National Audit Office

REPORT

Investigation into how government is addressing antimicrobial resistance

Department of Health & Social Care,
Department for Environment, Food & Rural Affairs

SESSION 2024-25
26 FEBRUARY 2025
HC 690

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Department of Health & Social Care, Department for Environment, Food & Rural Affairs

Report by the Comptroller and Auditor General

Ordered by the House of Commons
to be printed on 24 February 2025

This report has been prepared under Section 6 of the National Audit Act 1983 for presentation to the House of Commons in accordance with Section 9 of the Act

Gareth Davies
Comptroller and Auditor General
National Audit Office

18 February 2025

HC 690 | £10.00

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015484 02/25 NAO

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What this investigation is about

1 Antimicrobial medicines, including antibiotics, are widely used to treat infections and prevent their spread. An inevitable consequence of using antimicrobials is that pathogens (organisms which cause disease) evolve to develop resistance to them. Antimicrobial resistance (AMR) is common around the world, driven in part by misuse and overuse of antimicrobials. This is a major public health concern because it means antibiotics and other antimicrobials may be ineffective, both today and increasingly in the future.

2 For some years, the World Health Organization and other international bodies have urged countries to take wide-ranging measures to reduce the spread of AMR. In the UK, such action involves multiple public bodies including the Department for Health & Social Care (DHSC), the Department for Environment, Food & Rural Affairs (Defra), where AMR policy is led by the Veterinary Medicines Directorate (VMD), and the devolved administrations of Northern Ireland, Scotland and Wales. These and other public bodies have been coordinating their activities using five-year national action plans.

3 We are investigating the government's response to AMR because it is a serious public health threat, and because the UK's experiences during the COVID-19 pandemic showed the country was not as resilient to such threats as it expected to be.

Our scope

4 This report sets out information on the risk posed by AMR and the UK government's response. It focuses on the response in England, where the UK government has responsibility for the NHS and key aspects of animal health and environmental policy. It does not cover responses in the devolved administrations.[1] In the body of the report we consider:

- why AMR is an increasing threat (Part One);
- the UK government's response in the last five years (Part Two); and
- challenges and opportunities over the next five years (Part Three).

1 These functions of the devolved administrations may be subject to audit by Audit Scotland, Audit Wales and the Northern Ireland Audit Office.

Summary

Key findings

The risks posed by antimicrobial resistance

5 Antimicrobial resistance (AMR) is a major public health threat; poor practices across the world, including in the UK, have worsened the problem. AMR occurs naturally, but globally its acceleration is driven partly by people's misuse and overuse of antimicrobials in humans, animals and plants, as well as subsequent transmission of resistant pathogens, including in food and the environment. Poor practices include using antimicrobials when they are unnecessary (for example, prescribing antibiotics to treat a viral infection, against which they are inert), using the wrong antimicrobials (for example, not prescribing the most suitable antibiotic), or using antimicrobials for longer than necessary. Academic research refers to much antibiotic use in humans being inappropriate, while in England 20% of antibiotics prescribed in primary care are inappropriate. Inadequate infection, prevention and control measures and poor sanitation and hygiene practices increase the problem. There is a growing risk that the antimicrobials humanity relies on will no longer work to treat infections (paragraphs 1.4 to 1.6, 1.9 and 1.10, and Figure 1).

6 Development of new antimicrobials has slowed and is insufficient to withstand or reverse increasing AMR. A response to AMR is to develop new antimicrobials. However, only one new class of antibiotic (the most used type of antimicrobials) in use has been discovered since 1987. This is understood to be a global market failure – the financial returns to pharmaceutical companies from discovering antibiotics are insufficient to incentivise investment, even though new antibiotics would be of great public value. Furthermore – with existing antibiotics as other drugs – the market incentive is to sell in large volumes. But from the point of view of public health it would be better to hold antibiotics that continue to work against resistant pathogens in reserve for only the most serious cases (paragraphs 1.6 and 1.12 to 1.14).

7 There are huge foreseeable consequences for the world, including UK citizens, if humanity fails to address increasing resistance. AMR contributes to an estimated 5 million deaths globally each year; out of these, it is directly responsible for an estimated 1.3 million deaths. In the UK, AMR contributes to an estimated 35,200 deaths, of which it is directly responsible for 7,600 deaths. Research suggests that by 2050 AMR is likely to contribute to an estimated 8.2 million deaths globally each year, of which it would be directly responsible for 1.9 million. The future health effects will not be evenly spread. Health inequalities could worsen, and several groups will be disproportionately affected, particularly babies and the elderly, people with lower socio-economic status, and specific ethnic groups. Prior to antibiotics, infections were the most common cause of death, and life expectancy was on average 20 years lower. The World Bank estimates that AMR could result in $1.2 trillion of additional healthcare costs by 2050. Treating AMR infections already costs the NHS in England an estimated £180 million per year. If AMR continues to advance it may have a negative impact on some people's ability to work, and therefore on the wider economies of affected countries. Resistant pathogens in animals also present risks to their health and welfare, productivity, and food security (paragraphs 1.15 to 1.18).

The UK's National Action Plan 2019–2024

8 The UK government has taken a structured, cross-government approach to AMR for over a decade. Since 2013, there have been three five-year national strategies or action plans, covering 2013–2018, 2019–2024 and 2024–2029. The government also published a 20-year vision in 2019, which aims to see AMR effectively contained, controlled and mitigated by 2040. All include coverage of human health, animal health, food safety and the environment, which is known as a 'One Health' approach. Governance and proposed actions have covered the whole UK, including the devolved administrations. The UK has also sought to play a leading role in international advocacy and supporting the global fight against AMR (paragraphs 2.2 to 2.8 and Figure 3 and Figure 4).

9 The UK National Action Plan 2019–2024 (NAP19–24) was a coherent 'One Health' programme for tackling AMR, though there were some significant gaps. NAP19–24 identified five quantified targets and 133 commitments to reduce the burden of infection, optimise antimicrobial use, and invest in innovation and research. Some of the proposed actions sought ambitious change either in the UK or globally, including major reductions in human infections and antimicrobial use in agriculture. Others were exploratory or procedural in nature, such as gathering evidence on environmental risks from AMR. An external evaluation suggested that NAP19–24 paid less attention to the UK's aquatic environment than the importance of this issue warranted, and there was also limited coverage of social care and health inequalities (paragraphs 2.5 to 2.7, 2.35 and 2.38, and Figure 3).

10 The government spent around £567 million directly on AMR programmes between 2020-21 and 2023-24, while much more public money is spent on relevant activities like purchasing antibiotics and cleaning hospitals. The Department for Health & Social Care (DHSC) and its arm's-length bodies spent most of the direct funding, including £417 million DHSC spent on research and international aid. The Department for Environment, Food & Rural Affairs (Defra) allocated much less funding to AMR, spending around £16 million. To make the progress it has, Defra has relied on persuading the private veterinary sector and other external stakeholders to take voluntary measures. Overall, direct funding remained steady in real terms over the period of NAP19–24. However, some AMR programme staff were redirected from AMR to address the COVID-19 pandemic. A substantial amount of other spending is relevant to AMR, including antibiotic prescriptions, hospital cleaning, constructing new hospitals that are easier to keep clean, and investment in reducing wastewater spills (paragraphs 2.9 and 2.10, and Figure 5).

11 Only one of the government's five quantified domestic targets in NAP19–24 was met or on track to be met in the latest data.

- **There has been no sustained reduction in the amount of AMR-related human infections that the government tracks.** DHSC aimed to reduce human drug-resistant infections by 10% between 2018 and 2025. However, by 2023 infections in England had risen to 13% above the 2018 baseline. Similarly, a target to halve healthcare-associated Gram-negative bloodstream infections by 2023-24 was missed, with the number of infections reducing only slightly.[2] DHSC and the UK Health Security Agency (UKHSA) now consider that the original targets were overambitious due to basing targets on previous success in addressing MRSA infections, which turned out not to be comparable. They also point to the COVID-19 pandemic as a phenomenon that placed the NHS under financial and operational pressure, disrupting plans and making it harder to interpret trends in the data. On both targets, data for 2020-21 showed improvements, but this turned out to be a temporary, pandemic-associated dip (paragraphs 2.14 to 2.18 and 2.35, and Figure 6 and Figure 7).
- **Human usage of antibiotics has reduced in England, but by less than targeted.** DHSC aimed to reduce usage by 15% by 2024, through better diagnostics and prescribing, and by educating clinicians and the public. Again, usage fell significantly in 2020 and 2021 before rising, so that the level in 2023 was only slightly lower than in 2018. DHSC attributes this to a post-pandemic increase in circulating infections which increased demand for antibiotics. A shift from face-to-face to online GP appointments may also have contributed, with some research suggesting GPs may be more likely to prescribe antimicrobials during virtual interactions (paragraphs 2.19 and 2.20, and Figure 8).

2 Gram-negative refers to a group of bacteria which are named after the laboratory test used to identify them. They are the leading cause of healthcare-associated bloodstream infections and include a range of bacteria including *E. coli*.

- **The AMR programme failed to meet a target to report on the percentage of antibiotic prescriptions that are supported by an objective diagnostic test.** NHS England advised it would not be possible to measure the target reliably. Increasing the proportion of antibiotics issued after a diagnostic test was seen as crucial by the authors of the UK's 2016 review of antimicrobial resistance, because it could cut the volume of incorrect prescribing (paragraphs 2.11, 2.13, and 2.35).

- **The target for reducing antimicrobial use in food-producing animals in the UK was met one year late, in 2021, with subsequent targets also mostly achieved.** The target for a 25% reduction between 2016 and 2020 was narrowly missed in 2020 (22.6%), but achieved in 2021. Further targets were set for 2021 to 2024, and most were achieved. However, Defra is concerned that additional reductions could prove harder to secure, likely requiring fresh approaches and measures (paragraphs 2.21 and 2.22, and Figure 9).

12 NAP19–24 had 128 other commitments for DHSC and Defra to implement; some have produced valuable results but by the start of 2024 the government had only implemented seven in full. NAP19–24 included 128 commitments relating to the UK or England which were owned by DHSC and Defra (and 133 including those owned exclusively by devolved administrations). Of these, by January 2024, they had completed seven and they assessed that a further 46 were highly likely to be delivered successfully. The 128 commitments had no explicit deadlines, making it difficult both to assess progress and manage delivery (paragraphs 2.23 and 2.24, and Figure 10).

13 NHS England has made progress with a key commitment to find innovative ways to pay for antibiotics. NAP19–24 committed the NHS to exploring a new payment model which sees it pay a flat rate, or subscription, to pharmaceutical companies for certain important antimicrobial drugs, rather than paying for the quantity that patients consume. This aimed to incentivise the development of new antimicrobials while simultaneously facilitating reductions in their overall use. NHS England has now tested subscription arrangements for two antibiotics and expects to let further contracts in 2026. The UK is among the first countries to attempt such a model, which might be adopted by other nations. NHS England will need ongoing evaluation of the impact of its approach. The cost of the first round of contracts is substantial, an estimated £1.9 billion for supplying these antimicrobials to the NHS over 16 years. The effects remain uncertain given that the UK is only 3% of the global market for antibiotics. Pharmaceutical companies will remain free to determine whether or not they invest more in developing new antimicrobials, and are free to market these antimicrobials to other countries (paragraphs 2.25 to 2.29).

14 In 2019, awareness of AMR among health workers and the public needed to improve; it is not clear that it has. Health workers having accurate knowledge of AMR is important, so they advise and treat patients in ways that promote good stewardship. However, a 2019 survey of UK health workers found that only 59% could correctly answer a set of questions about antibiotic use and antimicrobial resistance, and only 78% felt they knew enough about the subject. When a 2024 survey asked the same set of questions, 62% of respondents answered correctly. Meanwhile, 90% of the UK public knew antibiotics were becoming ineffective but only 49% knew that antibiotics do not work against viruses. UKHSA has run some awareness and education campaigns, but there is limited evidence so far of their impact. Since the COVID-19 pandemic, health workers and the public alike have become more familiar with the principles of good infection prevention and control (paragraphs 2.30 to 2.32).

15 Assessments of NAP19–24's contents were broadly positive while recognising the problems with implementation. An academic review of 114 countries' national action plans ranked the UK's NAP19–24 third after Norway and the USA. Areas of strength included coordination, regulation and research. Areas for improvement included education, public awareness and accountability. An independent evaluation highlighted several gaps in NAP19-24's implementation, including the absence of a central diagnostics data source, limited surveillance of antibiotic use in cattle and sheep, and challenges from understaffing. It was particularly critical of the UK's management of wastewater, where it found a lack of baseline data and coordination (paragraphs 2.35 to 2.38).

The UK's future plans for addressing AMR

16 The National Action Plan 2024–29 (NAP24–29) has streamlined the previous approach and added new areas of focus. The government published NAP24–29 in May 2024. It continues the same themes as NAP19–24 but adds an additional one: being a good global partner (although global activity was already important in the past). There has been a change of emphasis, with more focus on factors that can affect the further development of AMR – a whole system approach to infection prevention and management, public engagement and education, and surveillance – and on health inequalities. Overall, the number of specific commitments has substantially reduced, from 133 to 30 more high-level strategic commitments. This is to enable a better focus on the monitoring of delivery. The role of adult social care as a setting for AMR risks has more prominence than previously, recognising that most deaths from AMR infections are in elderly people. Only four of the 133 commitments referred to social care in NAP19–24, whereas NAP24–29 refers to social care in six of its 30 commitments (paragraphs 3.2 and 3.3, and Figure 11).

17 NAP24–29 has less stretching targets that ought to be more achievable than those in NAP19–24, but in some cases it is unclear to us whether meeting the targets would represent progress towards the 20-year vision the UK set in 2019. NAP24–29 has new quantitative targets on Gram-negative and drug-resistant infections, and on human antibiotic usage, but they seek much less change than the NAP19-24 targets. With regard to human infection levels, the government aims to freeze these at 2019–20 levels, believing this to be very challenging to achieve because of the UK's ageing population, which has an increased number of co-morbidities and susceptibility to infection. But this would mean, other things being equal, that the UK continued to have the same burden of infection as it did in 2019-20 and continued to make the same contribution to increasing AMR. DHSC's view is that lowering these targets was necessary to make them achievable and realistic, and to get support from the healthcare system. The quantitative target on diagnostics was removed because it was deemed not to be measurable. There is no target regarding animal health, though the government told us that it hopes to endorse new targets that will be published in 2025 by the Responsible Use of Medicines in Agriculture Alliance. A new target has been added on the public's and healthcare professionals' knowledge of AMR (paragraphs 3.4 to 3.7 and Figure 11).

18 NAP24–29 has no quantitative target relating to environmental drivers of AMR, which experts agree pose a significant challenge. Research has shown that chemicals and residues in the aquatic environment affect the prevalence and diversity of AMR. In the UK, this impact is likely being exacerbated by the increasing incidence of untreated wastewater entering waterways. Environmental drivers of AMR were not a major focus of the previous NAP, and more progress needs to be made during the life of NAP24–29. Defra officials told us that their focus is on the water companies' investment in wastewater treatment and in reducing storm overflows, and that this will have a beneficial effect on wastewater as a potential source of AMR and infection (paragraphs 3.16 to 3.19).

19 There remain many gaps in knowledge of AMR and how best to manage it. Data on human health are generally strong in the UK; however, there are still key areas for improvement, particularly in understanding health inequalities and the extent to which objective diagnostic testing can support doctors when they are prescribing antimicrobials. In animal health, the gaps are still greater, with limited data on resistance and antimicrobial use in certain livestock species, such as cattle and sheep, and for pets (known as companion animals). The Food Standards Agency (FSA) led a programme with fixed-term funding to measure prevalence and transmission of AMR within the environment and agri-food systems –the Pathogen Surveillance in Agriculture, Food and Environment (PATH-SAFE) programme – but Defra told us that this activity will not continue after funding ends in March 2025. DHSC and Defra aim to address knowledge gaps by encouraging research proposals in the top 10 priority areas in NAP24–29 (paragraphs 3.14 and 3.20 to 3.23).

20 AMR is and will always remain a global phenomenon; the UK and other concerned nations need to move the global community towards measurable, verifiable change. Individually, the UK's internal efforts can provide only limited insulation from rising AMR, though, at their best, they can be templates for others to adopt. To date, partly through NAP19–24, the UK has helped to grow the number of nations that are concerned about AMR and has supported lower- and middle-income countries to improve their surveillance and management of AMR. However, as the UK recognises, further action is urgently needed internationally (paragraphs 1.10, 1.17, 2.1, 2.6 and 2.7, and Figure 11).

21 The Cabinet Office and the Government Office for Science have recently identified AMR as one of 26 chronic risks facing the UK, and intend this analysis to influence government policymaking and spending decisions. Chronic risks are those which pose a continuous challenge to the UK economy and our way of life, as opposed to acute risks which require an emergency response. The government has established a new process for identifying and assessing chronic risks that require a sustained response, of which AMR is one. It is one of only six chronic risks that the analysis directly links to loss of human life, and there are circumstances in which it could present an acute risk demanding an emergency response. The Cabinet Office is currently working with HM Treasury to take a joined-up approach to risk and resilience in the 2025 Spending Review. The Cabinet Office has not made public its chronic risk analysis, but doing so might contribute to increasing wider public awareness of AMR. To date, we are not aware that there has ever been a national resilience exercise which incorporated an AMR dimension (paragraphs 3.24 to 3.30).

Concluding remarks

22 AMR is a serious threat to the health of the public both in the UK and globally, and has the capacity to change our society radically for the worse, with negative consequences for individual human and animal health, for life expectancy, and for the functioning of the NHS, adult social care, and the wider economy, including food security. Although AMR is an inevitable consequence of using antimicrobials, it is also a threat exacerbated by human activity that has been given insufficient attention for a long time. The UK government has been taking seriously its responsibility to address the issue in the UK and to try to coordinate and strengthen international responses. In its national action plans it has adopted a cross-government, multi-disciplinary approach and in some areas has been willing to consider innovative solutions.

23 The limited progress made with NAP19–24 shows how difficult it is to achieve change. The COVID-19 pandemic had a disruptive effect, but more fundamentally it is proving hard to shift the expectations and behaviours of millions of citizens and thousands of public and private institutions, when they continue to find current practices necessary or convenient. The UK's fight against AMR is further complicated by the fact that its population is ageing and spending more years in ill health, both currently correlated with increased antimicrobial use. Sharp reductions in the sales of antimicrobials for animal use show that major changes can be achieved. But the UK remains a long way from the 20-year vision the government expressed in 2019: to control, contain and mitigate AMR through a lower burden of infection, the optimal use of antimicrobials, and new treatments so that everyday illnesses can continue to be cured.

Specific areas for the government to consider

24 As the government takes forwards NAP24–29, we think it should consider the following matters.

a How delivery of its current targets and commitments can be more successful than in NAP19–24, including through the use of strengthened performance monitoring and deadlines for implementation.

b Whether targets for no increase in a range of human infections are stretching enough to make a contribution to the vision of reducing the burden of infection.

c How the results of the new NHS antibiotic subscription model will be tracked, evaluated and made public, including any effects on the research and development of new drugs.

d What the UK's aquatic environment is currently contributing to rising AMR, particularly wastewater treatment and spills, and, as a result, whether new commitments or targets are needed in this area.

e How maximum beneficial impact can be achieved from the classification of AMR as a chronic risk and whether there is value in publishing the government's full list of chronic risks so that universities, funding bodies, businesses and other institutions can better understand the public sector's priorities for research and innovation.

f Whether a national preparedness exercise with a significant AMR dimension should be carried out.

Part One

Why antimicrobial resistance is an increasing threat

1.1 This part explains why it is very important for the UK government, and governments around the world, to address the problem of antimicrobial resistance (AMR). It covers the following questions.

- What is AMR?
- Why is it worsening?
- How widespread is it?
- Why has the development of new antibiotics slowed?
- What are the current and potential consequences?

What is AMR?

1.2 Antimicrobials are a category of therapeutic substances which include antibiotics, antivirals, antifungals, antiparasitics and antiseptics. They are widely used in human healthcare, animal healthcare and agriculture to treat infections and prevent their spread. Antimicrobials work by either killing microorganisms or stopping their growth. Antimicrobials are grouped according to the pathogen they target: antibiotics against bacteria, antivirals against viral infections, and so on.

1.3 An inevitable consequence of using antimicrobials is that organisms which cause disease (pathogens) can develop resistance to treatments they were previously susceptible to. This results in infections no longer responding to treatment, or having limited treatment options, which can lead to more prolonged or severe illness or death. The threat of AMR affects everyone, as anyone can acquire a resistant infection. While AMR is a natural process that occurs as pathogens evolve, there has been a marked increase in developed resistance as the human production and use of antimicrobials have increased, and due to an increasing infection burden. This issue has been given insufficient attention for a long time.

1.4 Resistance in bacteria such as *Mycobacterium tuberculosis* now present major global threats. Today's tuberculosis patients are frequently incurable by standard treatments, known as first-line treatments, and some infections will resist even last-resort antibiotics if a patient has contracted an extensively drug-resistant strain of the bacteria. Multidrug-resistant tuberculosis resulted in an estimated 191,000 deaths globally in 2021 (around 15% of the deaths caused by AMR).

Why is AMR worsening?

1.5 According to the World Health Organization, AMR is driven in large part by the misuse and overuse of antimicrobials. Poor practices in antibiotic use include using them when they are not needed (for example, to treat a viral infection, against which they are inert), using the wrong antibiotics (for example, not prescribing the most suitable antibiotic), or using antimicrobials for longer than necessary (which can increase the risk of pathogens developing resistance).

1.6 For some time, important pathogens have been developing resistance faster than new treatments are developed. All but one of the classes of antibiotics currently in use are based on those discovered between 1928 and 1987. As pathogens develop resistance to additional antibiotics, the list of treatments shortens, especially those which are optimally effective or less toxic.

1.7 The speed with which pathogens acquire resistance is related to the amount of exposure they get to antimicrobials. In addition to their use and misuse in human healthcare, antimicrobials are used or present in many other settings, including:

- sites where pharmaceuticals and other chemicals are manufactured;
- veterinary medicine for food-producing animals (livestock and aquatic);
- veterinary medicine for domestic pets;
- production of food crops; and
- wastewater and sanitation facilities.

1.8 In the UK, 706 tonnes of antibiotics were consumed in 2019, of which 68% by weight was by people, with the remainder by animals. Academic research regularly refers to an estimate that as much as half of global antibiotic use for humans may be inappropriate. In 2018, Public Health England reported that 20% of antibiotics prescribed in human primary care in England were inappropriate.[3] Sepsis is a leading cause of death in the UK, and it is treatable with antimicrobials. Clinicians may therefore prescribe them as a precautionary measure for infections. However, the overuse of antimicrobials for suspected sepsis contributes significantly to AMR.

1.9 In addition, inadequate infection, prevention and control measures contribute to higher infection rates, which increase pathogens' opportunity to develop resistance. Prevention more generally is a cornerstone of reducing AMR, including good hygiene but also vaccination programmes and the isolation of patients with potentially transmittable pathogens.

3 Public Health England, *Research reveals levels of inappropriate prescriptions in England*, press release, 27 February 2018.

1.10 AMR spreads globally, meaning that individual countries like the UK are significantly affected by developments elsewhere. Resistant pathogens can travel around the world in water, on plastics, via humans who are currently infected or have been colonised by resistant bacteria, via animals and animal products, via human and animal waste and the soil around it, and by being absorbed into the atmosphere and rained down elsewhere (**Figure 1** overleaf). Residues of prescribed antibiotics enter the wider environment in large quantities. Between 30% and 90% of antibiotics used in animals are released into urine and faeces, and the figures for humans are similar.

How widespread is AMR?

1.11 The Organisation for Economic Co-operation and Development has collated data on reported levels of antibiotic resistance around the world. In countries of the European Union/European Economic Area in 2019, for the infection types of greatest concern, there was resistance to antibiotics in 22% of human infections. In comparison, resistance was present in the UK on average in 11% of infections (**Figure 2** on page 17). Some countries have lower average resistance levels, with Denmark reporting the lowest (6%). In the UK, some pathogens are more frequently resistant than others. The worst case is *Acinetobacter baumannii*, a Gram-negative pathogen which causes lung, bloodstream, urinary tract and skin infections in people who have major illness or compromised immunity, and has a high mortality rate. This pathogen is now considered to be resistant to most first-line antibiotics, and in some cases has also developed resistance against 'last-line-of-defence' antibiotics.

Why has the development of new antibiotics slowed?

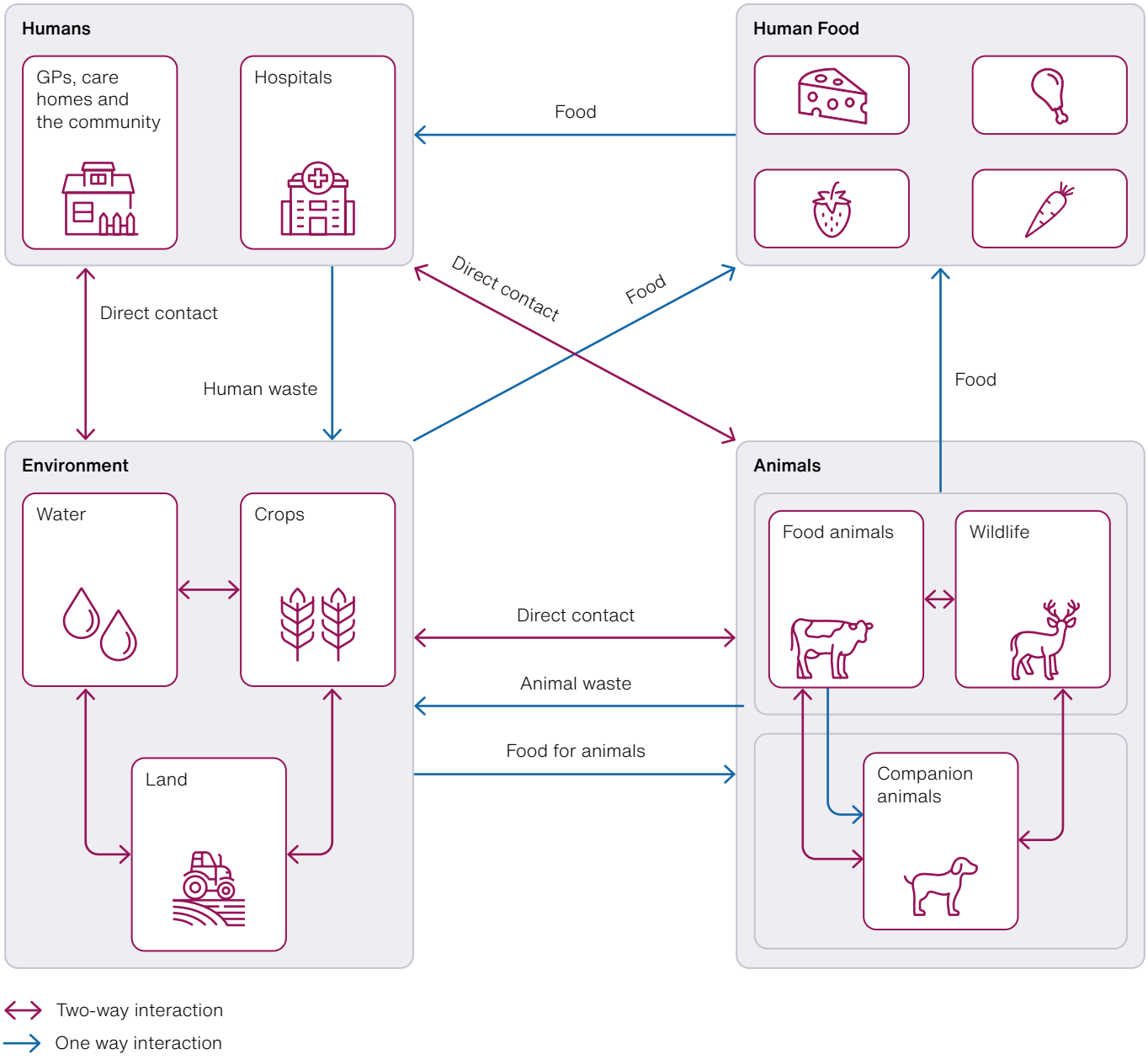
1.12 In the past, it was thought AMR could be tackled by continually discovering new antimicrobials, but this is now an unattractive investment for the pharmaceutical industry. In 2023 there were only 97 new antibiotics in the clinical pipeline. By comparison, more than 2,000 new clinical trials for cancer treatment began in the same year. All but one of the classes of antibiotic currently in use were discovered between 1928 and 1987. There is a common belief among experts that all easily found natural product antibiotics have been discovered, which has resulted in many large pharmaceutical companies deprioritising antibiotic research. Most new antibiotics in clinical trial today are derivatives or synthetic versions of existing classes.

1.13 To attempt to discover new classes of antibiotic could be very expensive and high risk commercially. The Organisation of Economic Co-operation and Development considers the lack of development of new antibiotics a market failure. Financial returns to pharmaceutical companies from discovering antibiotics are thought to be much lower than the full public value of such discoveries. It can now cost a company over $1 billion to develop a new antibiotic, with the research and development process taking up to 15 years.

Figure 1

The drivers of antimicrobial resistance

Contact between people, food, the environment and animals spreads organisms which drive antimicrobial resistance

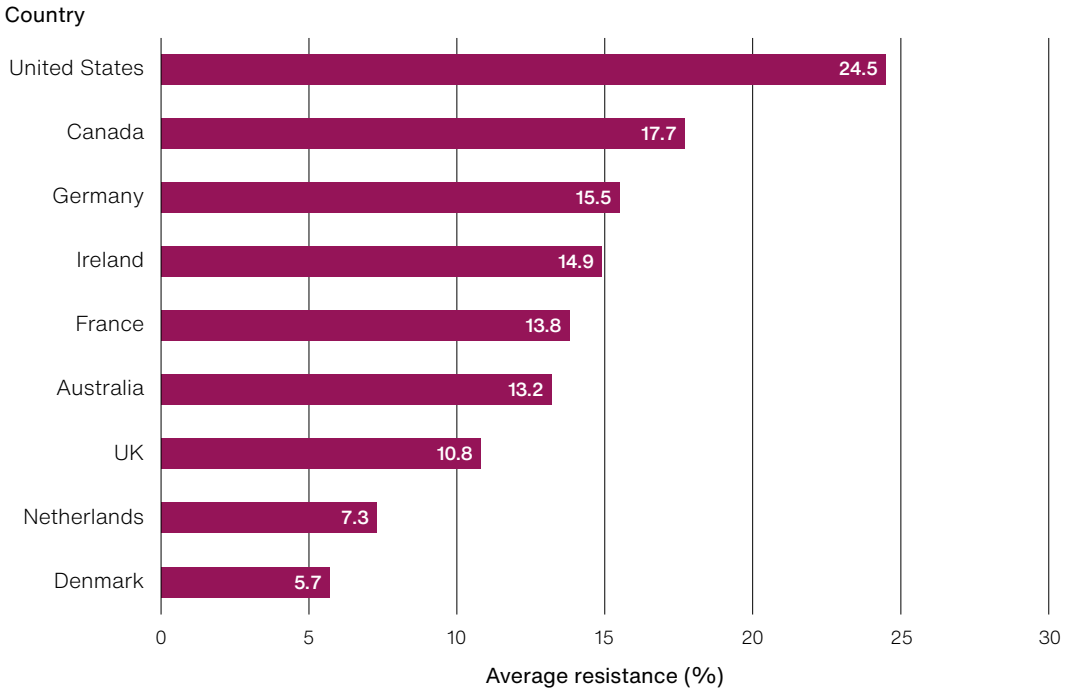


Source: National Audit Office analysis of Department of Health & Social Care documents

Figure 2

Prevalence of high-risk antibiotic resistance, 2019

Average resistance to antibiotics in the UK is lower than in many comparable countries, though some European countries have lower levels



Notes

1 Average resistance is calculated across 12 antibiotic-pathogen combinations that present the highest risks to human health. The 12 priority antibiotic-pathogen combinations included in the analysis are vancomycin-resistant *Enterococcus faecalis*, vancomycin-resistant *Enterococcus faecium*, third-generation cephalosporin-resistant *Escherichia coli (E. coli)*, carbapenem-resistant *Klebsiella pneumoniae (K. pneumoniae)*, third-generation cephalosporin-resistant *K. pneumoniae*, carbapenem-resistant *Pseudomonas aeruginosa*, meticillin-resistant *Staphylococcus aureus*, penicillin-resistant *Streptococcus pneumoniae*, fluoroquinolone-resistant *Acinetobacter baumannii (A. baumannii)*, carbapenem-resistant *A. baumannii*, fluoroquinolone-resistant *E. coli* and carbapenem-resistant *E. coli*.

2 We have compared the UK with a selected group of countries with a similar economic and cultural profile to the UK.

Source: National Audit Office analysis of Office for Economic Co-operation and Development data

1.14 A particular problem with the market for any new antibiotics is the public good in holding them in reserve for only the most serious cases as a 'last line of defence'. This makes sense from the perspective of AMR but reduces the likelihood of companies recouping their investment.

What are the current and potential consequences?

1.15 There are different ways to express the consequences of AMR. It is already associated with an estimated 5 million deaths globally each year; out of these, it is directly responsible for an estimated 1.3 million (around 2% of all deaths). According to recent research, AMR-associated deaths are likely to increase to 8.2 million globally each year by 2050, with AMR directly responsible for 1.9 million of these.[4] It is estimated that in the UK AMR is associated with 35,200 deaths each year, including 7,600 of which it is the direct cause. The former Chief Medical Officer for England, and current UK Special Envoy on AMR, Dame Sally Davies, told us that, if antibiotics in general were to fail, we might return to historic times when it was common for many people to die prematurely from infections. Prior to antibiotics, infection was the most common cause of death and life expectancy was on average 20 years lower.

1.16 When it is not deadly, AMR can still have serious impacts on human health. Patients may be sicker for longer and have longer stays in hospital, as doctors seek an effective response to resistant pathogens. Recovery times may be longer, too, with consequences for a patient's work and wider life. In animal health AMR infections pose risks to the health and welfare of companion animals, as well as the welfare and, productivity of livestock and subsequently the security of the food chain.

1.17 Research shows that the consequences of AMR are not felt evenly. Internationally, low- and middle-income countries are the most affected. The Global South (countries in Africa, South America, and Asia) have the greatest prevalence of AMR, with environmental contamination, poor or unregulated access to antibiotics, conflict, and uncontrolled urbanisation being key drivers. Within the UK, AMR disproportionately affects babies and the elderly, those with compromised immune systems, as well as those living in the highest areas of deprivation, and specific ethnic groups.

1.18 The World Bank estimates that AMR could result in $1.2 trillion of additional healthcare costs by 2050. In 2018 the Chief Medical Officer for England stated that AMR cost the NHS an estimated £180 million in treatment costs per year (this is the most recent estimate).

4 N Mosen et al., '*Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050*', *The Lancet*, volume 404, issue 10459, 28 September 2024, pp. 1199–1226.

Part Two

The UK government's response to antimicrobial resistance

2.1 The UK is one of the countries with a state-led programme to combat antimicrobial resistance (AMR). The World Health Organization's 2015 Global Action Plan on AMR recommended that Member States publish national action plans describing how they would address AMR. The UK has published such plans since 2013. This part of the report examines:

- how the UK government has been responding to AMR, including governance arrangements and spending to date;
- the progress made against targets in the 2019–2024 National Action Plan (NAP19–24); and
- progress made in delivering other AMR commitments.

2.2 The NAP19–24 covers the UK. In general, we have focused on progress in England. For the targets, the exception is progress on antimicrobial use in food-producing animals, for which data are reported on a UK-wide basis.

The government's response to AMR

2.3 The UK government started taking concerted action to combat AMR in 2000, when the then Department of Health published a three-year strategy. This plan recognised that a sustained long-term programme was needed to minimise morbidity and mortality due to infections and to maintain the effectiveness of antimicrobials. During the 2000s, the NHS focused on reducing hospital-acquired infections, of which antibiotic-resistant *Staphylococcus aureus* (MRSA) was the commonest. In 2013, the government reinvigorated its response to AMR, with publication by the Department of Health & Social Care (DHSC) and the Department for Environment, Food & Rural Affairs (Defra) of a five-year strategy. The strategy noted that, while AMR could not be eradicated, a multi-disciplinary approach could limit the impact on future health.[5] In 2014, the UK government commissioned an independent review of AMR to analyse the problem and propose actions to tackle it internationally. The final report of the review, led by Lord O'Neill of Gatley, was published in 2016.

5 Department of Health and Department for Environment, Food & Rural Affairs, *UK Five Year Antimicrobial Resistance Strategy 2013 to 2018,* September 2013.

2.4 In 2019, the government published a 20-year vision for controlling AMR by 2040.[6] The vision was for a world in which AMR is effectively contained, controlled and mitigated. To contribute to this, the UK aimed to fulfil nine ambitions through global partnerships in the human health, animal health, environment, food, and research spheres. The approach of working on the health of humans, animals and ecosystems together in an integrated, balanced way is known as 'One Health'. It recognises that pathogens and resistance do not respect species boundaries and are influenced by the whole environment.

2.5 In 2019, the government also published its five-year national action plan for AMR (NAP19–24).[7] This made specific commitments under three key themes: reducing exposure to antimicrobials; optimising their use; and investing in innovation, supply and access (**Figure 3**). This third theme included vaccine development. Vaccines are important in addressing AMR because they can reduce the need for antimicrobial treatment in the first place, as well as provide protection for the wider community. Despite its antimicrobial remit, NAP19–24 focused on antibiotic resistance and included no specific commitments about addressing resistance to antivirals or antifungals, both of which also present serious health concerns.

Figure 3
National Action Plan for Antimicrobial Resistance 2019 to 2024

The National Action Plan included 15 strategic outcomes under three themes

Reduce the need for and unintentional exposure to antimicrobials	Optimise the use of antimicrobials	Invest in innovation, supply and access
A lower burden of human infection	Optimal use in humans	Basic research
Clean water and sanitation	Optimal use in animals and agriculture	Development of new therapeutics
A lower burden of animal infection	Lab capacity and surveillance in humans	Wider access to therapeutics
Minimal environmental impact	Lab capacity and surveillance in animals	Development of and access to diagnostics
Better food safety		Development of and access to vaccines
		Better quality assurance

Source: National Audit Office analysis of Department of Health & Social Care and Department for Environment, Food & Rural Affairs documents

6 HM Government, *Contained and controlled: The UK's 20-year vision for antimicrobial resistance,* January 2019.
7 HM Government, *Tackling antimicrobial resistance 2019-2024: The UK's five-year national action plan,* January 2019.

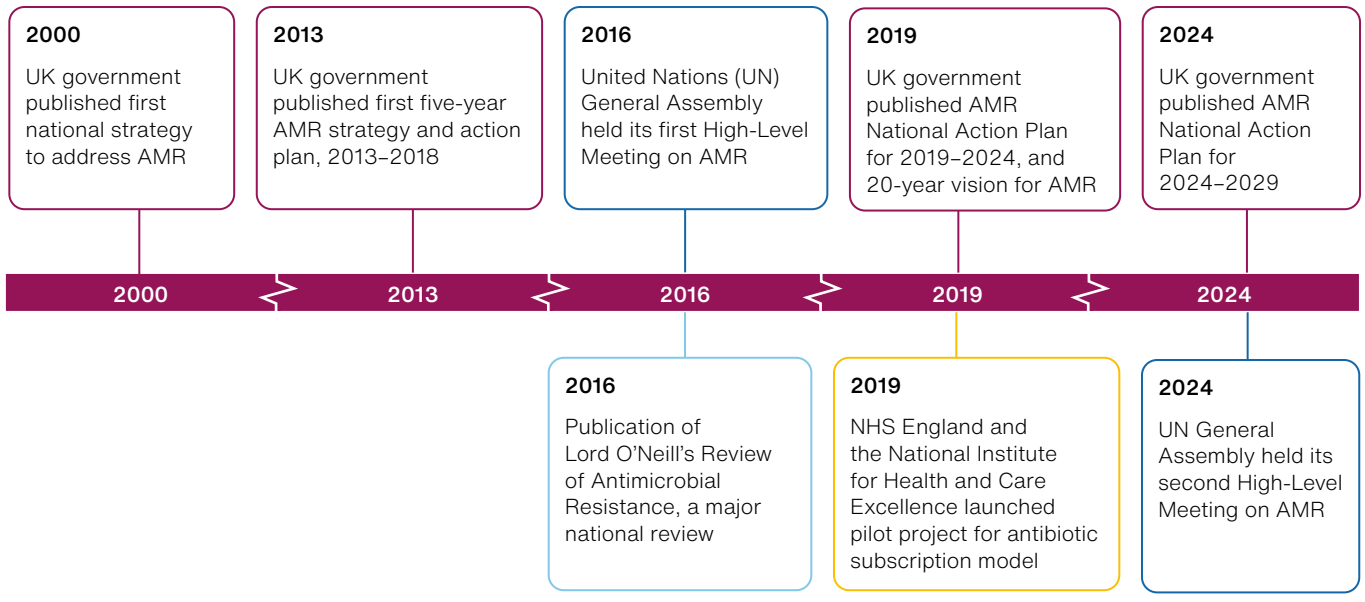
2.6 Addressing the risk of AMR in the UK is dependent on domestic and international action. AMR moves across borders, and the UK's internal efforts cannot provide full insulation from rising AMR – although they can at their best also be templates for others to adopt. The UK was at the forefront of a campaign which led to the 2016 UN Political Declaration on AMR (signed by 193 countries) and subsequently to a political declaration to address the needs of the most vulnerable nations at the 2024 High-Level Meeting at the United Nations (**Figure 4** shows a timeline of these and other key events).

2.7 To coincide with NAP19–24, the government appointed Professor Dame Sally Davies, the outgoing Chief Medical Officer, as UK Special Envoy on AMR, a diplomatic role to raise the profile of AMR on the global agenda and advocate for action. The UK also provides direct funding for AMR initiatives in low- and middle-income countries, particularly through the Fleming Fund, which supports surveillance and data collection, and the Global Antimicrobial Resistance Innovation Fund (GAMRIF), which pays for research.

Figure 4

Timeline of actions to address antimicrobial resistance (AMR), 2000 to 2024

UK action on AMR accelerated after the government published its first five-year strategy in 2013



Source: National Audit Office analysis of Department of Health & Social Care, NHS England, and United Nations documents

2.8 Leadership and oversight of NAP19–24 was provided by the AMR NAP Delivery Board. This met three times a year, and oversaw eight programmes covering:

- human health;
- animal health, food and the environment;
- research;
- international activities;
- surveillance; and
- one programme each for the three devolved administrations.

The programmes had responsibility for organising activities. Governance arrangements and commitments in NAP19–24 covered the whole of the UK, including in policy areas where government functions had been devolved to the administrations of Northern Ireland, Scotland and Wales.

Funding arrangements

2.9 It is difficult to identify how much the government has spent on efforts to address AMR. For instance, large sums are spent each year on cleaning hospitals and GP surgeries; while this is not considered to be AMR funding, it is vital to preventing the spread of infection. Similarly, spending on antibiotic prescriptions, the building of new hospitals and investment in reducing wastewater spills are all relevant to AMR. Between 2020-21 and 2023-24, the government allocated £567 million directly to its AMR programmes. In cash terms, this funding increased over the four years, meaning that its value remained broadly stable after adjusting for inflation.

2.10 DHSC and its arm's-length bodies received £543 million (96%) of the total funding, with Defra receiving £16 million (3%) (**Figure 5**). The Food Standards Agency spent £3 million of its research budget on AMR, and HM Treasury's Shared Outcomes Fund provided £5 million for AMR-focused work on the Pathogen Surveillance in Agriculture, Food and Environment (PATH-SAFE) programme. DHSC spent the majority of its core funding of £417 million on research and overseas aid. Of this, £280 million counted as Official Development Assistance (ODA), while the rest related to domestic spending. Defra's small share of AMR funding is mainly to pay for the Veterinary Medicines Directorate's (VMD) role as policy lead for AMR in animal health and the coordination of surveillance of antibiotic use and resistance. NHS England's AMR programme spending was very low in 2020-21 and 2021-22 because the relevant staff were occupied responding to the COVID-19 pandemic, which also led to delays in recruiting to AMR posts. Its spending increased in 2022-23 and 2023-24 due to the antibiotic subscription model.

Figure 5

Government spending for the antimicrobial resistance (AMR) programme, 2020-21 to 2023-24

The government has spent more than £560 million on the AMR programme between 2020-21 and 2023-24

Department	2020-21	2021-22	2022-23	2023-24	Total
	(£mn)	(£mn)	(£mn)	(£mn)	(£mn)
Department of Health & Social Care[2]	121	98	95	103	**417**
UK Health Security Agency[3]	12	16	21	19	**68**
NHS England[3]	1	3	27	28	**59**
Department for Environment, Food & Rural Affairs	4	4	4	4	**16**
Shared Outcomes Fund[4]	0	0	3	2	**5**
Food Standards Agency	1	1	1	1	**3**
Total (cash terms)	**138**	**121**	**151**	**157**	**567**
Total (real terms)	**156**	**138**	**160**	**157**	

Notes

1 This does not include UK Research and Innovation (UKRI) funding for AMR research. Among other things, UKRI supports the Pathways to antimicrobial clinical efficacy research programme, which has a budget of £30 million from 2023 to 2028, of which UKRI contributed £15 million.

2 The Department of Health & Social Care total includes funding for programmes and Career Development Awards run by the National Institute for Health and Care Research over five years. We have presented this funding as spread evenly in each year, however there may have been year-to-year variation.

3 The NHS England total includes the maximum allocation for the first two drugs within the new subscription model from 2022-23. It does not include the cost of treating patients with a resistant infection. Some UK Health Security Agency staff were also redirected from AMR work to address COVID-19 during the pandemic, reducing the amount spent on AMR in that period.

4 Spending on Pathogen Surveillance in Agriculture, Food and Environment (PATH-SAFE) is from HM Treasury's Shared Outcomes Fund. PATH-SAFE received total funding of £19 million from 2020-21 to 2023-24, of which £5 million was focused on AMR.

5 Real-terms values are in 2023-24 prices using HM Treasury's GDP deflators at market prices, October 2024.

6 Totals may not sum due to rounding.

Source: National Audit Office analysis of Department of Health & Social Care, NHS England, UK Health Security Agency, and Department for Environment, Food & Rural Affairs data

Progress made against the NAP19–24 targets

2.11 NAP19–24 had five quantitative targets relating to the UK.

- To halve healthcare-associated Gram-negative bloodstream infections by 2023-2024.
- To reduce the number of specific drug-resistant infections in people by 10% by 2025.
- To reduce antimicrobial use in humans by 15% by 2024.
- To reduce antibiotic use in food-producing animals by 25% between 2016 and 2020 and to define new objectives by 2021 for 2025.
- To be able to report on the percentage of prescriptions supported by a diagnostic test or decision support tool by 2024.

2.12 Taken together, the quantitative targets encompassed a reasonable range of the key inputs and outcomes. Perhaps necessarily, they focused on the national dimension, where the UK government has legislative and administrative power. A notable gap was the absence of targets relating to AMR in the environment.

2.13 The government had limited success in meeting the targets, which NAP19–24 had said would be "challenging" to achieve. The fifth target was to create a way to count the proportion of prescriptions supported by diagnostic tests. However, this target was not achieved by the end of the NAP period. NHS England told us that this was because of continuing unaddressed data limitations, including the ongoing use of paper prescriptions, diagnostic tests not being digitally recorded, pathology systems not being linked to electronic prescribing systems, and the lack of a standardised national digital pathology system in hospitals. Increasing the proportion of antibiotics issued after a diagnostic test was seen as crucial by the authors of the UK's 2016 review of antimicrobial resistance, because it could cut the volume of incorrect prescribing. There is some evidence that increasing the use of diagnostics would have significant associated costs. In the rest of this section, we look in greater detail at the remaining four targets.

Gram-negative and drug-resistant infections

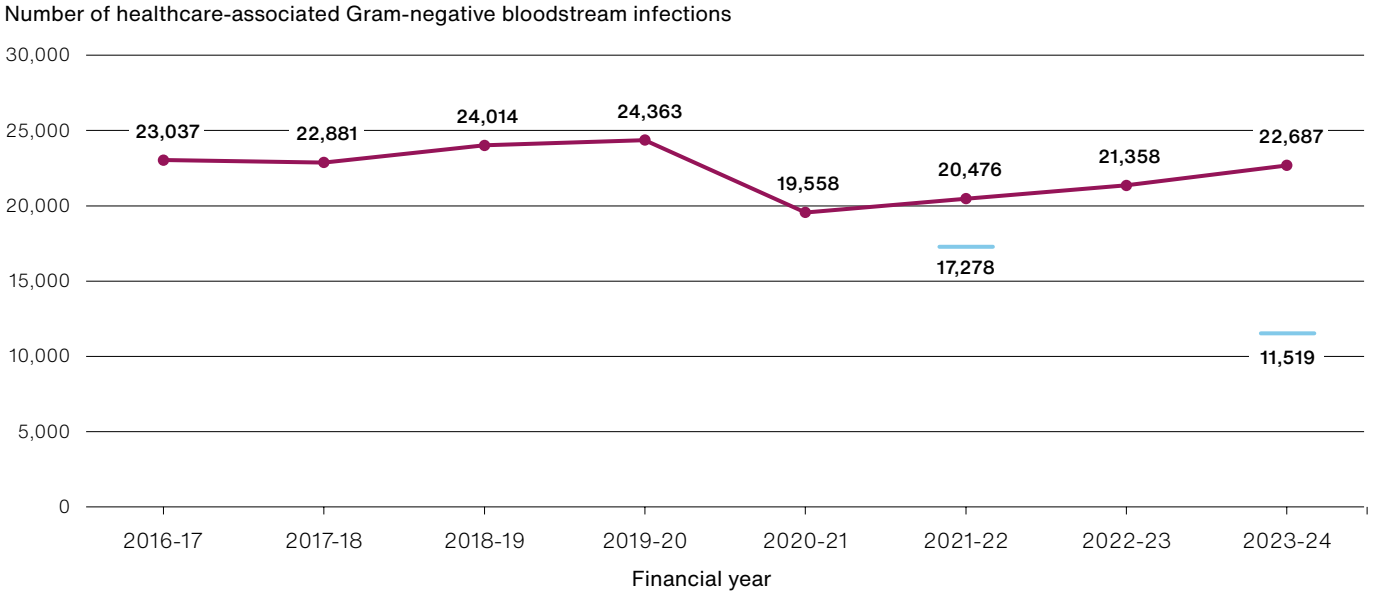
2.14 NAP19–24's first target was to reduce healthcare-associated Gram-negative bloodstream infections by 50% by 2023-24 (relative to 2016-17), with an interim target of reducing them by 25% by 2021-22. These infections are the leading source of healthcare-associated bloodstream infections, caused by bacteria such as *E. coli*. Gram-negative infections are of particular concern because they are more likely to be antibiotic-resistant than other infections. Of all antibiotic-resistant bloodstream infections recorded in 2023, 68% were *E. coli* while a further 18% were other Gram-negative pathogens.

2.15 As shown in **Figure 6**, the number of infections initially dropped by 20%. This coincided with the peak of the COVID-19 pandemic, when human social contact was unusually low, public behaviour shifted towards self-care methods such as over-the-counter medications, and infection prevention and control practices such as handwashing were being constantly and prominently encouraged. Following this, the number began rising again. In 2022, the government dropped the commitment to work towards the quantitative target, but continued to monitor performance and to support improvement and surveillance programmes to reduce the risk of resistant infections being transmitted.[8] Officials told us that the target was more challenging than those who set it had realised. They had based it on previous success in reducing hospital-acquired MRSA infections, which proved not to be comparable.

Figure 6

Healthcare-associated Gram-negative blood stream infections (HA-GNBSI) in England, 2016-17 to 2023-24

Gram-negative infections reduced in 2020-21 but have since increased



Notes

1 These data measure the number of bloodstream infections caused by three types of Gram-negative bacteria (being named after their results in a bacteria-testing method), which are healthcare-associated. Healthcare-associated infections are those which are contracted in a healthcare setting or as a direct result of healthcare interventions such as surgery. These infections may or may not also be drug-resistant.

2 The government withdrew its HA-GNBSI target in May 2022 but still collects data.

3 The UK Health Security Agency collects data annually between April and March of the following year. 2016-17 data, for example, encompasses data from April 2016 through to March 2017.

Source: National Audit Office analysis of UK Health Security Agency data

8 Department of Health & Social Care, Department for Environment, Food & Rural Affairs, *Tackling antimicrobial resistance 2019 to 2024: addendum to the UK's 5-year national action plan*, May 2022.

2.16 In the latest data, for 2023-24, Gram-negative bloodstream infections are still 1.5% lower than in 2016-17, but the trends are concerning. In the three years to 2019-20, the number of infections grew by an average of 1.9% a year. But in the three years since 2020-21 they have grown at an average rate of 5.1% a year. DHSC and the UK Health Security Agency (UKHSA) say there continues to be limited understanding of what interventions work to combat Gram-negative infections. They are less responsive to traditional infection prevention and control methods because they primarily live in our gut rather than on the skin. DHSC also told us it believes its efforts during the NAP19–24 period have meant that Gram-negative infections were some 20% lower in 2023-24 than they would have been had there been no COVID-19 pandemic and no NAP19–24.

2.17 The government's second target was to deliver a 10% reduction in specific drug-resistant infections in the UK between 2018 and 2025. As with the target for Gram-negative infections, there was an initial (10.4%) reduction during the peak of the COVID-19 pandemic, followed by a steady increase to reach 13% above the 2018 baseline by 2023 (**Figure 7**).

2.18 DHSC and UKHSA's view is that the failure to achieve the target was a result of ongoing pressures from dealing with the aftermath of the pandemic, a greater proportion of infections occurring in community settings where new interventions need to be developed, an ageing and increasingly comorbid population, and a limited evidence base to support the initial target setting. NHS England and UKHSA have also told us of the difficulty in understanding trends in infection during the period in question, as the pandemic caused sharp changes in data, but it was unclear whether and to what extent these could be directly attributed to the pandemic or other effects. The United States government has reported that it has also seen a significant increase of 20% in hospital-acquired AMR infections compared with before the pandemic. The numbers in the USA had stabilised by 2022, but remained above pre-pandemic levels. In England, the average rate of increase in the last three years has been a little lower (8.2%) than in the three years to 2019 (9.3%), but included a jump of 15.5% in 2023, larger than in any year in the last decade.

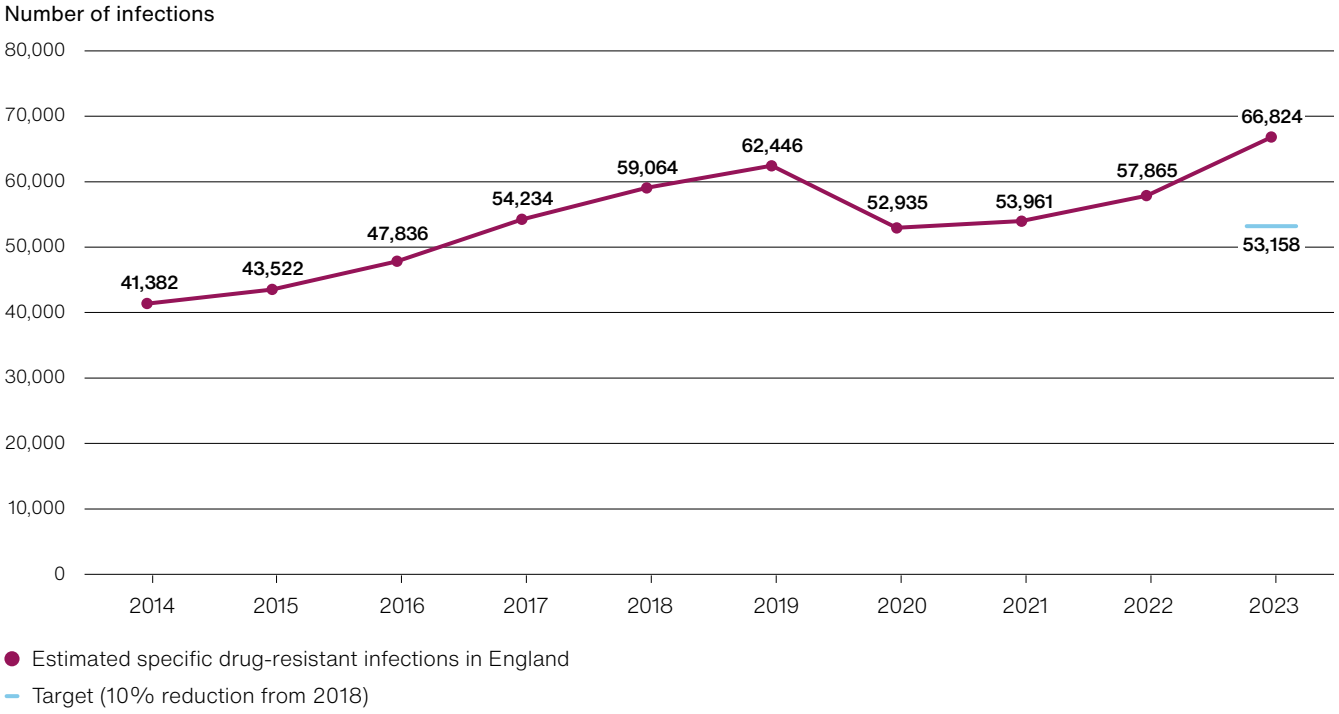
Antimicrobial use in humans

2.19 NAP19–24's third target sought to reduce overall antimicrobial use in humans by 15%. UKHSA measures performance against the target using data for antibiotics only and not for other antimicrobials. Performance followed a similar pattern to the infection targets, seeing an initial 15% reduction during the peak of the COVID-19 pandemic (see **Figure 8** on page 28), followed by increases in 2022 and 2023 by which point there had only been a 6% reduction relative to the baseline year. Data for 2024, the deadline for the target to be met, are not yet available.

Figure 7

Estimated specific drug-resistant infections in England, 2014 to 2023

The estimated number of specific drug-resistant infections has been increasing since 2020



Notes

1 These data measure drug-resistant infections caused by a specific set of eight pathogens, both Gram-negative and Gram-positive (being named after their results in a bacteria-testing method). These pathogens are *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter spp.*, *Staphylococcus aureus*, *Enterococcus faecalis, Enterococcus faecium* and *Streptococcus pneumoniae*.

2 The total number of resistant infections is generated by calculating the proportion of each pathogen reported as resistant to one or more specific antibiotics and ensuring that infection report is not counted in any subsequent antibiotic combinations to avoid double counting.

Source: National Audit Office analysis of UK Health Security Agency data

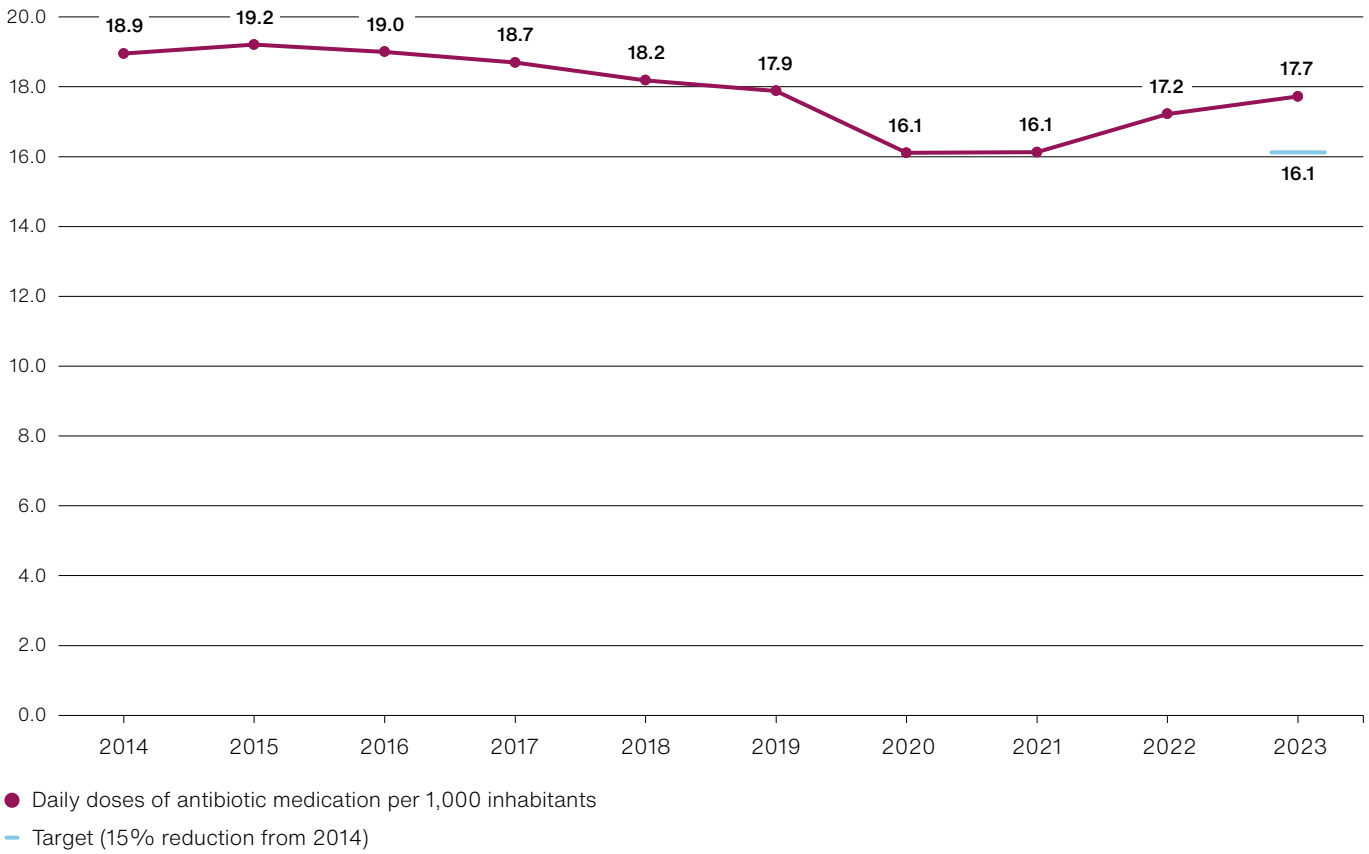
2.20 DHSC attributed the increase in 2022 and 2023 to a post-pandemic rise in the circulation of infectious diseases, such as an outbreak of invasive *Group A streptococcus*, which led to increased prescribing. The AMR board is also seeking to understand if other factors are involved. In particular, both it and academic experts are interested in the potential impact of a shift to online GP appointments, with some research suggesting GPs are more likely to prescribe antibiotics in an online consultation. It is also of concern, and indicative of rising resistance, that prescriptions for the most important antibiotics, those designated 'watch' and 'reserve', where usage is recommended to be limited, has been increasing since 2020.[9]

9 The most important antibiotics are designated 'reserve' or 'watch'. 'Reserve' antibiotics are the last-resort options which are meant to treat multi drug-resistant infections, and 'watch' antibiotics are those with a higher resistance potential.

Figure 8

Antibiotic use in humans, in England, 2014 to 2023

Antibiotic use met the government's target in 2020 and 2021 but has since increased



Note

1 Although the target is for antimicrobial use, the UK Health Security Agency measures performance using data on antibiotics only.

Source: National Audit Office analysis of UK Health Security Agency data

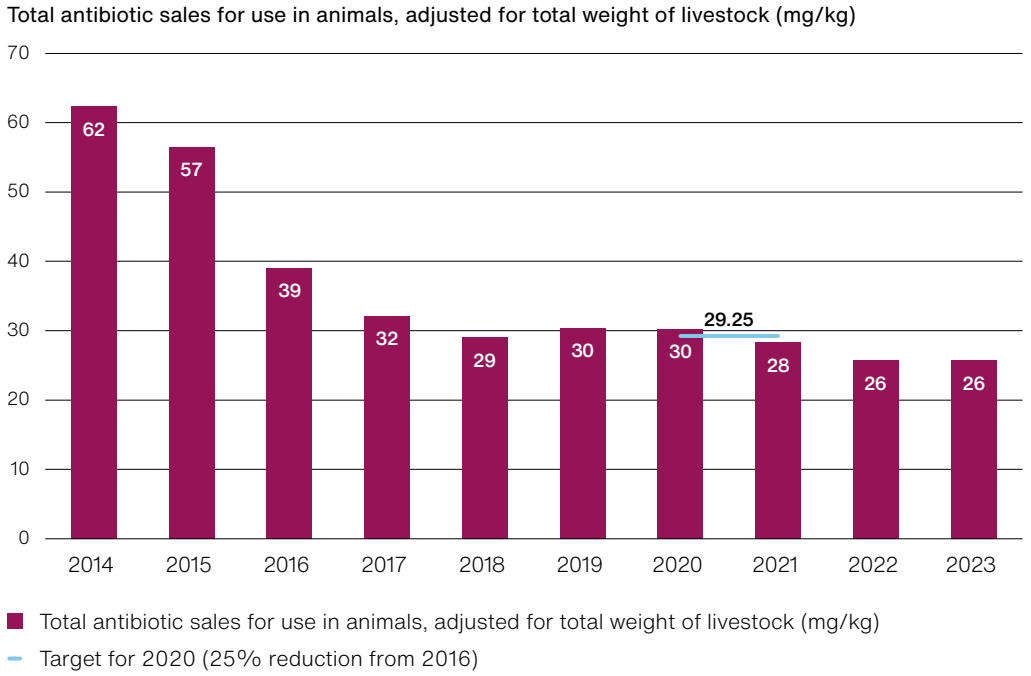
Antimicrobial use in animals

2.21 NAP19–24 included a target to reduce antibiotic use in food-producing animals by 25% in the UK by 2020, and to define new objectives for the period after 2021. The 2020 target was narrowly missed, with an actual reduction of 22.6% achieved by 2020 relative to 2016. Antibiotic use in food-producing animals continued to decline in 2021 and 2022 below the level of the 2020 target (**Figure 9**), and the majority of subsequent targets set from 2021 to 2024, and relating to reductions for different species, were met. This included reductions for the highest priority antibiotics. The agricultural sector also achieved increases in the uptake of vaccines in food-producing animals.

Figure 9

Sales of antibiotic medication for use in animals in the UK, 2014 to 2023

Sales of antibiotics for use in animals declined significantly between 2014 and 2018, followed by smaller reductions since 2020



Note

1 These data comprise food producing animals only, such as livestock for meat or dairy. They do not include antibiotic sales for companion animals such as pets.

Source: National Audit Office analysis of Veterinary Antimicrobial Resistance and Sales Surveillance report data

2.22 DHSC and Defra cite several reasons that progress on animal health targets has generally been greater than on human health targets. These include effective voluntary reductions in preventative and continual antibiotic use in farming, and early buy-in from the agricultural sector through setting up a designated taskforce. There are also indications that the rapid progress relied on major attitudinal shifts that delivered 'quick wins', which will not be repeated in future. There have been recent upticks in antibiotic use in some agricultural sectors, resulting in antibiotic use in 2023 neither increasing nor decreasing. If these increases continue, this could lead to rising AMR.

Progress made against the NAP19–24 commitments

2.23 Aside from the targets, NAP19–24 included a considerable number of other commitments for the UK government and the devolved administrations – 133 in total. Commitments were activities to be carried out under one or more of the AMR programme themes. Of these, 128 were owned by DHSC or Defra, relating to either activity in England, policy areas reserved for the UK government, or activities which these departments were undertaking for the whole UK by agreement with the devolved administrations. Some commitments were exploratory or procedural in nature, such as gathering evidence on environmental risks from AMR.

2.24 By January 2024, when tracking stopped, only seven of the 128 commitments had been completed. On the AMR dashboard, the departments marked 46 commitments as having 'Green' delivery confidence, meaning they assessed that successful delivery was still highly likely, and a further 38 commitments as 'Amber/Green', meaning successful delivery was probable but required constant attention. Twenty-three commitments were considered to be at risk and 12 were rescheduled for delivery during the National Action Plan 2024 to 2029 (NAP24–29). For two commitments, there was a nil return, meaning no evidence on progress was submitted (**Figure 10**). It should be noted that the commitments in NAP19–24 had no formal deadlines. Therefore, the departments' confidence in delivering a work package was based on their assessment of general progress, rather than an expectation that it would be complete by a specific date. DHSC told us that the substance of most of the uncompleted commitments is still being monitored through related commitments in NAP24-29. Assuming that those who wrote NAP19–24 intended its commitments to be delivered within its five-year span, we assess that progress with many commitments has been slower than government initially wanted. Below, we consider three important areas of work in greater detail.

Subscribing to antimicrobials

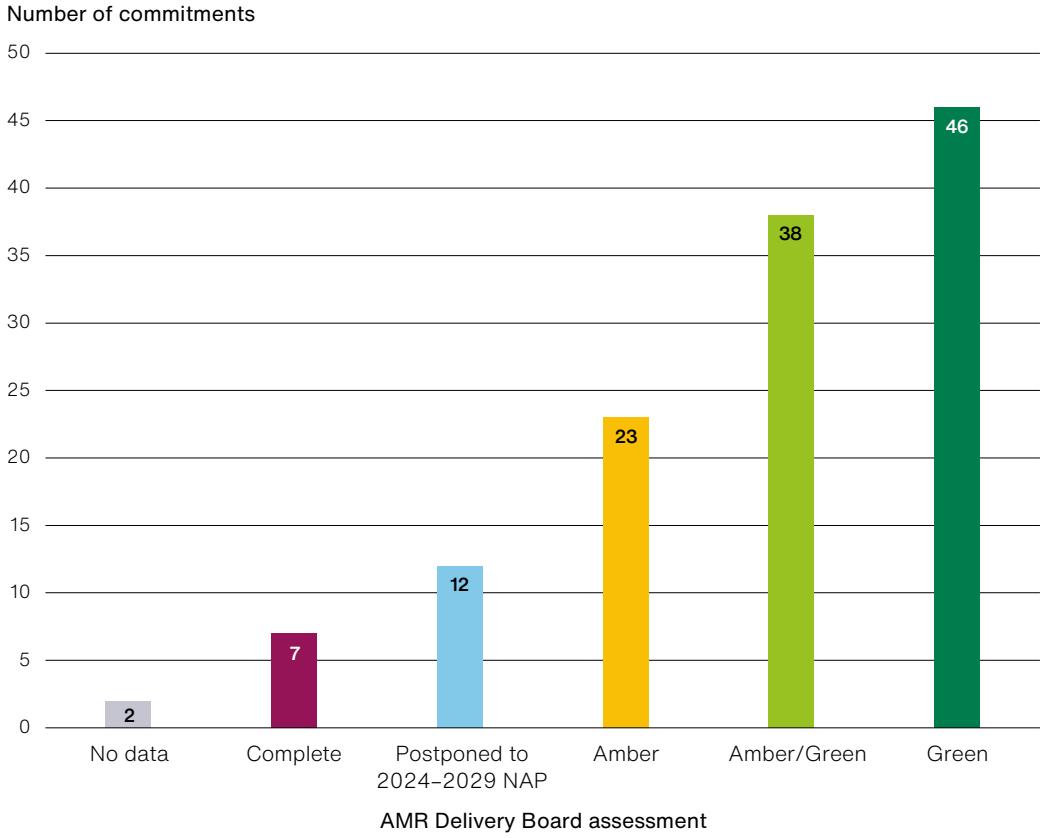
2.25 An important commitment in NAP19–24 was to develop and test new procurement models for antimicrobials, which would provide a revenue stream for manufacturers even when low volumes of drugs are used. This responds to a recommendation in the O'Neill Review to find ways to balance innovation with good stewardship of antimicrobials by removing the natural market incentives for suppliers to sell as many antimicrobials as they can.[10]

10 The Review on Antimicrobial Resistance, chaired by Lord O'Neill of Gatley, *Tackling drug resistant infections globally: final report and recommendations*, May 2016.

Figure 10

Government progress against the commitments made in the 2019 to 2024 National Action Plan (NAP)

In January 2024, the Antimicrobial Resistance (AMR) Delivery Board rated only seven commitments as complete, despite the majority of commitments being rated as 'Green' or 'Amber/Green'



Note

1 This figure includes only the 128 commitments relating to the UK or to England. A further five commitments were to be delivered by devolved administrations in Scotland, Wales and Northern Ireland.

Source: National Audit Office analysis of Antimicrobial Resistance Delivery Board data

2.26 During the period of NAP19–24, NHS England and the National Institute for Health and Care Excellence (NICE) developed a new antibiotic subscription model. Its three priorities are making it commercially viable to bring new antimicrobial products to market, maintaining good stewardship, and providing a supply of drugs to the NHS to keep pace with rising AMR. The model sees the NHS paying a flat rate, or subscription, to pharmaceutical companies based on the value of a particular drug to public health, rather than on the quantity of the drug patients consume. The model was piloted in England from 2022 with subscription contracts on two recently-licensed antibiotics. NHS England noted in the pilot that reliably estimating the value of the drugs was challenging for NICE because of the uncertainties of clinical trial evidence and national surveillance data, and the need to model benefits 20 years into the future.

2.27 The UK is among the first countries to test such a model, and there is significant international interest, with other countries exploring similar approaches. Making new antimicrobials requires sizeable time and financial investment, which is often hypothecated on high future sales volumes. By providing consistent funding that is decoupled from sales revenue, the government hopes to encourage companies to invest in new antimicrobials, even if they sell fewer existing antimicrobials.

2.28 In partnership with the health systems of the UK's devolved nations, NHS England now has a procurement process under way and expects to let further contracts for additional antimicrobials in 2026, alongside the two in the pilot. The cost annually for each subscription antimicrobial – irrespective of the level of usage – will be to up to £20 million (with the largest payments only available for very valuable or 'breakthrough' antimicrobials). The cost of the first round of contracts will be substantial, with NHS England issuing an initial invitation to tender for contracts with an estimated value of almost £1.9 billion over 16 years. NHS England currently pays up to £10 million per year for the two pilot contracts, which began in July 2022 and will run until the new subscription model contracts are in place.

2.29 The model will be evaluated by the National Institute for Health and Care Research (NIHR), the operational research funding arm of DHSC. This will be important, alongside strong contract management, to learn lessons from what is an innovative approach and to maximise the chance of the full benefits being realised. Noteworthy aspects of the model include the following.

- The subscription antimicrobials will not need to be new drugs, but will have to be effective against infections on the World Health Organization's critical pathogens list.
- Suppliers will be unrestricted in their ability to sell subscription antimicrobials elsewhere in the world (subject to other similar models being introduced). The UK is only 3% of the global market for antimicrobials.
- Payments provided are to be dependent on additional performance requirements such as compliance with good antimicrobial manufacturing practices and stewardship.

Public and professional engagement

2.30 Eighteen commitments in NAP19–24 related to public and professional awareness of AMR in England. Social research published in 2020 showed the public had both misconceptions about antimicrobials and limited understanding of resistance. Of those who have some awareness, research shows that most feel it is a global issue for the scientific community, rather than something they could personally have an impact on. DHSC and UKHSA told us that both public and professional behaviours have a significant impact on AMR, including prescribing and infection prevention and control, and that these behaviours can be difficult to shift.

2.31 UKHSA and its predecessors have run public awareness campaigns for the last two decades. These include e-Bug, established in 2006 and still active, which aims to educate children and young people by providing curriculum materials to teachers. For adults, Keep Antibiotics Working (KAW) (2017–2019) was a multi-channel public awareness campaign which provided information about the risks of antibiotic misuse via television, social media and other means. An evaluation of KAW found a 5% increase during the first year of the campaign in the number of individuals who were unlikely to ask for antibiotics. Surveyed GPs felt the campaign made patients less likely to ask for antibiotics, and helped them to refuse patients who did. However, these improvements reduced to within 0.6% of the original baseline once the campaign ended. A separate scheme, Antibiotic Guardian, continues today, asking both healthcare professionals and members of the public to pledge to exercise good stewardship over antimicrobials. UKHSA is conducting ongoing evaluation of its awareness campaigns.

2.32 Despite its commitments, NAP19–24 did not set out to achieve sustained, measurable change in the attitudes of either the public or professionals. European surveys such as the Eurobarometer questionnaire and the European Centre for Disease Prevention and Control survey of healthcare workers have shown that knowledge is comparable between the public and professionals in some areas, with 90% of UK members of the public knowing that unnecessary use of antibiotics makes them ineffective, compared with 94% of healthcare workers. However, there were discrepancies in other areas, as only 49% of the UK public knew that antibiotics do not kill viruses, compared with 98% of healthcare workers. Furthermore, in 2019 only 59% of UK healthcare workers could correctly answer a set of seven questions on AMR, and only 78% felt they knew enough about the subject. The former had increased slightly to 62% in a 2024 survey.

Antimicrobial resistance in food and animals

2.33 NAP19–24 included five commitments intended to improve food safety, including carrying out research, surveillance and awareness raising. Progress was rated as good for four of these commitments. The Animal and Plant Health Agency carried out surveillance for the Food Standards Agency (FSA). Its surveillance found that the presence of important drug-resistant variants of *E. coli* in UK retail chicken meat had fallen significantly, from 45% in 2016 to 12% in 2022.[11] The scientists stated that the reduction in the use of antimicrobials in poultry was thought to have produced this improvement. In contrast, although relatively lower than for chicken, the presence of these variants of *E. coli* in both beef and pork had increased between 2017 and 2021 (the latest data) to 1% and 4%, respectively. It should be noted that the sample size in 2021 was smaller than in 2017 and did not cover the whole year.

11 These results are for extended spectrum beta-lactamase (ESBL)-producing *E. coli*, a type which has resistance to certain antibiotics.

2.34 NAP19–24 included a commitment to implement plans to improve animal health and address endemic diseases. Although not included as a target in NAP19–24, VMD has reported making progress in reducing the level of multi-drug resistant *E. coli* in healthy pigs and poultry. VMD's surveillance found that the percentage of sampled *E. coli* isolates (a single bacterial species which has been isolated from other microbes) that were multi-drug resistant fell from 45% in 2016-17 to 27% in 2022-23.[12]

Overall assessments of NAP19–24

2.35 There have been three assessments of NAP19–24. The biggest was the evaluation carried out by the Policy, Research, and Innovation Unit (PIRU), an independent research unit funded by the NIHR. PIRU observed that the interface between AMR and the response to COVID-19 was complicated – including changes in health care settings, infection prevention and control, vaccinations, and in society – with some of the resulting changes being beneficial and others detrimental. PIRU found several gaps in the implementation of NAP19–24. In particular, it criticised the lack of a central diagnostics data source (related to the fifth target described in paragraph 2.13), which was "severely hampering cross-NHS knowledge transfer", as well as difficulties optimising antimicrobial use due to wider NHS challenges like understaffing. It also pointed out the limited data and surveillance of AMR in the environment, as for specific animal groups (such as beef and dairy cattle, sheep, and companion animals; see paragraph 3.22 for further information). The evaluation was particularly critical of the UK's management of wastewater, finding a dearth of baseline data on AMR and how wastewater impacts other water sources, with policy action hampered by conflicting opinions and funding constraints. Overall, the AMR Delivery Board acknowledged that the evaluation raised the prospect of the UK falling behind other high-performing countries which it used to see itself ranked alongside.

2.36 An academic, desk-based review of 114 countries' AMR national action plans was conducted by academics in Edinburgh, Leeds and Hamburg. This ranked the UK's plan third in the world after Norway's and the USA's. The UK's areas of strength included coordination between sectors, regulation of medicines to ensure appropriate use, and research into both the development of novel products and the drivers of AMR. Areas for improvement were the relative lack of focus on educating the health workforce and the public about AMR, and accountability to the government for NAP implementation.[13]

12 VMD monitors antimicrobial resistance in pigs and poultry. It alternates between them annually so the reported results are the average across two years, weighted by the size of the respective animal populations. This percentage refers to the proportion of *E. coli* sampled isolates which is found to be multi-drug resistant. It is not directly comparable to the statistics on *E. coli* in food (in paragraph 2.33), which refers to the proportion of retail meat which is found to have ESBL-producing *E. coli*.

13 J Patel, A Harant, G Fernandes, AJ Mwamelo, W Hein, D Dekker, D Sridhar, et al, '*Measuring the global response to antimicrobial resistance, 2020–21: a systematic governance analysis of 114 countries',* The Lancet Infectious Diseases, volume 23, issue 6, June 2023, pp. 706-718.

2.37 DHSC and Defra also carried out a self-assessment using a UN methodology, as part of the 2023 Tracking AMR Country Self Assessment Survey. It indicated strong progress in establishing, implementing and monitoring the NAP and on surveillance of AMR. The self-assessment identified weaker progress on some aspects of animal health, in particular surveillance of aquatic animals, animal husbandry, and laboratory integration. It also recorded the lack of government support at that time for nationwide AMR awareness campaigns. We note as a positive that both departments have been willing to recognise areas for improvement.

2.38 When developing the NAP24–29, the new authors identified that one of the shortcomings of NAP19–24 was having a very large number of commitments, which made the programme hard to manage. There was a lack of focus on adult social care in NAP19–24, where many infections start and many antimicrobials are consumed. In addition, some commitments were vaguely worded which made measuring progress more difficult, as did the lack of deadlines.

Part Three

Challenges and opportunities over the next five years

3.1 This part describes the Antimicrobial Resistance (AMR) National Action Plan 2024–2029 (NAP24–29) and some of the opportunities and challenges that the Department for Health & Social Care (DHSC) and the Department for Environment, Food & Rural Affairs (Defra) will face over the next five years. It covers:

- the content of NAP24–29;
- the current operating context and other challenges;
- the government's understanding of AMR risk and how this fits into the broader risk landscape; and
- some specific challenges and opportunities, including gaps in knowledge, data, access to diagnostic tools, and environmental health.

As with the AMR National Action Plan 2019–2024 (NAP19–24), the NAP24–29 covers the UK. In general, we have focused on challenges and opportunities in England and not on the devolved administrations in Scotland, Wales and Northern Ireland which have some separate management arrangements.

NAP24–29

3.2 The UK government and the devolved administrations of Northern Ireland, Scotland and Wales published NAP24–29 in May 2024.[14] It is intended to take the UK to the midpoint of its 20-year vision on AMR. It reflects lessons learned from NAP19-24, including:

- the importance of the capacity of the science sector and of using its outputs in policy development;
- a need to improve public and professional awareness of AMR;
- a greater focus on health inequalities; and
- a need to apply fully a UK-wide, 'One Health' approach where all organisations work towards common goals. We note, however, that NAP24–29 does not envisage flexibility for delivery organisations to move budgets between themselves.

14 HM Government, *Confronting antimicrobial resistance 2024 to 2029*, May 2024.

3.3 NAP24–29 is a shorter, more focused document. The government has reduced the total number of commitments from 133 to 30, to make delivery and monitoring more manageable. A summary of the plan's nine strategic outcomes and areas for action is in **Figure 11** overleaf. Of particular note is a greater emphasis on adult social care. Only four of 133 commitments referred to social care in the previous plan, whereas the new plan refers to it in six of 30 commitments. Vaccines are also an important part of NAP24–29, and are mentioned in three of the top 10 priorities for further AMR research.

3.4 There have been significant changes to the measurable targets, with some becoming less stretching than their equivalents in NAP19–24. In particular, NAP19-24 targets to reduce AMR infections in humans (by 10%) and Gram-negative bloodstream infections in humans (by 50%) were missed and have been replaced by targets to prevent any increase in the level of these infections from the 2019-20 baseline. The AMR delivery board for human health believes this is still stretching but achievable, and that preventing an increase in Gram-negative bloodstream infections would equate to a 17% reduction compared with UK Health Security Agency's (UKHSA) predicted levels of infections in 2029 allowing for demographic changes. DHSC also told us that the new, more realistic targets would help to secure the support of the healthcare system and achieve long-term change.

3.5 Similarly, the previous target to reduce antibiotic usage in humans by 15% has been replaced with one for a 5% reduction. This is lower than the 9% target set by the European Union (EU) for Member States similar to the UK to reach by 2030 (relative to 2019 levels). NHS England told us that the UK target made allowances for expected increasing clinical demand for antibiotics. NAP24–29 also contains a second usage target: for 70% of human use of antibiotics to come from the 'access' category (meaning first- and second-line antibiotics) in order to help prevent resistance developing to 'last-resort' antibiotics. This is more ambitious than the equivalent EU target, which is 65%.

3.6 NAP24–29 includes no targets relating to either infections or antibiotic use in animals. This is because the Responsible Use of Medicines in Agriculture (RUMA) Alliance, an animal and veterinary sectors' body which published targets for the agricultural sector for the periods 2017–2020 and 2021–2024, is due to publish new targets in 2025 for the period up to 2029. Defra told us that, if RUMA is sufficiently ambitious, the government will endorse these targets, which will be tailored to the specific circumstances of each sector.

3.7 NAP24–29 adds a specific target to increase UK public and healthcare professionals' knowledge on AMR by 10% by 2029. The 10% increase will be measured through a questionnaire-based assessment, using the same questions as the 2018 Eurobarometer questionnaire and 2019 European Centre for Disease Prevention and Control survey of healthcare workers about antibiotic use and resistance, which will serve as baselines.

Figure 11

Summary of the National Action Plan (NAP) for Antimicrobial Resistance (AMR), 2024 to 2029

The latest NAP has four key themes, underpinned by nine underlying strategic objectives

Quantitative targets	
Prevent any increase in specified set of drug-resistant infections in humans by 2029 (from 2019-20 baseline)	
Prevent any increase in Gram-negative bloodstream infections in humans by 2029 (from 2019-20 baseline)	
Increase the UK public's and healthcare professionals' knowledge of AMR by 10% by 2029 (from 2018 and 2019 baselines respectively)	
Reduce total antibiotic use in humans by 5% by 2029 (from 2019 baseline)	
Achieve 70% of total use of antibiotics from the Access category across the human healthcare system by 2029	
Key themes	
Reduce the need for, and unintentional exposure to, antimicrobials	**Optimise the use of antimicrobials**
Infection prevention and management (via informed interventions, the built environment, waste minimisation and effective waste management)	Antimicrobial stewardship and disposal (via clinical decision support, appropriate prescribing and disposal and behavioural interventions)
Public engagement and education (via public awareness and campaigns, use of educational settings, and an engagement guide)	AMR workforce (via health and social care training, health and social care workforce, health and social care governance, veterinary workforce knowledge and skills, and systems to support animal health)
Strengthened surveillance (via optimising surveillance and response and surveillance to form interventions)	
Invest in innovation, supply and access	**Being a good global partner**
Innovation and influence (via AMR solutions, overcoming market barriers, and improvement and adoption)	AMR diplomacy (via prevention and preparedness, access and stewardship, antimicrobial use in farming, standards for manufacturing and waste management, and advocacy and engagement)
Using information for action (via evidence generation and use and research networks)	
Health inequalities and health disparities (via data on health inequalities, health inequalities toolkit, and health inequalities interventions)	

Source: National Audit Office analysis of HM Government, *Confronting antimicrobial resistance 2024 to 2029*, May 2024

3.8 The programme has a new governance structure to support delivery. Instead of one delivery board, there are two, one covering human health, and the other animal, plant, food and environmental issues. This is intended to enable deeper scrutiny of progress with targets and commitments. The two boards oversee eight programmes of work, covering DHSC, NHS England, UKHSA, Defra, global AMR, and the three devolved administrations. Above the boards, a new strategy board will provide oversight and direction. All three will meet twice a year. The departments told us they were alert to the risk that the new model could engender siloed working. There are a further three cross-cutting bodies within the programme, to coordinate work on AMR in the international context, surveillance, and research.

Opportunities and challenges in addressing AMR

3.9 Effectively addressing AMR is difficult. Both resistance and human behaviour are dynamic. This means the problem is constantly changing and progress can easily be undone. The issue is also genuinely global, as pathogens are mobile. The experience of NAP19–24 shows how hard it has been for the UK government to make sustained improvements in human infection and antibiotic usage levels, the areas over which it has greatest influence. The UK remains a long way off from the vision that the government expressed in 2019: a lower burden of infection; the optimal use of antimicrobials; and new treatments so that everyday illnesses can continue to be cured. In this section we consider some of the opportunities and challenges those delivering the AMR plan will face in the next five years.

Conditions in the NHS

3.10 In the most recent data, for July to September 2024, cases of the resistant infections *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus* (MRSA) in England reached 13-year and 11-year highs respectively. Many of these infections are hospital-acquired. While the NHS has long understood the practices and behaviours that limit such infections, these may be becoming harder to implement.

3.11 The health system in England has not yet recovered from the COVID-19 pandemic, with all parts of the NHS remaining under operational and financial pressure. Our report *NHS financial management and sustainability* (2024) concluded that the scale of challenge facing the NHS was unprecedented.[15] Patients are arriving in hospital with more pre-existing conditions and the average length of stay has increased, both factors that can make opportunistic infections more likely. A population that is ageing and spending more years in ill health is ordinarily one where more people will need to take antibiotics more often, increasing the risk of AMR.

15 Comptroller and Auditor General, *NHS financial management and sustainability*, Session 2024-25, HC 124, National Audit Office, July 2024.

3.12 The pandemic caused healthcare organisations to tighten their infection prevention and control standards, with updated guidance from NHS England, UKHSA and others on both NHS and adult social care settings. However, busy staff delivering oversubscribed services may struggle to comply with best practice at all times. Meanwhile, the NHS estate has seriously deteriorated in recent years, with some hospitals and other healthcare settings not meeting the demands of modern medicine. Old buildings and equipment may be harder to service and keep clean, and there are insufficient side rooms to isolate infectious patients. Programmes to construct new hospital buildings and renovate GP practices provide an opportunity to bring parts of the estate up to the latest standards. It is vital that initiatives like Hospital 2.0, the standard model for future hospitals, treat AMR as a key risk to mitigate.[16]

Phage therapy

3.13 Bacteriophages ('phages') are a form of antimicrobial discovered in the early twentieth century. They are viruses which kill bacteria, and it is difficult for microbes they attack to become resistant to them. Currently, only a small number of countries, including Georgia, Poland and Russia, have the capacity to produce and use phages. However, conceptually, they offer a potential answer to the question of how humanity could continue to treat infections in a post-antibiotic world.

3.14 In 2023, the House of Commons Science, Innovation and Technology Committee made recommendations to DHSC and its arm's-length bodies to support UK development of phage therapy, including funding research and looking at arrangements for licensing treatments.[17] The then-government's response was that, while phage therapy was gaining attention as a potential solution to AMR, there were regulatory and practical challenges, and generalised use in the NHS was still a long way off. The government declined to publish a roadmap for developing phage therapy or to agree to prioritise research in the area. As part of NAP24–29's top 10 research priorities to address knowledge gaps on AMR, phages are mentioned as a potential area for innovation.

3.15 NAP24–29 mentions phage therapy briefly, including in a commitment to fund and deliver research into alternatives to antibiotics. In 2023, the University of Leicester opened the UK's first dedicated Centre for Phage Research. Phage therapy is both innovative and, as yet, clinically unproven, and the government has adopted a cautious approach to investing its finite resources in this area. Similar to the innovative subscription model for antibiotic purchases, phage therapy may be an area where the government needs to revisit the scale of its investment regularly.

16 Hospital 2.0 is the standardisation of hospital design to create efficiencies in both construction and productivity. Further detail can be found in Comptroller and Auditor General, *Progress with the New Hospital Programme*, Session 2022-23, HC 1662, National Audit Office, July 2023.

17 House of Commons Science, Innovation and Technology Committee, *The antimicrobial potential of bacteriophages*, First Report of Session 2023–24, HC 328, Session 2023-24, 3 January 2024.

Environmental drivers of AMR

3.16 AMR-driving chemicals, such as metals, biocides, pesticides, and antimicrobial residues, can have a significant impact on the environment. The build-up of these in wastewater and the wider aquatic environment (rivers, groundwater and soil) can increase the prevalence and diversity of AMR in the environment. In the UK, this impact is likely being exacerbated by the increasing incidence of untreated wastewater entering waterways via storm overflows. In 2016, 862 storm overflows were monitored for spills, and each site averaged 15 spill events. By 2023, the number of storm overflows monitored had increased to around 14,000 and they averaged 33 spill events each in the year.

3.17 NAP19–24 had limited ambitions with regard to the environment: six commitments for Defra, relating to research, policy and regulation, capability building and environmental stewardship standards. Defra did not report its progress against three of these commitments in an assessment by the AMR board at the start of 2024. It told the AMR Delivery Board that it would need additional resources if it were to manage its environmental commitments relating to AMR.

3.18 In October 2024, the UK and Welsh governments launched the Independent Water Commission to deliver recommendations to government on reforms to the water sector. The commission will report in 2025 and its terms of reference state that a key outcome is to "ensure the water industry has clear objectives for future outcomes and a long-term vision to support best value delivery of environmental, public health, customer, and economic outcomes". Defra officials told us that, in the meantime, it has been focusing on reducing untreated wastewater spills and is developing a programme of research into the broader impacts of the wastewater system on public health.

3.19 The Policy, Innovation and Research Unit's (PIRU) assessment of NAP19–24, which was critical of the plan's modest ambitions for the environment, stated that "academic studies have uniformly demonstrated the capability of wastewater and its by-products (sludge) to have a significant impact on the prevalence and diversity of AMR in the receiving environment". Defra and Ofwat have been involved in the development of investment plans for the water industry, covering the period 2025 to 2030. Ofwat's final determinations have set expectations that water companies will increase investment in reducing storm spills from £3.1 billion in the previous five years to £12 billion, and reduce the number of spills by 45% compared with 2021. It also expects companies to invest in upgrades to over 1,700 wastewater treatment works. If achieved, this would be a major step forward. Defra has also committed to further investment to address agricultural and slurry pollution, as well as to improve water quality in bathing waters.

Data on AMR and its drivers – a challenge and an opportunity

3.20 The collection of data is essential to the fight against AMR, for understanding both its incidence and the impact of policy interventions to combat it. The UK has played an important role in supporting other nations to develop data systems. For instance, during NAP19–24, DHSC's Global AMR Innovation Fund supported Zambia to develop an AMR surveillance platform whose adoption is now being considered by other countries.

3.21 There are still areas for improvement.

- Opportunities for managing the risks of AMR better may arise from connecting primary care and secondary care prescribing data, and improving information about infections acquired in community settings, such as adult social care, rather than in hospital.
- UKHSA and NHS England agree that there is a need to improve data, for example relating to diagnostics. There is no central repository of diagnostics data, and the results of tests are not linked to prescription information. This might make it harder to drive up the proportion of antibiotics that are prescribed based on objective tests.
- There are strong indications that AMR is a health inequalities issue, both within the UK and globally, but routine data on this are very limited. The latest report of the English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) showed that, in 2023, the most deprived quintile of the population had a rate of drug-resistant bloodstream infections of 38.1 per 100,000 people, compared with 26.7 per 100,000 in the least deprived quintile. The causes of these specific inequalities are poorly understood. This new area of focus in NAP24–29, including a commitment to collect better data, is welcome.

3.22 Data on AMR in animals is collected by the Veterinary Medicines Directorate (VMD) and published in the annual *Veterinary Antimicrobial Resistance and Sales Surveillance (VARSS)* report.[18] This includes data on the sale and usage of veterinary antibiotics and on levels of antimicrobial resistance in different species. There are greater obstacles to effective clinical surveillance in animals because, unlike in human health, the vast majority of clinical AMR testing is carried out privately. While some infections are reportable by law for some species, access to other data is not straightforward. Defra considers that it does not have sufficient funds to enable it to extend VMD's surveillance activities in animals. At present, routine AMR surveillance data is only collected for healthy pigs, chickens and turkeys. There is no routine surveillance of other healthy species. For 2023 only, surveillance data was collected for healthy beef cattle, dairy cattle and sheep as part of the Pathogen Surveillance in Agriculture, Food and the Environment (PATH-SAFE) programme (see paragraph 3.23), but this work is not ongoing. There is only limited surveillance of unhealthy animals that do not go to slaughter as current surveillance only covers government labs and not private laboratories. The veterinary and farming sectors provide data on antimicrobial usage in food-producing animals on a voluntary basis and the volume of data varies by sector. There is also only limited surveillance of AMR in companion animals, such as dogs and cats. Research in the USA has found that AMR is common in companion animals.

3.23 Between 2021-22 and 2024-25, the Food Standards Agency (FSA) has run the PATH-SAFE programme, funded in part by HM Treasury's Shared Outcomes Fund. This programme has improved understanding of AMR prevalence and transmission within the UK environment and agri-food systems, including through surveillance activities in 2023. It has also identified mechanisms for future surveillance. However, currently there are no plans to continue this work after March 2025.

AMR as a chronic risk facing the UK into the future

3.24 The Cabinet Office runs the resilience directorate, which oversees the whole of the government's activities to identify and manage the country's most significant risks. We have previously described this strategic approach and the UK government's resilience framework in our 2023 report on *Government resilience: extreme weather*.[19]

18 Veterinary Medicines Directorate and Animal and Plant Health Agency, *UK Veterinary Antibiotic Resistance and Sales Surveillance Report: UK-VARSS 2023*, November 2024.
19 Comptroller and Auditor General, *Government resilience: extreme weather*, Session 2023-24, HC 314, National Audit Office, December 2023.

3.25 The Cabinet Office currently distinguishes between acute and chronic risks. Acute risks are those likely to require an emergency response. The most serious acute risks are gathered in the National Security Risk Assessment and, subject to security considerations, published in the National Risk Register (NRR).[20] Acute risks in the areas of human, animal and plant health include a pandemic (the highest scoring of all risks on the NRR), outbreaks of an emerging infectious disease, and major outbreaks of animal diseases. Chronic risks are distinct from acute risks in that they pose a continuous challenge that might erode our economy, community, way of life or national security. Chronic risks generally extend over a longer timeframe, while still requiring a robust government-led response in the present. Such responses tend to involve sustained strategic, operational and policy changes, rather than readiness to take emergency action.

3.26 In September 2024, the Cabinet Office and the Government Office for Science completed their first analysis of the UK's chronic risks. This document identified AMR as one of 26 chronic risk drivers. The analysis pointed out not just the direct effects of AMR but also how it could indirectly exacerbate other national risks. For instance, AMR could make it harder to treat patients during a pandemic, depending on the pathogen involved. The analysis is currently an internal, classified document; however, the list of drivers of chronic risk has been included in the National Risk Register 2025.

3.27 The UK COVID-19 Inquiry has investigated national pandemic preparedness and resilience, including risk management arrangements, in its work to date. The Inquiry's Module 1 report, published in July 2024,[21] included recommendations that, if accepted by government, would result in major changes to national emergency management structures and arrangements. A key part of resilience is to carry out exercises and identify improvements. Although workshops held in 2024 for local resilience forums tested some AMR-related scenarios, national exercises have not incorporated an AMR dimension. This will be something for DHSC and Defra to consider when they next run exercises for both human and animal pandemic preparedness. However, the Cabinet Office told us that it is already sufficiently reassured about the government's focus on AMR.

3.28 In previous iterations of the NRR there was no categorical distinction between acute and chronic risks. DHSC and Defra initially worried that the classification of AMR as a chronic risk might lower its visibility within the government and its status as a priority for funding. Officials told us that their view now is that this is unlikely and they expect the government's focus on AMR to be maintained.

20 HM Government, *National Risk Register: 2023 edition*, August 2023.
21 UK COVID-19 Inquiry, *Module 1 report: The resilience and preparedness of the United Kingdom*, HC 18, July 2024.

3.29 This is important, because it would not take much for AMR to become an acute, emergency concern. Already, it is one of only six chronic risk drivers in the chronic risk analysis directly associated with loss of human life. Were all antimicrobials to fail routinely for just a single disease, such as tuberculosis or gonorrhoea, levels of death and serious harm might spike, and emergency population-wide measures might be necessary.

3.30 We have previously reported that the government was not feeding risk assessments into its decision making about funding, meaning that opportunities for investing in national resilience might be missed. Our report on extreme weather recommended that the Cabinet Office work with HM Treasury and other departments to bring forward from 2030 to 2025 a commitment they made to ensure investment in resilience was cost-effective and achieved the greatest possible benefits. The Cabinet Office told us that it is currently working with HM Treasury to ensure a joined-up approach to risk and resilience in the 2025 Spending Review, with departments being asked to identify and consider how investment and spending bids will contribute towards resilience objectives.

Appendix One

Our investigative approach

Scope

1 We conducted an investigation into three specific areas:

- why antimicrobial resistance (AMR) is an increasing threat and what the consequences to the UK are;
- the UK government's response to antimicrobial resistance; and
- challenges and opportunities over the next five years.

Methods

2 In examining these issues, we drew evidence from interviews, document review and data analysis.

3 We interviewed key individuals from the Department of Health & Social Care (DHSC), NHS England, the UK Health Security Agency (UKHSA), Cabinet Office, the Food Standards Agency (FSA), and the Department for Environment, Food & Rural Affairs (Defra), including its arm's-length bodies the Veterinary Medicines Directorate (VMD), the Animal and Plant Health Agency (APHA), and the Environment Agency (EA), to establish the threat that AMR poses both globally and to the UK, and to determine what actions the government is taking to mitigate the threat.

4 We conducted 25 interviews with the audited bodies, as well as with Dame Sally Davies (the UK Special Envoy on AMR), Lord O'Neill of Gatley, the Government Office of Science, and the British Infection Association.

5 We reviewed 371 documents both in the public domain and from the relevant departments. This included documents from DHSC, NHS England, UKHSA, Defra (including the VMD, APHA, and EA), FSA and the Cabinet Office in response to our evidence requests. We analysed publicly available data to understand recent and historical trends and developments in AMR. This included human health data on the burden of infections within the UK and globally, international comparisons of resistant pathogens, mortality rates, the drivers of infection, and the global costs of rising AMR.

6 We analysed financial information from DHSC, NHS England, Defra, UKHSA and FSA to understand the current and historical financial spend of these bodies regarding AMR. We also analysed data on the quantitative targets and management information on the delivery of commitments of the AMR National Action Plan 2019–2024.

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National Audit Office

Design and Production by NAO Communications Team
DP Ref: 015484-001

£10.00
ISBN: 978-1-78604-599-7