



Library Note

Tackling Drug-Resistant Infections Globally

This House of Lords Library briefing has been prepared for the debate in the House of Lords on the final report of the Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), scheduled for 15 September 2016. The briefing includes background to the subject of antimicrobial resistance (including commentary from the Review itself and from the World Health Organisation (WHO)), a summary of the recommendations and economic costings in the Review, and brief information on how the UK and the WHO are already looking to combat the issue.

The Review (which was commissioned by the Coalition Government in July 2014) describes antimicrobial resistance as “a natural process whereby microbes evolve to be able to resist the action of drugs, making them ineffective”. Over time, this can lead to antibiotics (and other antimicrobials) becoming less effective or, in some cases, ineffective entirely. Although describing it as a “natural phenomenon”, the WHO state that the rate of resistance is accelerated by the overuse or misuse of antibiotics (both in humans and in animals) and by poor infection prevention and control practices. The Review estimated that 700,000 people worldwide a year currently die of resistant infections, and that (if action is not taken) by 2050 this number could rise to around 10 million a year. It also estimated that this would cost around a cumulative \$100 trillion in global economic output.

Emphasising that the issue needed to be dealt with on a global basis, the Review set out the importance of addressing issues connected to the supply and demand of antimicrobials. The [final report](#) of the Review set out ten recommendations to work towards this. Of these, four were highlighted as “particularly important” in the foreword to the report by Lord O’Neill of Gatley, who led the review. These were: a global public awareness campaign to educate people about the issue of drug resistance; introducing market entry rewards for the development of certain successful new drugs; stimulating the market and development of diagnostic technologies to reduce the unnecessary prescription of antimicrobials; and reducing the use of antibiotics in agriculture. The Review estimated that its recommendations would cost around \$40 billion globally over a decade.

The Coalition Government published a [five-year strategy for addressing AMR](#) in 2013 and, in 2015, the WHO published its [global action plan](#) on the issue. On 21 September 2016, the issue is due to be discussed at the meeting of the United Nations annual General Assembly as a High Level Meeting agenda item for the first time.

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7 September 2016
LLN 2016/044

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I. Background to Antimicrobial Resistance

The website of the Review on Antimicrobial Resistance (“the Review”) described the issue of antimicrobial resistance (AMR) as follows:

Antimicrobial resistance is a natural process whereby microbes evolve to be able to resist the action of drugs, making them ineffective. Resistance arises from the selection pressure that antimicrobials put on populations of microbes; essentially selecting or allowing those microbes to survive and proliferate, typically through genetic changes. This leads to antibiotics becoming less effective over time and in many extreme cases, ultimately useless.¹

Similarly, the World Health Organisation (WHO) defines AMR as follows:

Antimicrobial resistance is resistance of a microorganism to an antimicrobial drug that was originally effective for treatment of infections caused by it. Resistant microorganisms (including bacteria, fungi, viruses and parasites) are able to withstand attack by antimicrobial drugs, such as antibacterial drugs (eg antibiotics), antifungals, antivirals, and antimalarials, so that standard treatments become ineffective and infections persist, increasing the risk of spread to others.

The evolution of resistant strains is a natural phenomenon that occurs when microorganisms replicate themselves erroneously or when resistant traits are exchanged between them. The use and misuse of antimicrobial drugs accelerates the emergence of drug-resistant strains. Poor infection control practices, inadequate sanitary conditions and inappropriate food-handling encourage the further spread of antimicrobial resistance.²

However, the WHO does differentiate between the terms “antibiotic resistance” and “antimicrobial resistance”, stating that antibiotic resistance refers specifically to the resistance to antibiotics that occurs in common bacteria that cause infections, and that antimicrobial resistance is broader, “encompassing resistance to drugs to treat infections caused by other microbes as well, such as parasites (eg malaria), viruses (eg HIV) and fungi (eg Candida)”.³ As antibiotics are a class of antimicrobial drug, this briefing uses both terms interchangeably, but considers the issue in its broadest sense (ie antimicrobial resistance).

Noting evidence suggesting a “high correlation” between levels of antibiotic use and resistance, the Review’s website stated that “resistance has increasingly become a problem in recent years because the pace at which we are discovering new antibiotics has slowed drastically, while antibiotic use, and therefore resistance, is rising”.⁴ Indeed, the Review set out estimates suggesting 700,000 people worldwide a year currently die of resistant infections, and that (if action is not taken) by 2050 this number could rise to around 10 million a year. Regarding

¹ Review on Antimicrobial Resistance, ‘[Background](#)’, accessed 1 September 2016.

² World Health Organisation, ‘[Factsheet on Antimicrobial Resistance](#)’, April 2015.

³ *ibid.*

⁴ Review on Antimicrobial Resistance, ‘[Background](#)’, accessed 1 September 2016.

deaths that could be attributed to AMR in the United Kingdom, the then Parliamentary Under Secretary of State for Public Health, Jane Ellison, stated in a written answer on 2 June 2016:

Specific information on the number of deaths attributable to antimicrobial resistance is not currently available. However, a [Europe wide study of multi-drug resistance](#) estimated the number of deaths in the European Union, Norway and Iceland, due to multi-drug resistance in five specific bacteria. On the basis of population size, other things being equal, the conclusions reached in the study would imply that around 3,000 deaths per year in the United Kingdom may be due to multi-drug resistance in those specified infections. This is likely to be an underestimate as it omits consideration of large numbers of other bacteria.⁵

The WHO has also highlighted the urgency of the problem, stating:

[A]ntibiotic resistance is no longer a prediction for the future; it is happening right now, across the world, and is putting at risk the ability to treat common infections in the community and hospitals. Without urgent, coordinated action, the world is heading towards a post-antibiotic era, in which common infections and minor injuries, which have been treatable for decades, can once again kill.⁶

In addition to the increased risk to people's lives caused by resistance, the WHO stress that AMR:⁷

- **Hampers the control of infectious diseases:** As treatment becomes less effective, patients remain infectious for longer, increasing the chance of them spreading resistant microorganisms to others.
- **Increases the cost of healthcare:** More expensive treatments may be needed as an alternative to first line drugs, and longer illnesses may result in longer hospital stays and an increased burden on families and the state.
- **Jeopardises healthcare gains across societies:** Advances in modern medicine are impacted by AMR. For example, “without effective antimicrobials for prevention and treatment of infections, the success of organ transplantation, cancer chemotherapy and major surgery would be compromised”.⁸

Some of the key concerns raised by the WHO related to evidence of growing resistance in the following areas:⁹

- **Resistance in bacteria:** There was evidence of a critical gonorrhoea treatment now failing in several countries and that there was widespread resistance to treatments for life-threatening infections caused by common intestinal bacteria and to treatments for urinary tract infections.

⁵ House of Commons, [Written Question: Antibiotics—Drug Resistance](#), 2 June 2016, 38143.

⁶ World Health Organisation, [Factsheet on Antimicrobial Resistance](#), April 2015.

⁷ *ibid.*

⁸ *ibid.*

⁹ *ibid.*

- **Resistance in tuberculosis:** In 2013, there were an estimated 480,000 new cases of multidrug-resistant tuberculosis (MDR-TB) in the world. It also stated that “3.5 percent of new TB cases and 20.5 percent of previously treated TB cases are estimated to have MDR-TB, with substantial differences in the frequency of MDR-TB among countries”.¹⁰
- **Resistance in malaria:** In parts of the Greater Mekong region there was increasing evidence of resistance to the best available treatment for falciparum malaria (artemisinin-based combination therapies).
- **Resistance in HIV:** Resistance to a form of HIV treatment, antiretroviral therapy (ART), is increasing around the world, and is associated to the rise in the use of the treatment. The organisation feared that such treatments may become ineffective in the coming years. It estimated that, in 2010, drug resistance among adults who had not begun treatment in countries scaling up ART was found to be about 5 percent globally, and that there was now evidence this was increasing to 22 percent in some areas.
- **Resistance in influenza:** Due to the constantly evolving nature of influenza, resistance to certain antiviral drugs used as treatment during influenza epidemics and pandemics is continuously emerging. Although it is an issue that is regularly monitored, the organisation flagged up the fact that certain strands of the virus are already resistant to some of the most frequently used drugs.

Although stating that the development of AMR is a “natural phenomenon”, the WHO reasoned that certain human actions can effectively accelerate it. For example, the organisation stated that “inappropriate use of antimicrobial drugs, including in animal husbandry, favours the emergence and selection of resistant strains, and poor infection prevention and control practices contribute to further emergence and spread of antimicrobial resistance”.¹¹

2. Review on Antimicrobial Resistance

2.1 Background to the Review

In July 2014, the Coalition Government announced that it was commissioning the Review on Antimicrobial Resistance, which would be lead by Jim O’Neill (now Lord O’Neill of Gatley, Commercial Secretary to the Treasury (Conservative)).¹² The Review was sponsored by the Wellcome Trust and was backed by the Department of Health, the Foreign and Commonwealth Office and HM Treasury. Speaking at the time of the announcement, the then Prime Minister, David Cameron, stated:

Resistance to antibiotics is now a very real and worrying threat, as bacteria mutate to become immune to their effects. With some 25,000 people a year already dying from infections resistant to antibiotic drugs in Europe alone, this is not some distant threat but something happening right now. If we fail to act, we are looking at an almost

¹⁰ World Health Organisation, ‘[Factsheet on Antimicrobial Resistance](#)’, April 2015. The World Health Organisation also provided maps showing the varying percentages of new TB cases with multidrug-resistant tuberculosis and previously treated TB cases with multidrug-resistant tuberculosis around the world.

¹¹ *ibid.*

¹² Wellcome Trust, ‘[Internationally Focused Commission on Antimicrobial Resistance Announced by PM](#)’, 2 July 2014.

unthinkable scenario where antibiotics no longer work and we are cast back into the dark ages of medicine where treatable infections and injuries will kill once again.

That simply cannot be allowed to happen and I want to see a stronger, more coherent global response, with nations, business and the world of science working together to up our game in the field of antibiotics. Following discussions at the G7 last month, I have asked the economist Jim O'Neill to work with a panel of experts and report back to me and other world leaders on how we can accelerate the discovery and development of a new generation of antibiotics.¹³

In addition, the Chief Medical Officer, Professor Dame Sally Davies, stated:

The soaring number of antibiotic-resistant infections poses such a great threat to society that in 20 years' time we could be taken back to a 19th-century environment where everyday infections kill us as a result of routine operations. We have reached a critical point and must act now on a global scale to slow down antimicrobial resistance. In Europe, 25,000 people a year already die from infections which are resistant to our drugs of last resort. The biotech and pharmaceutical industry will be central to resolving this crisis which will impact on all areas of modern medicine. We cannot tackle the problem on our own and urgently need coordinated international action, which is why I am delighted to see the Prime Minister taking a global lead by commissioning this review.¹⁴

The terms of reference of the Review set out the need to look at the issue on an international level, and to make recommendations and conduct new research as necessary.¹⁵ The terms of reference also highlighted the need to focus on the economic issues surrounding the containment of AMR, including those connected to the global research and development of new antimicrobials and the potential impact of a failure to contain AMR. The full terms of reference are available on the [Review's website](#). In addition, the website contains further information and material relating to the Review's work, including the eight thematic papers published by the Review prior to the final report.¹⁶

2.2 Final Report of the Review

Entitled *Tackling Drug-resistant Infections Globally: Final Report and Recommendations*, the Review's final report was published on 19 May 2016.¹⁷ The report stressed the importance of taking a coordinated global approach to tackle the problem, involving policy makers and governments around the world: "what is certain is that no single country can solve the AMR problem on its own and several of our proposed solutions will require at least a critical mass of countries

¹³ Wellcome Trust, '[Internationally Focused Commission on Antimicrobial Resistance Announced by PM](#)', 2 July 2014.

¹⁴ *ibid.*

¹⁵ Review on Antimicrobial Resistance, '[Terms of Reference](#)', accessed 1 September 2016.

¹⁶ Review on Antimicrobial Resistance, '[Publications](#)', accessed 1 September 2016.

¹⁷ Review on Antimicrobial Resistance, '[Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#)', 19 May 2016.

behind them if they are to make a difference”.¹⁸ The report then set out the overarching need to address the supply and demand problem contributing to the rise in drug-resistant infections:

To stop the global rise of drug-resistant infections, there is a supply and demand problem that needs to be fixed. The supply of new medicines is insufficient to keep up with the increase in drug resistance as older medicines are used more widely and microbes evolve to resist them. At the same time, the demand for these medicines is very badly managed: huge quantities of antimicrobials, in particular antibiotics, are wasted globally on patients and animals who do not need them, while others who need them do not have access.

Fundamental change is required in the way that antibiotics are consumed and prescribed, to preserve the usefulness of existing products for longer and to reduce the urgency of discovering new ones. Governments should be held accountable on this goal to reduce the demand for antimicrobials and in particular antibiotics, as should the main sectors that drive antibiotic consumption: healthcare systems, the pharmaceutical industry and the farming and food production industry.¹⁹

Review's Recommendations

The report set out ten recommendations to work towards these goals.²⁰ In brief, these are as follows:

Largescale global awareness campaign

The campaign should be focused on increasing awareness of AMR with the aim of reducing demand from patients and farmers, and limiting prescriptions from clinicians and veterinarians for antibiotics when they are not needed and on ensuring policy makers bring forward policies to tackle AMR.²¹ The Review estimated that this may cost between \$40m and \$100m a year, which could be met by existing public health programmes in high-income countries, support for programmes in lower income countries and corporate sponsorship.

Improving hygiene and the spread of infection

This would limit infections, and therefore reduce the need for antibiotics. The Review again stressed that action would need to be taken across the world, with developing countries needing to focus on improving access to clean water and sanitation, and more developed countries focusing on reducing the spread of infections in health and care settings and encouraging proper hand washing.²²

Reduce unnecessary use of antimicrobials in agriculture and their dissemination into the environment

Although recognising that there are circumstances where the use of antibiotics in agriculture and aquaculture is required, the Review argued that the use of antibiotics is vast and is often

¹⁸ Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), 19 May 2016, p 4.

¹⁹ *ibid.*

²⁰ *ibid.*, pp 4–7.

²¹ *ibid.*, p 4.

²² *ibid.*

used to prevent infections or promote growth (rather than for treatment).²³ As an example, the Review highlighted statistics suggesting that, in the US, “of the antibiotics defined as medically important for humans by the US Food and Drug Administration (FDA), over 70 percent (by weight) are sold for use in animals”. The Review proposed three steps to tackle this issue; first, the introduction of a ten-year target in 2018 to reduce antibiotic use in agriculture (with milestones to support progress alongside countries’ economic development). Second, restrictions on certain types of highly critical antibiotics. And third, improved transparency from food producers on antibiotic use in the meat produced to inform consumers.

On this matter, the National Office for Animal Health (NOAH) (a body representing companies that research, develop, manufacture and market licensed animal medicines in the UK) issued a response to the report stating:

Whilst NOAH welcomes certain recommendations, a number specific to the veterinary sector lack context and evidence, which we seek to address here [...] [T]he important role that antibiotics and other veterinary medicines play in the production of an affordable, sustainable food supply must be recognised. Inappropriate targets for reduction in use, or the removal of antibiotics needed by vets and farmers to treat diseases, could lead to unintended consequences and impact on the availability of food from animals. Whilst steps can be taken to reduce unnecessary use in livestock, antibiotics will remain an important tool in maintaining animal health and welfare. For as long as we keep and farm animals, we have an obligation to care for their health and well-being and this must include providing proper treatment and care when they are ill.²⁴

The response also requested that the UK and international organisations consider the needs of the animal medicines sector generally when implementing all the recommendations in the Review.

Regarding the dissemination of antimicrobials into the environment, the Review highlighted the impact of effluent from factories involved in the manufacture of antimicrobials in nearby water systems. The report recommended regulators set minimum standards for manufacturers regarding waste treatment and standards throughout the supply chain.

Improve global surveillance of drug resistance and antimicrobial consumption

Stating that surveillance was one of the “cornerstones of infectious disease management”, the report highlighted the work being done in this area through the UK’s [Fleming Fund](#), the US [Global Health Security Agenda](#) and the WHO’s [Global AMR Surveillance System](#).²⁵ However, the Review called for more work to be done in this area, particularly to make use of ‘big data’ and to support other countries to collect data about antimicrobial consumption and resistance levels.

²³ Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), 19 May 2016.

²⁴ National Office for Animal Health, [NOAH Response to Final O’Neill AMR Review Report](#), July 2016.

²⁵ Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), 19 May 2016, p 5.

Promoting better diagnostics to cut unnecessary use of antibiotics

The Review stated that rapid diagnostics could slow AMR, as it would cut down on unnecessary use of antibiotics and would therefore cause the existing drugs to last longer.²⁶ Claiming there has been a lack of progress over the last 140 years in the technology used to inform the prescription of such drugs, the report called on “rich countries” to lead the way on this issue. For example, it recommended that, by 2020, it should be made mandatory in certain countries that the prescription of antibiotics would need to be informed by data and testing technology wherever possible when informing doctors’ judgements to prescribe.

Promoting development and use of vaccines and alternatives

The report highlighted vaccines and other alternative approaches as a good way to reduce demand for antimicrobials, through the prevention and treatment of infections.²⁷ Therefore, it called for: the increased use of vaccines and other alternatives; more early-stage research; and the maintenance of a more viable market for vaccines and alternatives.

Improving the number, pay and recognition of people working in infectious disease

Noting that people working in AMR-related fields or infectious disease doctors often receive less financial reward and prestige than those in other fields of medicine or science, the report called for an “urgent rethink” to improve career paths and financial rewards in this area.²⁸

Establish a Global Innovation Fund for early-stage and non-commercial research

Looking at the need to increase the number of effective antimicrobials to treat infections that are becoming more resistant, the Review argued that there was currently insufficient private and public investment in research and development aimed at tackling AMR.²⁹ Therefore, it proposed a Global Innovation Fund (of up to \$2bn over five years) to support early-stage research.

Better investment to promote investment for new or improved drugs

The report stated that, compared to certain other drugs, the commercial return on research and development into antibiotics is less attractive to firms, which therefore reduces levels of investment.³⁰ It recommended that market entry rewards of around \$1bn per drug are introduced for the development of effective treatments (whether new or improved) in areas of urgent need. It also recommended changes to governments’ purchase and distribution systems for antibiotics.

²⁶ Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), 19 May 2016, p 5.

²⁷ *ibid.*

²⁸ *ibid.*, p 6.

²⁹ *ibid.*

³⁰ *ibid.*

Building a global coalition for action

Finally, again noting the global nature of the issue, the Review called on the G20 and the UN to immediately focus on AMR and on the need to take action on both the supply and demand of antimicrobials.³¹

Economics of Tackling AMR

Based on its prediction that, by 2050, failure to tackle AMR could result in the loss of 10 million lives a year around the world, the Review estimated that the economic cost of a failure to act could be a cumulative \$100 trillion of economic output.³² In contrast, the Review estimated that the cost of global action on AMR would be around \$40 billion over a decade.³³ This estimated cost is made up of:

- \$16 billion over ten years to promote the development of new antimicrobials and to improve the use of existing ones.
- \$2 billion over five years for a Global Innovation Fund to support research in drugs, vaccines and diagnostics.
- \$1 billion to \$2 billion a year to enable the rolling out of existing and new diagnostics and vaccines.
- Between \$40 million and \$100 million a year on running global public awareness campaigns.

As to how this could be funded, the report contains a number of options.³⁴ These include:

- Allocating a “very small percentage” (around 0.05 percent) of G20 countries’ healthcare spending to tackling AMR through stimulating innovation for new products and supporting the use of vaccines and diagnostics globally.
- Reallocating some of the global funding from international institutions to tackling AMR (for example, by looking into market failures affecting AMR and better supporting lower-income countries in prevention and innovation).
- Charging pharmaceutical companies an antibiotic investment charge (based on a percentage of their sales and made a condition of market entry) which could be used to pay for long-term incentives for new product development.
- Encouraging countries to consider introducing a tax on antibiotics, particularly for those used in agriculture (the Review also suggests that some of the revenue from the tax could be used to support farmers’ transition to farming systems that use fewer antibiotics and to improve infection prevention).

³¹ Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), 19 May 2016, pp 6–7.

³² *ibid*, p 4.

³³ *ibid*, p 64.

³⁴ *ibid*, pp 65–8.

- Introducing tradable ‘vouchers’ to reward new antibiotics (an idea currently under consideration in the US), which could be used to speed up the approval process for new drugs or used to extend market exclusivity for a drug developer. Although the Review noted some potential issues with the system, mostly related to possible costs on patients and healthcare systems, it did suggest it could work in some jurisdictions.

Implementation and Next Steps

The Review reasoned that the work to tackle AMR would require the creation of a specific international entity, although it remained open about how this could be organised:

A wholly new organisation may need to be created or an existing one could create a group focused on driving global solutions for AMR. We are conscious of the burden that establishing a new institution could create, and also of the global debate at present surrounding the role and function of key bodies within the global health architecture. Efforts should be made to consider in the first instance which existing institutions might be best placed to manage supra-national incentives for addressing AMR, rather than jumping to conclusions about the need for establishing a brand new body. At the very least, a supra-national entity is required to set the global priorities on AMR [...]

This assessment of risks and priorities needs to be agreed based on global patterns of disease. This approach will ultimately deliver benefits to all. The needs and risks from drug resistance will change with time and will need to be reconsidered and updated. A lot of this can be done by strengthening or coordinating the work of existing institutions (including the WHO, the Food and Agriculture Organisation of the United Nations (FAO), and the World Organisation for Animal Health (OIE)) but it will need more power and focus than existing institutional arrangements to deliver clear and agreed priorities across sectors and across regions. It would benefit from having one organisation solely focused on delivering results in tackling AMR.³⁵

The report also spoke of the importance of discussions on a national level to improve purchasing arrangements so as to preserve antimicrobials, and highlighted a number of upcoming opportunities for international organisations to discuss how AMR would be tackled.³⁶ In particular, the Review noted that the September 2016 meeting of the United Nations annual General Assembly featured AMR as an agenda item for the first time in a High Level Meeting. This meeting is due to take place on 21 September 2016, with the UN setting out the following details on its website:

On 21 September 2016, the President of the UN General Assembly convenes a one-day high-level meeting at the UN Headquarters in New York on “Antimicrobial Resistance”, with the participation of Member States, non-governmental organizations, civil society, the private sector and academic institutions, in order to provide input. The primary objective of the meeting is to summon and maintain strong national, regional and international political commitment in addressing antimicrobial resistance comprehensively and multi-sectorally, and to increase and improve awareness of antimicrobial resistance.

³⁵ Review on Antimicrobial Resistance, [Tackling Drug-resistant Infections Globally: Final Report and Recommendations](#), 19 May 2016, p 69.

³⁶ *ibid*, pp 69–70.

The meeting emphasizes the important role and the responsibilities of governments, as well as the role of relevant inter-governmental organizations, particularly the World Health Organization within its mandate and in coordination with FAO and OIE, as appropriate, in responding to the challenges of antimicrobial resistance, and the essential need for multi-sectorial and cross-sectorial efforts and engagement of all relevant sectors of society—such as human and veterinary medicine, agriculture, finance, environment and consumers—to generate an effective response, including towards a one-health approach.³⁷

3. UK Strategy on Tackling AMR

3.1 UK Five Year Antimicrobial Resistance Strategy

In addition to supporting the work of the Review, the Coalition Government published a five-year strategy for addressing AMR.³⁸ This was originally published in September 2013, and expires in 2018. The strategy document stated:

The overarching goal of the strategy is to slow the development and spread of AMR. It focuses activities around 3 strategic aims:

- improve the knowledge and understanding of AMR.
- conserve and steward the effectiveness of existing treatments.
- stimulate the development of new antibiotics, diagnostics and novel therapies.³⁹

The strategy listed seven key areas for action in pursuit of these aims, namely:⁴⁰

- Improving infection prevention and control practices (through measures connected to hygiene and good farm management, for example).
- Optimising prescribing practice (the strategy highlighted genomic technologies as a further potential means to improve appropriate, prompt patient treatment).
- Improving professional education, training and public engagement (eg by ensuring that continuing professional development courses for clinicians focus on appropriate antibiotic use and that more is done to raise public awareness of the issue).
- Developing new drugs, treatments and diagnostics (for example, addressing commercial viability issues and improving the regulatory regimes connected to the licensing and approval of antibiotics).

³⁷ General Assembly of the United Nations, '[High-level Meeting on Antimicrobial Resistance](#)', accessed 2 September 2016. The concept of 'one-health' is connected to the idea that the health of humans, animals and ecosystems are interconnected and therefore tackling potential or existing risks often requires a collaborative or cross-sectoral approach (see: One Health Global Network, '[What is One Health?](#)', accessed 6 September 2016).

³⁸ Department of Health and the Department for Environment, Food and Rural Affairs, [UK Five Year Antimicrobial Resistance Strategy: 2013 to 2018](#), September 2013.

³⁹ *ibid*, p 7.

⁴⁰ *ibid*, pp 16–20.

- Better access to and use of surveillance data that focuses on bacterial resistance, the epidemiology of bacterial infections, drug utilisation and clinical outcomes.
- Better identification and prioritisation of AMR research needs, therefore ensuring evidence gaps in AMR research are targeted.

Strengthened international collaboration. The strategy states that the UK has already played a “leading role in influencing European and international thinking, seeking support, securing commitments to prioritise the issue and mobilising action to deliver the scale of change needed”, and that this has raised the profile of the issue at an international level.⁴¹ Despite this, the strategy called for increased collaborative working at an international level and for further joint initiatives along the lines of the [EU/USA Transatlantic Task Force on AMR](#).

Further details on how it proposed the actions in these areas should be implemented can be found in the full strategy document. The strategy document concluded that:

The comprehensive programme of work set out in this strategy, if implemented effectively, will deliver significant improvements in the way AMR is addressed, provide a solid foundation to bring about some fundamental changes in approach and capability that will extend beyond the five year term.⁴²

The Coalition Government published a progress report and implementation plan for the strategy in December 2014.⁴³ The report detailed progress under the headings: prescribing; behaviour change; research; international collaboration; and new drug development and improved diagnostics.⁴⁴ The progress listed under these headings included the publication of national antimicrobial prescribing quality measures, the UK’s collaboration with Sweden to aid the development of the [WHO’s Global Action Plan](#) and the establishment of the [AMR Research Funders’ Forum](#). Based on the reported progress, the document stated:

Together, these achievements form a valuable basis from which to progress the work set out in the implementation plan. The emerging use and resistance data provide a benchmark to measure progress in achieving the aims of the strategy. Sustained activity is required, and our focus now is on strengthened accountability for consistent delivery of local infection prevention and control practices and antimicrobial stewardship.

Our aim is to reach a point where all health and care providers are reporting into national surveillance systems and receive feedback on surveillance outputs in a format that is useable and relevant to support good practice. Over the next four years, data on antibiotic prescribing/consumption for individual animal species will be collected for the first time.

We want, in the first instance, to return total antibiotic prescribing to 2010 levels in primary care (Clinical Commissioning Group level); to 2012 levels in secondary care (Area Team level) and increased diversity in prescribing (reduce inappropriate use of

⁴¹ Department of Health and the Department for Environment, Food and Rural Affairs, [UK Five Year Antimicrobial Resistance Strategy: 2013 to 2018](#), September 2013, p 19.

⁴² *ibid*, pp 29–30.

⁴³ HM Government, [UK 5 Year Antimicrobial Resistance \(AMR\) Strategy 2013–2018: Annual Progress Report and Implementation Plan, 2014](#), December 2014.

⁴⁴ *ibid*, pp 3–5.

broad spectrum antibiotics) in both primary and secondary care. We also want to reduce antimicrobial use in livestock production in real terms over the next four years.⁴⁵

3.2 Other UK Resources

In addition to the UK's five-year strategy, the UK Government has published a website of resources on AMR. This includes links to clinical or technical guidance, research publications, resources for healthcare professionals and resources for livestock professionals. As part of the work in this area, the Government also published a report in July 2015 on human and animal antibiotic use, sales and resistance in the UK in 2013.⁴⁶ It reported recent UK data on antibiotic resistance in key bacteria that are common to animals and humans and detailed the amount of antibiotics sold for animal health and welfare and antibiotics prescribed to humans. For example, it reported on antibiotic resistance rates for treatments connected to escherichia coli (E. coli), campylobacter and salmonella.⁴⁷ As to usage levels, the report stated that:

In 2013, total antibiotics dispensed to humans through prescriptions was 531.2 tonnes and total sales for animal use comprised 418.7 tonnes. Consumption of systemic antibiotics and intestinal antibiotics in humans equated to 135mg per kg of human biomass. Sales of antibiotics for systemic, intramammary and intestinal use in food producing animals equated to 55.6mg per kg.⁴⁸

Based on its findings, the report also set out ten public health recommendations for national human and animal organisations to take forward.⁴⁹ For example, the report recommended that public health organisations should analyse data on human sales of antibiotics from manufacturers and other authorised bodies and should “support the work of professional organisations to transition UK clinical laboratories to a single standardised nationally agreed methodology for routine antibiotic testing”.⁵⁰

On 10 March 2016, NHS England announced a national programme to combat the overuse of antibiotics.⁵¹ Starting in April 2016, NHS England stated that:

The programme offers hospitals incentive funding worth up to £150 million to support expert pharmacists and clinicians review and reduce inappropriate prescribing. Clinical commissioning groups are being supported to reduce the number of antibiotics prescribed in primary care by 4 percent, or to the average performance levels of 2013/14. Hospital trusts will also receive payments for gathering and sharing evidence of antibiotic consumption and review within 72 hours of the beginning of treatment.⁵²

⁴⁵ HM Government, [UK 5 Year Antimicrobial Resistance \(AMR\) Strategy 2013–2018: Annual Progress Report and Implementation Plan, 2014](#), December 2014, p 5.

⁴⁶ HM Government, [UK One Health Report: Joint Report on Human and Animal Antibiotic Use, Sales and Resistance, 2013](#), July 2015.

⁴⁷ *ibid*, pp 10–11.

⁴⁸ *ibid*, p 12.

⁴⁹ *ibid*, pp 13–14.

⁵⁰ *ibid*, p 13.

⁵¹ NHS England, [‘NHS England Launches National Programme to Combat Antibiotic Overusage’](#), 10 March 2016.

⁵² NHS England, [‘Antimicrobial Resistance’](#), accessed 5 September 2016.

4. World Health Organisation's Strategy on Tackling AMR

The World Health Organisation published a global action plan for tackling AMR in 2015.⁵³ The WHO stated that “the goal of the draft global action plan is 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”.⁵⁴ The WHO highlighted the “slow progress” made on tackling AMR over recent years, which it suggested was due to inadequate reporting and monitoring at national, regional and global levels and also due to a lack of recognition by stakeholders of the need to take action in their respective areas. As such, the WHO stated:

At the national level, operational action plans to combat antimicrobial resistance are needed to support strategic frameworks. All Member States are urged to have in place, within two years of the endorsement of the action plan by the Health Assembly, national action plans on antimicrobial resistance that are aligned with the global action plan and with standards and guidelines established by intergovernmental bodies such as the Codex Alimentarius Commission, FAO and OIE. These national action plans are needed to provide the basis for an assessment of the resource needs, and should take into account national and regional priorities. Partners and other stakeholders, including FAO, OIE, the World Bank, industry associations and foundations, should also put in place and implement action plans in their respective field of responsibility to counter antimicrobial resistance, and report progress as part of their reporting cycles.⁵⁵

It then set out five strategic objectives to work towards the goal of ensuring the continued treatment and prevention of infectious diseases with effective and safe medicines, namely:

- **Objective 1:** Improve awareness and understanding of antimicrobial resistance through effective communication, education and training.
- **Objective 2:** Strengthen the knowledge and evidence base through surveillance and research.
- **Objective 3:** Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures.
- **Objective 4:** Optimize the use of antimicrobial medicines in human and animal health.
- **Objective 5:** 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.⁵⁶

For each of these objectives, the organisation set out detailed guidance on how each should be achieved in the framework published on pages 12 to 19 of the action plan. This framework was divided up into actions to be taken by member states, the Secretariat and by international and

⁵³ World Health Organisation, [Global Action Plan on Antimicrobial Resistance](#), 2015.

⁵⁴ *ibid*, p 1.

⁵⁵ *ibid*, 2015, p 5.

⁵⁶ *ibid*, pp 8–11.

national partners (such as the FAO, OIE and the World Bank). For example, objective one included the following recommendations:

- Member States to increase awareness of antimicrobial resistance through public communication programmes.
- The Secretariat to develop and implement global communication programmes and campaigns, including an annual world antibiotic awareness campaign, building on existing regional and national campaigns and in partnership with other organizations (such as UNESCO and UNICEF).
- Intergovernmental organizations, including FAO, OIE and the World Bank, should raise awareness and understanding of antimicrobial resistance and, in collaboration with WHO, should mirror the actions of the Secretariat within their constituencies.⁵⁷

In addition, on 29 April 2015, the WHO published the results of an initial two-year analysis (conducted from 2013 to 2014) to determine the extent to which countries had put in place effective practices and structures to address antimicrobial resistance.⁵⁸ The report's findings indicated the extent to which countries had action plans for AMR or monitored the issue varied, with lower income countries less likely to have the infrastructure to monitor for AMR or have access to high-quality medicines.⁵⁹ The report also found that public awareness of AMR was generally low in all regions and that:

The sale of antimicrobial medicines without prescription was widespread, and many countries lacked standard treatment guidelines for health care workers. Thus, overuse of antimicrobial medicines by the public and by the medical profession was a potential problem in all regions.⁶⁰

The WHO website contains further resources on AMR, including information on specific diseases or infections, additional material on the five strategic objectives set out in the action plan, access to a [regular newsletter](#) and information relating to [World Antibiotic Awareness Week 2016](#) (which this year runs from 14–20 November 2016).

5. Further Resources

The following is a list of further resources from national and international bodies relating to AMR, including websites containing information as to how different organisations are planning on tackling the issue and reports on specific aspects of the issue:

- Food and Agriculture Organisation of the United Nations, '[Antimicrobial Resistance](#)', accessed 5 September 2016
- World Organisation for Animal Health, '[Antimicrobial Resistance](#)', accessed 5 September 2016

⁵⁷ World Health Organisation, [Global Action Plan on Antimicrobial Resistance](#), 2015, p 12.

⁵⁸ World Health Organisation, [Worldwide Country Situation Analysis: Response to Antimicrobial Resistance](#), 29 April 2015.

⁵⁹ *ibid*, p 37.

⁶⁰ *ibid*.

- European Commission, '[Antimicrobial Resistance](#)', accessed 5 September 2016 (including links to action being taken at an [EU level](#) and at a [global level](#))
- Organisation for Economic Co-operation and Development, [Antimicrobial Resistance in G7 Countries and Beyond: Economic Issues, Policies and Options for Action](#), September 2015
- NHS England, '[Antimicrobial Resistance](#)', accessed 5 September 2016
- Public Health England, '[Antibiotic Guardian](#)', accessed 5 September (campaign encouraging people to make pledges to improve the use of antibiotics)

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