "Changing Priorities in Vaccinology: Antibiotic Resistance Moving to the Top." *Frontiers in Immunology*, Frontiers Media S.A., 30 May 2018, www.ncbi.nlm.nih.gov/pmc/articles/PMC5992407/.

² Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. 2014;(accessed 6.6.16)

³ YouTube, YouTube, www.youtube.com/watch?v=_LGA2tcS-Fs&v=en.

In developing countries, we are witnessing increasing numbers of people that are consuming chicken and meat products, and with growing populations there's more people to feed with exponentially growing economies. Hence, one can deduce that more and more people can afford red meat derived from animals making the citizens more susceptible to superbugs.

Whilst, in the developed world most countries have reached the maximum food consumption but in world giant emerging countries like China and Brazil, it's been growing for decades and it will continue to grow for decades.

Rise of superbugs in MEDCs

In More Economically Developed Countries, poor hospital-level regulation and lack of sanitation have empowered such superbugs with the hospital sphere. For instance, *K. pneumoniae* which is a major cause of infections acquired such as; pneumonia, bloodstream infections, and infections in newborns and intensive-care unit patients.

Furthermore, excessive use in food-producing animals. Data reveals that the sales of antimicrobials sky rocketed by nearly 26% from 2009 to 2015. ⁴ Additionally, during 2016, 96% of antimicrobials for medical and nonmedical use were sold over-the-counter without needing a veterinary prescription.

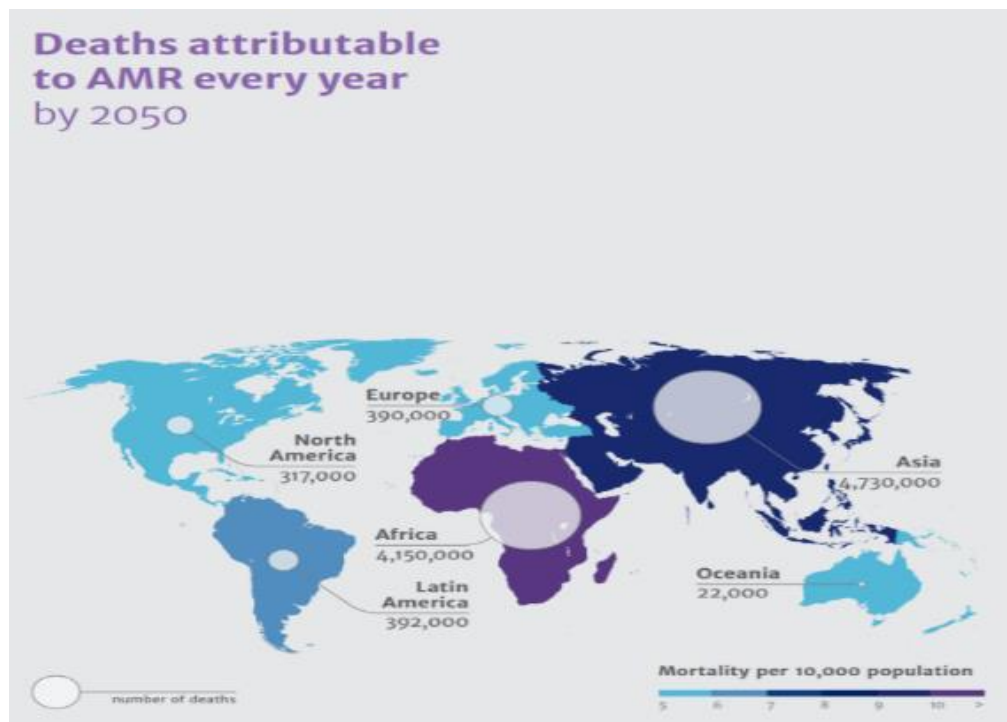


Figure 2 AMR deaths by 2050 annually

⁴ Chokshi, Aastha, et al. "Global Contributors to Antibiotic Resistance." *Journal of Global Infectious Diseases*, Medknow Publications & Media Pvt Ltd, 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6380099/.

Rise of superbugs in LEDCs

Some key factors that contributed to the increase of superbugs in Less Economically Developed Countries include the following.

Lack of surveillance of resistance development

In 2014, ⁵WHO released their first report on antimicrobial resistance (AMR), where the WHO collected national data regarding the most prominent 9 bacterial infections, classified as the greatest threats to global health. ⁶ “The data revealed that out of 194 countries, only 129 provided data, of which only 22 had data on all nine infection-antibiotic resistance combinations deemed to be emerging global threats”. So, the 2014 WHO report was the first attempt to obtain a more comprehensive analysis of the extent of worldwide antimicrobial resistance. It was an unsuccessful report not only emphasized the high levels of antibiotic resistance globally but also portrayed the lack of willingness, coordination and substantial gaps in surveillance, especially in many of the MEDCs with high burden of antibiotic resistance from where no national data was retrieved for AMR.

In order to narrow gaps in surveillance WHO enacted the decision to launch the Global AMR surveillance system (GLASS), in which more than ¼ of the WHO member states have been enrolled until December 2017.

Lack of funding

Currently, LEDCs are constricted and limited in terms of implementation. As, they lack the suitable infrastructure and access to resources that are essential to ameliorate the surveillance of antimicrobial resistance.

DEFINITION OF KEY TERMS

Antimicrobial resistance

Antimicrobial resistance occurs when microorganisms (such as; parasites, bacteria, viruses, fungi) develop the ability to defeat the antimicrobial drugs (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintic) that have been engineered to destroy them. Essentially, the hinder the efforts that the drugs make to

⁵ Chokshi, Aastha, et al. “Global Contributors to Antibiotic Resistance.” *Journal of Global Infectious Diseases*, Medknow Publications & Media Pvt Ltd, 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6380099/.

⁶ Chokshi, Aastha, et al. “Global Contributors to Antibiotic Resistance.” *Journal of Global Infectious Diseases*, Medknow Publications & Media Pvt Ltd, 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6380099/.

kill them, and rise to persist in their growth.⁷

HOW ANTIBIOTIC RESISTANCE HAPPENS

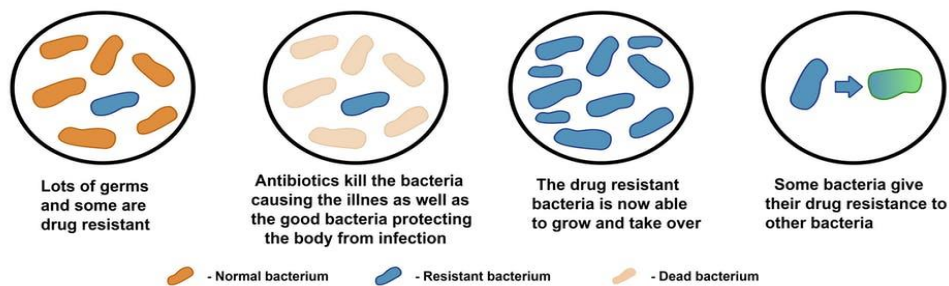


Figure 3 The process of AMR resistance

Superbugs

Superbugs are microorganisms that undergo antimicrobial resistance. Consequently, the medicines intended to cure the diseases become ineffective. Hence, resulting in increased severity of the infections that continue to grow within the body.

Multidrug-resistant organisms

Generally, bacteria which are resistant to more than one drug, are classified as multi-drug resistant organisms. Two ways by which this can happen are the following. One being that the “bacterium, can have several different resistance genes, each providing resistance to a particular antibiotic. The other possibility is that, a single resistance mechanism gives resistance to more than one antibiotic.”⁸

E. coli

This is a prevalent bacterium “commonly found in the intestines of humans and other animals, some strains of which can cause severe food poisoning”.⁹



Figure 4 E. coli

Tuberculosis (TB)

An infection triggered by a bacterium namely, “Mycobacterium tuberculosis”

⁷ “Antibiotic Resistance Images.” Shutterstock, [www.shutterstock.com/search/antibiotic resistance](http://www.shutterstock.com/search/antibiotic%20resistance).

⁸ Munita, Jose M, and Cesar A Arias. “Mechanisms of Antibiotic Resistance.” *Microbiology Spectrum*, U.S. National Library of Medicine, Apr. 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC4888801/.

⁹ “E. Coli: Meaning of E. Coli by Lexico.” *Lexico Dictionaries | English*, Lexico Dictionaries, www.lexico.com/definition/e._coli.

that often targets the lungs. Tuberculosis is transmitted via air breathed out by TB infected patients or throat coughs, sneezes, or interactions with the patient.

E. Artemisinin-based combination therapy

A treatment involving the combining of two different drugs in one capsule, namely “co-formulated drug” which is essential to ensure the utilization of both drugs.¹⁰ This has proven to be a successful solution to controlling the spread of malaria in an effective way.

Salmonella

A bacterium that occurs mainly in the gut, especially a serotype causing food poisoning. It is a zoonotic disease per se, so it can be passed on from animals to humans.¹¹

Malaria

It is a fatal disease “caused by parasites that are transmitted to people through the bites of infected female *Anopheles* mosquitoes.”¹²

BACKGROUND INFORMATION

Back in 1928 mould(fungi) accidentally contaminated a petri dish in Alexander Fleming’s Laboratory at St Mary’s Hospital in London, and he discovered that it produced a substance (penicillin) that killed the bacteria that he was examining.

Thus, over the course of the preceding 12 years Fleming and others had transformed this finding into a genuinely effective and what one may call extraordinary drug, which could cure patients with bacterial infections¹³.

Consequently common & fatal diseases i.e. pneumonia and tuberculosis could be treated relatively effectively. Likewise, due to the development of antibiotics, a small cut was no



Figure 5 Petri dish with a phage culture

¹⁰ “Malaria Consortium - Artemisinin-Based Combination Therapy (ACT).” *Malaria Consortium - Home*, www.malariaconsortium.org/pages/112.htm.

¹¹ “Salmonella: Definition of Salmonella by Lexico.” *Lexico Dictionaries | English*, Lexico Dictionaries, www.lexico.com/en/definition/salmonella.

¹² “Fact Sheet about Malaria.” *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/malaria.

¹³ Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. 2014;(accessed 6.6.16)

longer deadly if infected. Moreover, the risks of surgery i.e. hip surgery and childbirth were drastically reduced.

Predominantly, it is prominently known that a plethora of bacteria and other pathogens continuously evolve in order for them to survive and resist the new drugs that medicine has used to combat them, in selection pressure.

Concurrently in very recent years, AMR (antimicrobial resistance) has become a more significant issue. As over the course of the years, the rate of new antibiotic production has declined, whilst antibiotic use has surged.

AMR (antimicrobial resistant report in 2014) threatens: “many of the most important medical advances we have made, and this report will go on to quantify the costs that society will face if action is not taken.”

Below are some superbugs that have been classified as threatening and heinous to our societies placing us at risk of several epidemics.¹⁴

E. K. pneumoniae, is widely regarded as a very resistant superbug. Hence treatments such as; “carbapenem antibiotics” are no longer deemed effective in “more than half of people treated for K. pneumoniae infections.”¹⁵

Gonorrhea

As far as Gonorrhea is concerned, WHO reported that “treatment failure to the last resort of medicine for gonorrhea (third generation cephalosporin antibiotics) has been confirmed in at least 10 countries including; Australia, Austria, Canada, France, Japan, Norway, Slovenia, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland.”¹⁶

Resistance in tuberculosis (TB)

Back in 2014, the WHO identified that there were roughly 480,000 new cases of multidrug-resistant tuberculosis, a form of tuberculosis that is resistant to the 2 most powerful anti-TB drugs. The domino effect of the drug-resistant tuberculosis, a form of tuberculosis resistant to 4 of the most prominent anti-TB drugs, has been recorded in ¹⁷105 countries.

¹⁴ Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. 2014;(accessed 6.6.16)

¹⁵ “Antibiotic Resistance.” *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

¹⁶ “Antibiotic Resistance.” *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

¹⁷ Antibiotic Resistance.” *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

E. coli

Another major AMR is E. coli. Fluoroquinolone antibiotics have been widely utilized as medicine for AMR resistance in E. coli. Consequently, the WHO has reported that “there are countries in many parts of the world where this treatment is now ineffective in more than half of patients.”¹⁸



Figure 6 *E. coli*¹⁹

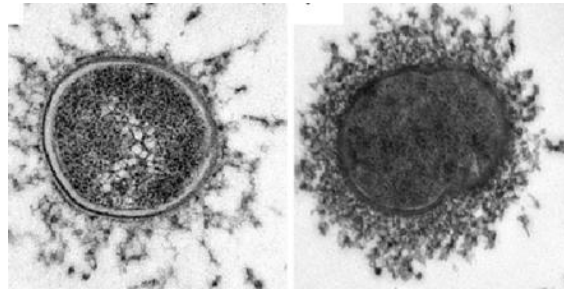


Figure 7 Image of stained *E. coli*²⁰

MRSA (methicillin-resistant *Staphylococcus aureus*)

With respect to another fatal superbug, MRSA (methicillin-resistant *Staphylococcus aureus*), people impacted by it are estimated to be ²¹64% more likely to die than people with a non-resistant form of the infection.

Resistance in malaria

Since July 2016, resistance to the first-line treatment for “*P. falciparum* malaria”, an ACT.

A “WHO Strategy for Malaria Elimination in the Greater Mekong subregion” a project from 2015-2030, was approved by all nations with Veto Power.

Resistance in HIV

In 2010, an estimated 7% of victims whom were affected by drug-resistant HIV started antiretroviral therapy (ART).²² In 2015, the WHO raised awareness that victims should commence with their ART as a treatment.

¹⁸ Antibiotic Resistance.” *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

¹⁹ “What Is E. Coli?” *LiveScience*, Purch, www.livescience.com/64436-e-coli.html.

²⁰ Formate Research Centre, Editors: A Mendez-Vilas, Jan. 2017, researchgate.net/publication/317002592_Transmission_electron_microscopy_protocols_for_capsule_visualisation_in_pathogenic_respiratory_and_meningeal_bacteria.

²¹ Antibiotic Resistance.” *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

²² “Global Trends – Other Microbes.” *World Health Organization*, World Health Organization, 16 Feb. 2020, www.euro.who.int/en/health-topics/disease-prevention/antimicrobial-resistance/about-amr/global-trends-other-microbes.

Nevertheless, it is fundamental to note that increased usage of such treatment, will proportionally increase the incidence of ART-resistance. Consequently, to optimize the “long-term effectiveness of first-line ART regimens, and to ensure that people are taking the most effective regimen.”²³ According to the WHO, “it is essential to continue monitoring resistance and to minimize its further emergence and spread. In consultation with countries, partners and stakeholders, WHO is currently developing a new Global action plan on HIV drug resistance (2017–2021).”²⁴

The cost of the drugs to combat the latest mutation of HIV called “third-line drugs” will be 18 times more expensive than the first drugs developed to combat HIV before, called “first-line drugs”.²⁵

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

Qatar

They recognize the essence of research contribution to tackle AMR-related issues in the future. Thus, the Hamad General Hospital based in Doha, Qatar has sent affected patient samples to labs, in order to identify (via e-testing which assesses sensitivity to antimicrobials) and conclude which combination of antibiotics is most effective for the superbugs.

USA

In the USA, 80% of antibiotics sold every year are fed to animals. Supporting this, a survey suggested that 63,000 tons were fed to chickens, pigs and cattle each year.²⁶

China

The people’s republic of China has released a “One Health National Action Plan to Contain Antimicrobial Resistance” along with 14 ministries to guarantee a holistic approach to tackling this concerning issue. This plan is set to take place from 2016-2020, and has proved to be effective in the hospital where there has been a reduction

²³ “Global Trends – Other Microbes.” *World Health Organization*, World Health Organization, 16 Feb. 2020, www.euro.who.int/en/health-topics/disease-prevention/antimicrobial-resistance/about-amr/global-trends-other-microbes.

²⁴ “Global Trends – Other Microbes.” *World Health Organization*, World Health Organization, 16 Feb. 2020, www.euro.who.int/en/health-topics/disease-prevention/antimicrobial-resistance/about-amr/global-trends-other-microbes.

²⁵ Global Trends – Other Microbes.” *World Health Organization*, World Health Organization, 16 Feb. 2020, www.euro.who.int/en/health-topics/disease-prevention/antimicrobial-resistance/about-amr/global-trends-other-microbes.

²⁶ *YouTube*, YouTube, www.youtube.com/watch?v=_LGA2tcS-Fs&vl=en.

in antimicrobial use among patients, with rates drastically” dropping from 67.3% in 2010 to 36.9% in 2017.”

“In 2017, an estimated 73,000 people in China developed multi-drug resistant tuberculosis, representing 13% of the global incident cases of multi-drug resistant TB and the second-highest number of cases in the world.”²⁷

India

In LEDCs, due to the lack of funding, doctors are often obliged to use substandard drugs or postpone treatment. Resulting in increased rates of AMRs to the extent that a 2020 report stated that “40-60% of infections are caused by superbugs” in the region. To, make matter worse, “70% of infections for several common bacteria are caused by superbugs.”²⁸

The Global Antimicrobial Resistance Surveillance System (GLASS)

Launched in October 2015, this system was established by WHO to track antimicrobial resistance (AMR) data and create policies on a national and ultimately global level to encourage action across the board. With goals such as; to improve awareness and understanding of antimicrobial resistance and reduce the occurrence of AMRs. Also, to incentivize and develop the economic case for sustainable investment that takes account of “the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.”²⁹

Global Antibiotic Research and Development Partnership (GARDP)

A joint initiative of WHO and Drugs for Neglected Diseases Initiative (Dandi), GARDP encourages novel research and development via public and private sector co-operations. By 2023, the partnership aims to develop and deliver up to four new treatments in the form of new antibiotic drugs.



Figure 8 The WHO’s GLASS framework

²⁷ “Antimicrobial Resistance - China.” *World Health Organization*, World Health Organization, www.who.int/china/health-topics/antimicrobial-resistance.

²⁸ Kollewe, Julia. “Lack of Antibiotics in Low Income Countries 'Worsening Superbugs Threat'.” *The Guardian*, Guardian News and Media, 21 Jan. 2020, www.theguardian.com/society/2020/jan/21/lack-of-antibiotics-in-low-income-countries-worsening-superbugs-threat.

²⁹ “GLASS | Global Antimicrobial Resistance Surveillance System (GLASS).” *World Health Organization*, World Health Organization, 23 Nov. 2019, www.who.int/glass/en/.

Interagency Coordination Group on Antimicrobial Resistance (IACG)

This was founded by the United Nations Secretary-General to enhance and encourage efficient coordination between international organizations. In order to secure effective global action against this threat to health & food security. The IACG is co-chaired by the Director General of WHO & UN Deputy Secretary-General & comprises top tier representatives of related UN agencies, other international organizations, and individual experts across different sectors.

TIMELINE OF EVENTS ³⁰

Date	Antibiotic Released		Date	Antibiotic-resistant superbug discovered
1943	Penicillin		1967	Penicillin resistant Streptococcus pneumoniae Penicillinase-producing Neisseria gonorrhea
1958	Vancomycin		2002	Vancomycin-resistant Staphylococcus aureus
1959	Amphotericin B		2016	Amphotericin B-resistant Candida Auris
1960	Methicillin		1960	MRSA
1980	Extended-spectrum cephalosporins		1983	Extended-spectrum beta-lactamase producing E. coli
1980	Azithromycin		2011	Azithromycin-resistant Neisseria gonorrhea
1985	Imipenem		1996	K. pneumonia
1987	Ciprofloxacin		2007	Ciprofloxacin-resistant Neisseria gonorrhoeae
1990	Fluconazole		1988	Fluconazole-resistant Candida
2001	Caspofungin		2004	Caspofungin-resistant Candida
2003	Daptomycin		2004	Daptomycin-resistant MRSA
2015	Ceftazimide-avibactam		2015	K. pneumonia

³⁰ "About Antibiotic Resistance." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 4 Nov. 2019, www.cdc.gov/drugresistance/about.html. 2050 photos:

RELEVANT RESOLUTIONS, TREATIES AND EVENTS

Improving the containment of AMR Resolution WHA A58/27 (April 2007)

The Health Assembly requested the Director-General to expand and strengthen the provision of technical support to Member States in order to accelerate the implementation of promoting the containment of that resistance especially on a national level.³¹

The founding of GLASS (Global Antimicrobial Resistance Surveillance System) in Resolution: WHA A68/20 (October 2015)

This was established by WHO to track antimicrobial resistance (AMR) data and create policies on a national and ultimately global level to encourage action across the board. With goals such as; to improve awareness and understanding of antimicrobial resistance and reduce the occurrence of AMRs. Also, in order to incentivize and develop the economic case for sustainable investment that takes account of “the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.”³²

FAO (Food and Agriculture Organization) Report on AMR Action Plan (November 2018)

“The 39th session of FAO Conference adopted Resolution 4/2015 on AMR”. Henceforth, has adopted a strategic framework in which it has pledged to raise and ameliorate awareness on AMR and integrate and innovate surveillance via the Assessment Tool for Laboratories and AMR Surveillance System (ATLASS) which was designed to aid countries in their monitoring diagnostic capacity.³³

The Antimicrobial Resistance Summit in Asia (December 2019)

Thus, the panel assembled experts from government, industry and academia representing “Cambodia, Indonesia and Vietnam through the South Korea and Singapore and took AMR to a mainstream policy priority for governments across the world.” Discussions enrolled regarding the necessity of data surveillance to control the deploying of resources, surveillance infrastructure remains weak, especially in South Asia. To add, the SDGs (Sustainable Development Goals) in Asia along with the One Health Agenda were central topic areas to ensure compliance with SDG 3: Good Health

³¹ World Health Organization, Secretariat, 5 Apr. 2007, apps.who.int/medicinedocs/index/assoc/s16339e/s16339e.pdf?ua=1.

³² “GLASS | Global Antimicrobial Resistance Surveillance System (GLASS).” *World Health Organization*, World Health Organization, 23 Nov. 2019, www.who.int/glass/en/.

³³ “FAO’s Action Plan on Antimicrobial Resistance (AMR).” *Food and Agriculture Organization of the United Nations*, FAO Coordinator for Antimicrobial Resistance, Oct. 2018, www.fao.org/3/mx383en/mx383en.pdf.

& Well-Being, whilst also securing the cooperation between pharmaceutical companies and the food and agriculture industry to enact the agenda with the R&D funding required.³⁴

POSSIBLE SOLUTIONS

Tackling the issue in LEDCs³⁵

Treating the cause by reducing and controlling them. To improve hygiene and sanitation both in and outside hospitals, less transmission and preventing people from getting sick to begin with.

Training and upgrading the skills of informal providers is very much required if you want to prevent this disease. As, in LEDCS, impoverished communities such as New Delhi the drug resistant strains of bacteria can be passed to members of the community via contaminated water & waste, thus it is vital to re-evaluate and fix India's healthcare system.

Additionally, in the status quo the private sector and philanthropists such as; Bill & Melinda Gates Foundation fund awareness videos as seen above and tackle issues on malaria and HIV/AIDS.

Concurrently, investing in sanitation and basic health infrastructure that protect citizens from alarmingly high rates of infection.

In GLASS, ameliorate the regulatory framework to control antibiotic use globally. Via clear guidelines by WHO, in order to maintain consistency across nations.

Tackling the issue in MEDCs

Initially, regulating three factors would be essential to combating such epidemic those being. One, hospital-based interventions with the infrastructure. Secondly, the prescription of antibiotics. Thirdly, monitoring antibiotics use in food-producing animals

To add, persistence in the cooperation between the EU and the USA on collaboratives_innovative research for new antibiotics involving academics, clinicians and companies, large and small.

In compliance with this, R&D funding from MEDCs to invest in novel research for antibiotics will improve diagnosis, detected and reported worldwide, so that we can fight back faster when bacteria evolve to resist drugs.

³⁴ "Antimicrobial Resistance Summit Asia." *The Economist*, The Economist Newspaper, [events.economist.com/events-conferences/asia/amr-summit](https://www.economist.com/events-conferences/asia/amr-summit).

³⁵ Chokshi, Aastha, et al. "Global Contributors to Antibiotic Resistance." *Journal of Global Infectious Diseases*, Medknow Publications & Media Pvt Ltd, 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6380099/.

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