Introduction

Living in a world where technology is highly developed, and humans are aware of the millions of microbes and bacteria encircling us everyday, medication plays a vital role. However, with the exponential increase in the world’s population, the use of antimicrobials and antibiotic medicine has increased as well. This increase is partly explained by the low cost, relatively safe use and widespread availability of antimicrobials; consequently making them some of the most misused medicines of all time. The excessive misuse of antibiotics has progressed over the years, causing a potential worldwide problem: antimicrobial resistance. According to UN agencies, by 2050, five million people may die each year in Asia due to AMR. Antimicrobial resistance develops naturally over time; however, the excessive use of antimicrobials is accelerating it.

Antimicrobials are overused when treating microbes in humans, livestock and agriculture. Globally, the WHO found that the majority of antimicrobials are used in livestock and agriculture. Antimicrobials are given to animals to prevent diseases, treat diseases and act as growth boosters to produce more food. Likewise, antimicrobials are used in agriculture to eliminate all forms of microbes and diseases potentially ruining the crops. In both scenarios, the chemicals will eventually end up in the food chain. Excessive use of these chemicals only compounds the problem. We are facing more and more cases of bioaccumulation--the gradual build-up of substances, mainly chemicals such as pesticides, in an organism.

As a result, the excessive use of antimicrobials in food production and their presence in the environment has severe public health repercussions, depending on the region. These chemicals can be found in lakes, rivers, soil, sewage, in animals and in human beings. They can further aid bacteria resistance, making future antibiotics we consume less effective.

Definition of Key Terms
Antimicrobials

The World Health Organisation (WHO) defines an antimicrobial as a drug to treat a microbial infection. It is a general medical term which refers to a group of drugs, including antibiotics, antifungals, antiprotozoals, and antivirals. Antimicrobials can be used on humans, in agriculture or even in livestock to eliminate all forms of harmful microbes in the surrounding areas. Once called the “miracle drug”, antimicrobials have however lost their efficacy over the years due to misuse and excessive use, causing increased resistance and mutations of microbes.

Antimicrobial Resistance

According to the WHO, antimicrobial resistance (AMR) occurs when microorganisms change in ways that render the medications used to cure the infections they cause useless. When microorganisms become resistant to most antimicrobials they are often called “superbugs”. AMR has become a global concern because resistant infections may kill, spread to others, and cause huge costs to individuals, livestock, agriculture and society. This resistance occurs mostly naturally but can be facilitated by the misuse of antibiotics, which is a growing problem in today’s society.

Microorganisms

A microorganism is any living organism which cannot be seen with the naked eye, such as protozoa, bacteria or even fungi. These organisms are thus only visible when viewed through a microscope and play a vital role in plant life and health, and soil composition. Microorganisms can include the billions of tiny living creatures that decompose fallen leaves, bark, or trees. However, microorganisms are also responsible for infections, as they prey on harmful plants or insects and spread to other plants or insects. An example of a beneficial microorganism is yeast, a simple single-celled fungus used for fermentation. Nonetheless, some microorganisms, notably parasitic and pathogenic bacteria, are harmful to humans, livestock and agriculture.

Livestock

According to the Food and Agriculture Organisation of the United Nations (FAO), livestock are domesticated animals which are kept on a farm and raised for an asset, and are one of the fastest growing parts of the agricultural economy. Livestock contributes to 40 % of the global value of agricultural output and supports the livelihoods and food security of up to 1.3 billion people. The transformation and expansion of the sector offers opportunities for agricultural development, poverty reduction and food security gains.

Excessive use
An excessive use refers to using something of an amount which is above the recommended limit. Going over this limit could possibly imply that there would be severe consequences, such as costs, health problems or ethical reasoning. Anything which is being excessively used is exceeding what is usual, proper, necessary or normal. In this case, there is excessive use of antimicrobials in the livestock industry, excessive amounts given to humans and excessive use in agriculture, which consequently endangers the environment and our health.

**Background Information**

**History**

The use of antimicrobials or antibiotics is not a recent concept. Since the earliest civilisations in 3150 BC, antibiotics have helped treat infections and illnesses using different techniques. Nonetheless, during the 20th century there was remarkable progress made towards the improvement and development of antimicrobials, when it became clear that infections were caused by pathogens. Even though populations did not get wiped out each time an infection spread, mortality rates were higher without effective antibiotics.

*The discovery of penicillin*

Many are familiar with how penicillin was discovered in 1928 by Alexander Fleming, a Scottish biologist of the 19th and mid 20th century. However, many scientists before him discovered the use of mould in treating infections. In 1871, Joseph Lister experimented with Penicillium glaucium, explaining that it had an antibacterial effect on human tissues.

In the end of the 19th and beginning of the 20th century, a chemist and a bacteriologist named Oscar Löw and his partner Rudolf Emmerich through experiments were able to identify the bacteria causing the growth of further microbes within infected patients. With this information, Löw and Emmerich successfully created the first antibiotic to treat human infections, called Pyocyanase. With help from Paul Ehrlich, the era of antimicrobial therapy truly began. Working with his team in 1909, Ehrlich developed Salvarsan, an arsenic-based chemical which concluded a successful treatment for syphilis.
Previously realising penicillin had a potential in treating infections, Fleming was challenged with transforming what could treat a guinea pig into a medicine that could be made widely available for everyone around the world.

After successful trials in treating human wounds, collaborations with British pharmaceutical companies made mass production of penicillin (produced by Penicillium notatum) possible. Following a fire in Boston, in which nearly 500 people died, many survivors received skin grafts. After the immense success of skin grafts with the treatment of penicillin, the US government began supporting the mass production of the drug. By 1944, penicillin was being used to treat soldiers for infections both in the field and in hospitals throughout Europe. Consequently, by the end of the Second World War, penicillin was nicknamed ‘the miracle drug’ and had saved thousands of lives.

In 1945, Ernst Chain, Howard Florey and Alexander Fleming received the Nobel Prize in Medicine for their role in creating the first mass-produced antibiotic.

Scientists shortly noticed with the development of more and more antibiotics, so too did antibiotic resistance. New methods and medications were found and developed to combat this resistance. In 1959, methicillin was identified by Beecham as the first penicillinase-resistant β-lactam antibiotic. Penicillin was used to treat thousands of hundreds of children, women, soldiers, and the general population from infections and diseases.
The end of the golden age

Science and the human body is constantly trying to keep up with an increasing amount of resistant bacteria. Nonetheless, more efforts are required to maintain the effectiveness of our current antibiotics and develop stronger ones. Scientists are looking at combining multiple antibiotics; however, more in-depth research is required before this is put into practice.

Antimicrobial resistance is linked with many other worldwide problems, one of them being deforestation and global warming. A report published by the University of Edinburgh in February 2019 affirmed that deforestation is indeed linked to changed in spread of infectious diseases. A very common infection in Malaysia, Borneo is malaria, transmitted through bites by infected mosquitoes. A forest in the center of Borneo was studied using technology and satellites over a period of time. Originally, macaques carry this disease. Due to deforestation, notably in Malaysia, the macaques carrying the disease would move from habitat to habitat, getting closer and closer to the villages on the outskirts of the forest. This increased the spread of the disease onto mosquitoes, and exposed more individuals to malaria. With the increase of the spread of the disease, it was impossible to treat everyone just once, as the disease started resisting rapidly to the little medications provided.

Present situation

Currently, more and more bacteria resistance genes are spreading from agriculture, livestock and to humans, reducing the effectiveness of antibiotics to cure diseases. Resistance prevents basic medication to play its role, making medical procedures more difficult to operate. Hence, it is difficult to guarantee a successful treatment, such as chemotherapy, organ transplants, major surgeries or even diabetes management. AMR is consequently putting the Sustainable Development Goal 3, good health and wellbeing, at risk.

Resistance in bacteria

Antibiotic resistance can be found in any country in the world. Patients affected by infections created by drug-resistant bacteria have an increased chance of severe health problems and potentially death. For more than half of the patients in the world, depending on the country, the treatment of resistance in E. coli is now ineffective. With the carbapenem antibiotics being one of the most widely used medicines for the treatment of urinary tract infections, this infection is struggling to be treated.

Even though scientists rapidly developed methicillin and ampicillin (used to treat infections related to Staphylococcus aureus), a resistance equally developed. Bacteria strains which are resistant to these antibiotics are known as methicillin-resistant Staphylococcus aureus (MRSA). Individuals with
MRSA are estimated to be 64% more likely to die than people with a non-resistant form of the infection, according to the US National Library of Medicine.

**Figure 4: Map of the world representing the percentage of Staphylococcus Aureus isolates resistant to methicillin, data from 2011-2014, AMRcontrol.com**

The use of antimicrobials in food production

Globally, the exact amount of antimicrobials used in food production is challenging to estimate. Evidence from the UN, the WHO and the FOA shows us however, that the amount of antimicrobials used in agriculture is possibly equivalent to the amount used to treat humans. However, this information varies from different countries and regions of the world. For example, over 70% of crucial antibiotics are used in livestock in the United States, a greater use in animals than in humans. With the constant development of new techniques for producing more and more food in the agriculture sector, the use of antimicrobials is likely to increase annually.

**Figure 7: Map and bar chart of the projected consumption of antibiotics in agriculture, from 2010 to 2030, EEAD**

Brazil, Russia, India, China and South Africa (BRICS) are expected to double their use of antimicrobials in agriculture between 2010 and 2030. BRICS equally contribute immensely to the worldwide production of livestock and agriculture. As previously mentioned, an excessive and unnecessary use of antimicrobials builds up a resistance to current or future diseases, making them harder to treat, thus forcing the use of more and stronger antimicrobials, creating a vicious cycle. Resistance in agriculture presents a multitude of disadvantages. The most common one is the spread of drug-resistant strains, passed on through direct contact between humans and animals. Farmers are most commonly exposed to this kind of transmission. These drug-resistant strains can moreover be passed onto humans through the consumption of animals containing that strain. Furthermore, the soil can likewise be contaminated with drug-resistant strains, as they are found in animal excretion, exposing it to the development of drug resistance.

Respecting official usage guidelines presented by the WHO, antimicrobials should only be used to treat infections to limit their contamination. Many countries and organisations are working to reduce
their use of antimicrobials which are for subtherapeutic reasons, with the notable EU ban in 2006 for these specific purposes.

**Livestock**

The majority of antibiotics used in animals are not for strictly therapeutic reasons. They are used excessively in healthy animals to prevent the development of infections, improve mass and growth production or to speed up their growth process. Even though many laws have been passed in the world preventing the unnecessary use of antibiotics in livestock, many farmers do not respect the rules, claiming that regulating and stopping the use of antimicrobials would strongly impact their benefits and income.

On the 1st of January 2017 in the United States, the Food and Drug Administration (FDA), made it illegal for antibiotics doses to be used for subtherapeutic reasons. These reasons include rapid unnatural growth and improved feed efficiency.

**US and EU policies on sub-therapeutic use of antibiotics in food animals**

![Image of US and EU policies](image)

It is estimated that global antibiotic consumption each year can vary from 63,000 tonnes to over 250,000 tonnes, according to the Proceedings of the National Academy of Sciences of the United States of America.

According to the FDA, over 70% of the antibiotics which are medically important for humans sold in the United States are used for livestock. This means the masses of antibiotics which are being injected into livestock, which we consume, end up consequently affecting human health as they enter our food chain.

**Figure 8: Infographic of US and EU policies on the use of sub-therapeutic use of antibiotics in livestock, The Center For Disease Dynamics, Economics & Policy**

**Figure 9: Chart representing the different uses for livestock of antimicrobials, and their purposes, The Guardian**
Even though many farmers and mass food producers consider antimicrobials in livestock an immense help for their business, there are many endangering factors which accompany the use of antimicrobials. The biggest misconception is that even though antimicrobials do increase the growth of livestock, they do not ensure the health of the livestock. According to calculations by the FDA and IMS (Intercontinental Medical Statistics), animal consumption of antibiotics were of 8,893,103kg and human consumption of 3,379,226kg in 2012.

Agriculture

In the agricultural sector, it is always about producing more, faster and cheaper. This combination has only become possible with the help of pesticides. According to the WHO, pesticides are chemicals used to kill anything which could negatively affect the quality of crops or plantations. They have the ability to kill insects, fungi, rodents or even mosquitoes, which can carry deadly diseases like malaria. However, pesticides are extremely toxic for humans, and their use and disposal needs to be regulated. In 2007 alone, the world used over 5.2 billion pounds of pesticides. While they are helping many farmers produce fast, eliminate pests and potential illnesses, they are causing serious health problems worldwide.

Pesticides are being used almost everywhere. However since the 19th century, pesticide sales in North America have not increased much, and their usage is declining thanks to weaker pesticides and genetically modified plants.

![Global pesticide sales by region](image)

Nonetheless, sales in Europe have been growing, driven by the sales in Eastern Europe. Africa and the Middle East seem to use the least pesticides.

*Figure 10: Graph representing the global pesticides sales by region by millions of USD over time*

Luckily, MEDCs have decreased their use of organophosphates over the years. Organophosphates were developed and first used in the 1940s in Germany. They are found to be to this day extremely effective and pose hardly any environmental problems. However, they are extremely toxic for humans. Dana Barr, a scientist who studied organophosphate poisoning explains that “They're
considered junior-strength nerve agents because they have the same mechanism of action as nerve gases like sarin.”.

Many of these extremely toxic pesticides are still used in LEDCs, because they are very effective and cheap.

![Figure 11: Bar chart representing the types of insecticide use in the US, FDA](image)

Many environmentalist organisations and UN bodies estimate that the worldwide consumption of antimicrobials are to increase by 67% percent from 2010 to 2030 in agriculture.

Indeed, the biggest and most important disadvantage is the development of resistant bacteria. An experience was carried out in 2013 in Chinese swine farms involving the different uses of antimicrobials (which you can find more information out about [here](#)). As a result, the regions which had been affected by a sub-therapeutic use had an immense increase in the quantity of antibiotic resistance genes.

![Figure 12: Bar chart representing the antibiotic use in agriculture by country as of 2011, European Medicines Agency and the governments of the United States, Australia and New Zealand.](image)
Humans

There has been immense scientific progress regarding antimicrobials and their use because of humans. Humans can however be affected by the dangers of the excessive amount of antimicrobials by consuming foods which have been heavily dosed with antimicrobials, working in the agricultural or livestock sector, or even by being given unnecessary prescriptions. All these factors can subsequently contribute to AMR. Even though in 2012, 30% of the antibiotics in the world were consumed by humans (according to the FDA) we are often the most affected. Between 2000 and 2010, human global consumption of antibiotics increased by 36%. As mentioned earlier, antibiotics are relatively safe, cost efficient and widely available.

When resistance increases, stronger and larger antibacterial strains are used, further increasing the bacteria’s resistance to these drugs. This becomes a vicious cycle for the development and prescription of antimicrobials. What is needed to slow this process down is the restriction of antibiotic use, and the development of different treatment methods.

The consequences

Antimicrobial resistance

AMR occurs when microorganisms change in ways that render the medications used to cure the infections they cause useless. When microorganisms become resistant to most antimicrobials they are often called “superbugs”. This resistance is mainly heightened by the aforementioned causes of unnecessary use of antimicrobials in today’s society. Antimicrobial resistance is a major issue which can cause detrimental health, environment and scientific damage. For further information, please find the United Kingdom’s House of Commons, Health and social care committee report on antimicrobial resistance of 2017 to 2019 and the National Institute for Health and Care Excellence report on antimicrobial resistance in the Appendix below.
“Overuse and misuse of antibiotics are the leading causes of antimicrobial resistance. Without effective antibiotics and other antimicrobials, we will lose our ability to treat common infections.” declared Dr Suzanne Hill, Director of the Department of Essential Medicines and Health Products at WHO.

Public health consequences

Public health will always be affected when it comes to antimicrobials, whether it’s negatively or positively. On one hand, antimicrobials have treated millions of individuals for decades, while on the other hand, they are increasing the risk of resistant pathogens developing.

Every year, bacterial resistance to antibiotics leads to nearly 25,000 deaths in Europe. By 2050, it is estimated that over 10 million people a year will die as a result of antibiotic resistance globally.

Once this resistance has built up, the patient either has to consequently obtain stronger drugs. This resistance is mostly found in LEDCs, where different treatment techniques or stronger drugs are not available, causing many deaths. Recently, statistics worldwide demonstrated that deaths as a result AMR could surpass the number of cancer patients dying per year, causing the UN to declare AMR a “global health emergency.” and has to be tackled with as much urgency as Ebola and HIV.

Environmental consequences

Animal waste is a very common way to pass on resistant bacteria. According to the FDA, 93% of medically-important antibiotics were given to livestock via feed, and by water in agriculture in the US.
Further studies also imply that around 70 to 90% of antibiotics fed to animals, are found in faeces. These then end up in water sources, sewage systems and the environment.

In every antimicrobial, there exists active pharmaceutical ingredients, called APIs. In order to prevent as much contamination as possible, APIs need to be manufactured differently. The majority of APIs are manufactured in India and China, as the workforce is cheaper than in Europe or the United States. As a result, the least developed and most densely populated countries are the ones with the highest concentration of APIs in their environment. This is an issue which needs to be solved with the pharmaceutical industries running in the country.

A study in 2007 conducted by Swedish researchers showed that many rivers in India were contaminated with pharmaceutical ingredients and medicines. This was because of the waste from the industries being dumped into the rivers, without the population’s consent. As a result of polluting an area with antibiotics, a resistance to them consequently develops. A similar research was conducted in China, where levels of antibiotic concentration in rivers were shockingly higher than the patient taking the drug themselves.

### Major Countries and Organizations Involved

**Cyprus**

As of 2011, Cyprus statistically consumed over 4000mg per kg of antimicrobials in agriculture. This is two times more than a vast majority of countries in the world, including New Zealand, the United Kingdom and even the United States. Cyprus finds itself often on the news in Europe for being criticized about the antibiotic content in its products. This has contributed to a worsening reputation of the country regarding its consumers health, and a fractured economy.

**United States of America**

The United States has always had high prescribing rates throughout history to this day. According to the European Surveillance of Antibiotic Consumption, they were ranked 7th in the world in 2004 for the highest prescribing rate globally. A study in 2013 focused on how US hospitals treated types of urinary tract infections. At the end of the study, it showed that 37% of prescriptions for the infections were found to be not the most effective ones, or even ineffective. As a result, the US needs improvement as they lack awareness on the appropriate usage of antibiotics.

**World Health Organisation**

The WHO is an organisation which is part of the UN, and deals with human health across the world. Its priorities range from ebola, antibiotic resistance to sexually transmitted diseases. As they
represent human health, they have been more and more concerned amongst the years about the impact of antimicrobials on human health. They attend and host many conferences around the world in order to find solutions to regulate the excessive use of antimicrobials and raise awareness. Furthermore, they release very regular reports about this topic. Please find their work and their attempts at solving the issue further down.

**Food and Agriculture Organisation of the United Nations (FAO)**

The FAO is an agency of the United Nations specializing in food and agriculture, with a main goal of defeating world hunger and famine. They are mostly active in helping LEDCs and countries facing war and international efforts to defeat hunger. Recently, they have been more active and showing immense efforts in defeating the excessive use of pesticides and antimicrobials in agriculture.

**The Global Antimicrobial Resistance Surveillance System (GLASS)**

The GLASS is a UN and WHO supported system. They specialise in the collection, analysis and sharing of data connected to antimicrobial resistance worldwide. They furthermore influence important decisions taken by nations or organisations, raise awareness and provide legitimate and reliable statistics.

**Timeline of Events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Description of event</th>
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<tr>
<td>September 3rd, 1928</td>
<td>Alexander Fleming discovers a mould called Penicillium notatum, later developing it into an antibiotic called Penicillin.</td>
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<tr>
<td>1961</td>
<td>Released on European markets, Ampicillin became the first synthetic penicillin found to be effective in treating Enterobacteriaceae infections.</td>
</tr>
<tr>
<td>January 1st, 1989</td>
<td>Applications for medically important antimicrobials used in food-producing animals are to be approved as drugs with veterinary feed (VDF) or prescription products.</td>
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<tr>
<td>January 1st, 2006</td>
<td>The EU withdraw the approval for antibiotics to be used as growth promoters.</td>
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<td>January 2015</td>
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The European Food and Safety Authority published the first integrated analysis of data from humans and animals. They conclude that the use of certain antimicrobials in animals and humans is associated with resistance.

October 2015

State of California passes a law banning the use of human antibiotics in animal feed.

January 1st, 2017

The Food and Drug Administration made it illegal for antibiotics doses to be used for subtherapeutic reasons in the US.

October 2017

The EFSA, the European Medicines Agency (EMA) and the European Centre for Disease Prevention and Control (ECDC) establish a set of indicators to aid Member States of the EU to assess their progress in decreasing the use of antimicrobials they use.

FDAs AMR Monitoring Program officially begins. Further expansion of the number of participating laboratories from 20 to 25 AMR testing laboratories.

2019

Expanded testing from 3 prioritized pathogens to 4. Data collected will be available to the public through CFSAN’s GenomeTrakr.

Relevant UN Treaties and Events

- Draft global action plan on antimicrobial resistance, 2015, (WHAA68/20)
- Resolution on antimicrobial resistance, 2014, (WHA67.25)
- Improving the containment of antimicrobial resistance, 5 April 2007, (WHAA60/28)
- Improving the containment of antimicrobial resistance, 27 May 2005, (WHA58.27)
- Emerging and other communicable diseases: antimicrobial resistance, 10 March 1998, (WHAA51/9)

Previous Attempts to solve the Issue

Currently, there is not much being done about the excessive use of antimicrobials in agriculture, humans or livestock. However, more and more organisations, companies and people are becoming aware of the dangers it poses, which mostly affect our health. There have been increasing efforts to
identify the levels of concentration of antimicrobials in the environment, which could be useful in
developing drug-specific limits for waste water, soil, plants and animals. Furthermore, there is the annual
World Antibiotic Awareness Week every mid November and the European Antibiotic Awareness Day on
the 18th of November in order to raise awareness.

World Health Organisation

The WHO have been extremely alert and thorough with instances of antimicrobial resistance as a
result of excessive use of antimicrobials. They recently published new treatment guidelines for
gonorrhoea, syphilis and chlamydial infections, discouraging the use of some antibiotics and referring to
more efficient ones. A "WHO Strategy for Malaria Elimination in the Greater Mekong subregion (2015-
2030)" was endorsed by all Cambodia, Laos, Myanmar, Thailand and Vietnam, as well as China. The
WHO is furthermore developing a new "Global Action Plan for HIV Drug Resistance (2017-2021)".

Food and Agriculture Organisation of the United Nations

In 2015, the FAO launched a two year Global Action plan on AMR for humans, agriculture and
livestock. Over 150 member states volunteered to take action. After two years, around 100 countries
concluded that they had a plan, and 50 countries have a plan under development. For the human sector,
105 countries reported that they have a surveillance system and 68 have a system for tracking
consumption of antimicrobials at national level. Whilst this is encouraging, only 61 countries have
enrolled in the GLASS, with only very small amounts of data being sent and recorded. Nonetheless, not
a single member state had a plan after two years to decrease the use of antimicrobials in agriculture not
livestock.

Possible Solutions

AMR is an extremely complex problem which affects the world and is driven by many
interconnected factors. As a result, isolated interventions have limited to no impact. Action from
organisations, member states and healthcare institutions is needed to prevent the intensification of
antimicrobial resistance. Thus, all countries need national action plans on AMR. Vaccines, improved
medication and diagnostic tools are a requirement. Furthermore, progress and research is needed
towards plant, animal and environmental surveillance. In order to make policies, pass laws and raise
awareness, data is a necessary. Monitoring and collecting data becomes an absolute necessity, with the
potential installation of AMR policies and intervenies.

Finally, there are a multitude of simple solutions which could be adopted to regulate the
excessive use antimicrobials in humans, livestock and agriculture. The first one being to discourage the
distribution of antibiotics without a prescription, to animals and to humans. Regulating the sale through
taxes would lessen the damage created on a country’s economy. Another solution would be to develop and improve vaccines to be given at birth for livestock and humans to avoid any repercussions in the future, as well as the consumption of antibiotics. Finally, a solution which is being increasingly used is the use of organic pesticides, which do not damage crops. Nonetheless many member states, especially LEDCs, do not have enough financial resources to purchase and use organic crops on their thousands of hectares of harvesting fields.

Bibliography


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“Which Countries Use the Most Antibiotics?” World Economic Forum, Joe Myers, 20 November 2015
www.weforum.org/agenda/2015/11/which-countries-use-the-most-antibiotics/


Appendices

Interactive pages on antimicrobial resistance by the EFSA found here.
Report on the experience carried out in 2013 in Chinese swine farms involving the different uses of antimicrobials can be found [here](#).

2018 country self-assessment AMR report on monitoring global progress on addressing AMR published by the WHO, FAO and OIE can be found [here](#).