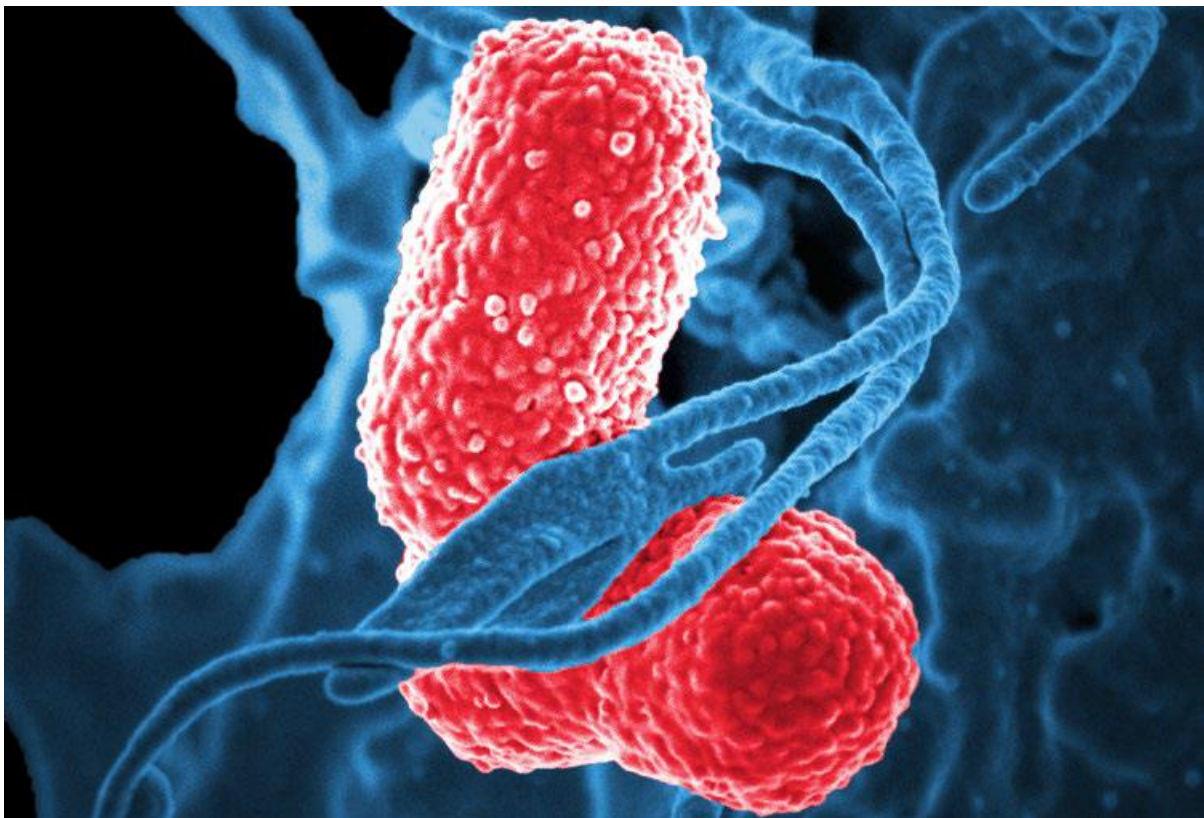


Implementation of the UK Five Year Antimicrobial Resistance (AMR) Strategy – strengthening international collaboration

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Executive Summary

Antimicrobial Resistance (AMR) is a global challenge requiring coordinated action across countries and key institutions. The UK Five Year Antimicrobial Resistance (AMR) Strategy 2013-2018 includes actions designed to strengthen international collaboration, and refers to working with and through a wide range of governmental and non-governmental organisations, international regulatory bodies, and others to influence opinion, galvanise support and mobilise action to deliver the scale of change needed globally to combat AMR.

This document reports on key stakeholders' views and experience of how much progress has been made on the international work outlined in the Strategy, and on the potential challenges to the UK continuing to situate itself prominently within the global anti-AMR landscape. The findings are drawn from 43 interviews with key stakeholders conducted between June and September 2017, as well as key documents, and outputs from the Cross-Government International AMR Strategy Workshop, 19 January 2018.

The report is organised according to the UK's planned Strategy Actions to participate in the global response to AMR, including reported progress, challenges, and implications for the next steps in the UK's contribution to the international response after 2018.

Progress on implementing actions to strengthen international collaboration on AMR

Interviews with key informants consistently identified the UK's strategic leadership role, particularly by Dame Sally Davies, but also intensive and sustained engagement of UK government departments and agencies with UN organisations and at the EU level. The UK was notably instrumental in drafting and gaining support for a UN declaration on AMR, agreed at the UN General Assembly (UNGA) in September 2016. When considered in terms of the UN Inter-agency Coordination Group on AMR (IACG) Framework for Action, the UK is extensively involved in contributing to 1) reducing need for antimicrobials and unintentional exposure to antimicrobials or microbes that have become resistant to antimicrobials, 2) optimizing use of medicines, and 3) investing in innovation, supply and access to old and new antimicrobials, vaccines and diagnostics.

Interviewees also highlighted several challenges in the UK's leadership of an international response to AMR. These include the challenges of working effectively across sectors and across nations, notably with the objective of implementing the concept of One Health. Other reported challenges are the difficulty of increasing public awareness on AMR consistently across countries and challenges related to international data sharing. Differences between countries in terms of technological and/or regulatory readiness for addressing the AMR challenges are a further challenge particularly in terms of pacing the advancement of restricting usage in humans as well as along the food chain.

Discussions about the process of UK withdrawal from the EU (the so-called "Brexit") revealed major concerns and substantial uncertainty about the consequences for the UK's role in tackling AMR, especially in European organisations, committees and working groups, but also on the potential impact of Brexit on the UK's capacity to tackle AMR.

Implications for the next steps

The implications of these findings, expressed by interviewees, and particularly in the context of "Brexit", centre on a need to strengthen a sustainable implementation of the One Health approach, and linked to this to increase focus on understanding the drivers of veterinary prescribing. Moreover there is a need to maintain credibility as a world leader in AMR, especially in light of "Brexit". Also,

there is a need to strengthen the global leadership of the UK on AMR by continuing to participate in global AMR initiatives, and linked to this, strengthen international capacity for addressing AMR. Finally an important implication is also the need to ensure appropriate funding for research and development on AMR as part of international consortia.

Introduction

AMR is a global challenge requiring coordinated action across countries and key institutions, and as such the UK Five Year Antimicrobial Resistance (AMR) Strategy 2013-2018 proposes a set of actions designed to strengthen international collaboration. The Strategy's "Strengthening international collaboration" section thus refers to working with and through a wide range of governmental and non-governmental organisations, international regulatory bodies, and others to influence opinion, galvanise support and mobilise action to deliver the scale of change needed globally.

The focus on strengthening international collaboration (Key Area 7 of the Strategy), recommends building on the well-established leading role of the UK in "influencing European and international thinking, seeking support, securing commitments to prioritise the issue and mobilising action to deliver the scale of change needed." The Strategy calls for more joint AMR initiatives to improve data and technology sharing/transfer between animal and human health fields, encourage innovative approaches to develop rapid diagnostics, new antibiotics and novel therapies, and encourage greater research collaboration. The Strategy refers to the existing mechanisms established by the European Commission such as Horizon 2020 funding, the Innovative Medicines Initiative, the Joint Programming Initiative on Antimicrobial Resistance, and a range of other mechanisms, including to improve surveillance, data collection and public awareness.

Though the Strategy recognises the importance of these and other international mechanisms and the opportunity for the UK to share data and experience, it cautions that the pace in some areas needs to be accelerated if these mechanisms are to have a significant impact. Moreover it recommends improved collaboration at the global level under the One Health approach to encourage innovation in the development of new antimicrobial agents, diagnostics and multi-disciplinary collaborations between researchers working on AMR in humans, animals and the environment. Finally it suggests working to "review the regulatory framework, international standards and resolutions to contain antibiotic use, reduce sub-optimal prescribing of antimicrobials, strengthen data collection and analysis systems to provide comparable human and animal information, and make better use of prescribing and sales information."

In order to implement the above, the Strategy proposes seven overarching actions needed to strengthen international collaboration with international bodies to improve knowledge and understanding of AMR, improve conservation and stewardship of existing antibiotics and facilitate development of new antibiotics, diagnostics and novel therapies. These actions are to:

- continue to demonstrate leadership in the task of building political support for action at a global and national level,
- support efforts to strengthen international partnerships and coalitions to facilitate the development of new antibiotics and other treatments,
- seek assurances from WHO of its commitment to accelerate the pace of progress with respect to implementation of the 2001 WHO 'Global Strategy on the Containment of AMR',
- press the European Commission to accelerate progress to implement the '2011 EU AMR Strategic Action Plan',
- facilitate international action by helping WHO develop a framework for action to underpin an integrated programme of work to harness greater collaborative working,
- take a leading role in the development of a new AMR resolution for consideration by the World Health Assembly and pursuing supporting action in FAO and OIE (the UN bodies for food and animal health), and
- consider the need for a future international treaty to protect special medicines like antibiotics which are in short supply.

The objectives of this report are to share key stakeholders' views and experience of the UK's progress in implementing Strategy actions to participate in the global response to AMR, including reported challenges, and implications for next steps.

This component of the evaluation used semi-structured interviews with key informants to ask about their views and experience of how much progress has been made on the international work outlined in the Strategy, and potential challenges in terms of the UK continuing to situate itself prominently within the global AMR landscape. The findings were drawn from a total of 43 interviews with key stakeholders from a range of departments and organisations including Department for Environment, Food and Rural Affairs (Defra), the Department of Health and Social Care (DHSC), the Department of International Development (DFID), the Veterinary Medicines Directorate (VMD, an executive agency sponsored by Defra), Department for International Development (DFID), public health agencies and health services of the Devolved Administrations, Public Health England (PHE), the Food Standards Agency (FSA), the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR), the British Veterinary Association (BVA), Advisory Committee on Antimicrobial Prescribing, Resistance and Healthcare Associated Infection (APRHAI), as well as the European Commission, and members of the tripartite i.e. the World Health Organization (WHO), the Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE). We also draw on outputs from the UK Cross-Government International AMR Strategy Workshop, 19 January 2018. This report reflects the situation as reported at the time of interviews in 2017.

Progress in implementing the Strategy's actions for global response to AMR

Figure 1 provides an overview of the UK's role in the international response to AMR as described by interviewees. As the information leading to this figure was mainly extracted from the interviews we conducted it does not provide a complete summary of UK involvement, and some of the details are likely to have changed since the interviews were undertaken. The main UK agencies and departments involved are listed at the centre of the figure. Much of the AMR work has been led by the Chief Medical Officer (CMO), Dame Sally Davies, in the context of a High-Level Steering Group (HLSG) based at DHSC, and including members such as PHE, Defra, VMD, NHS England and the Devolved Administrations, as well as other departments and agencies.

Global leadership on AMR

The UK is seen as a key player in developing the global roadmap, governance and coordination efforts on AMR, including building coalitions and political commitment on AMR. Respondents have overwhelmingly described the UK contribution to international work on AMR as highly influential in driving AMR up the global political agenda:

the UK plays a key part in influencing Europe and is highly regarded in basically bringing and mobilising the populations across Europe together.

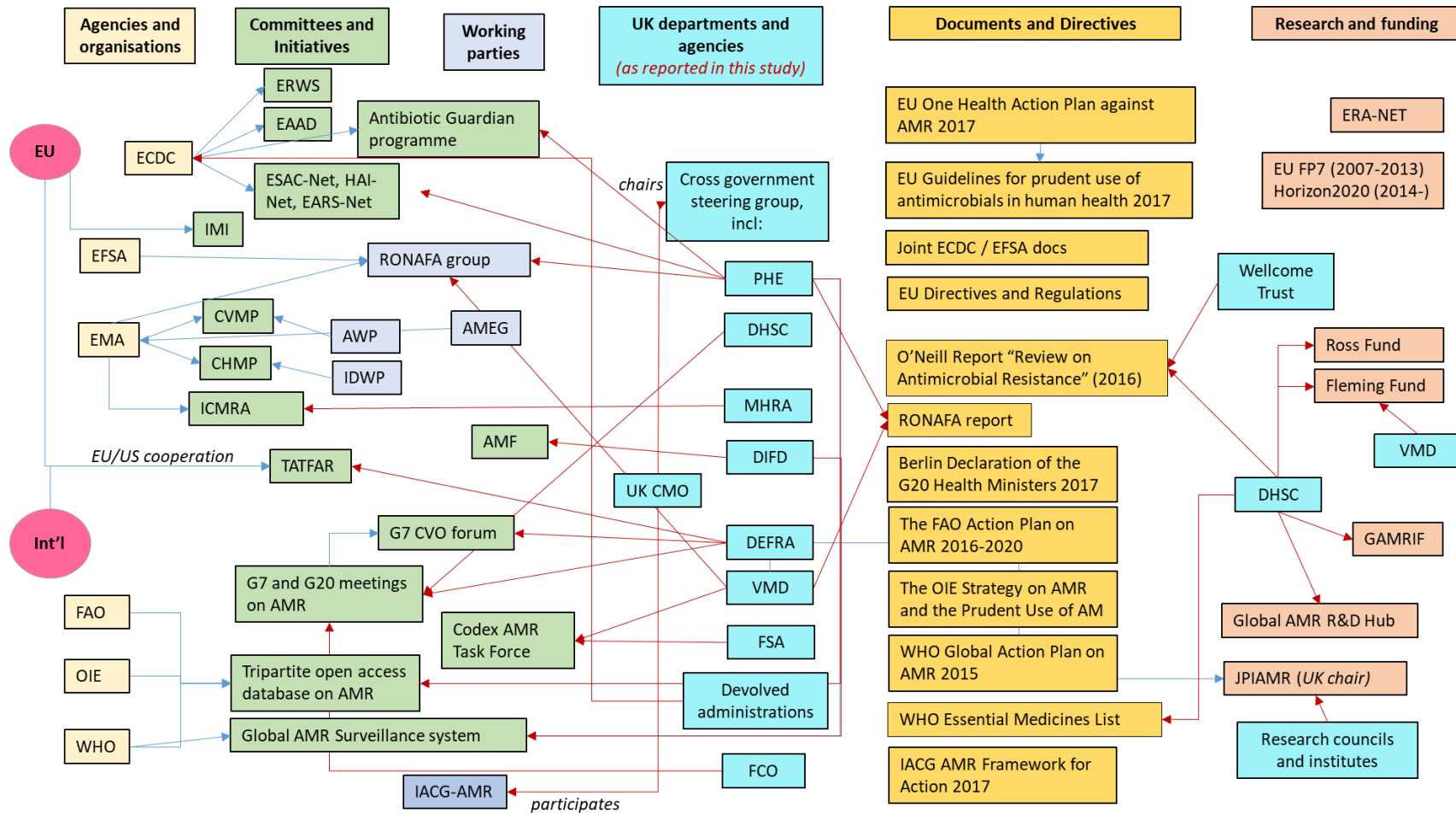
International respondents confirmed this central role of the UK in global AMR control. For example, an interviewee from the OIE felt that:

[...] the engagement of the UK on an international level, that's very strong, and very efficient [...]. That's quite impressive, at least [...] for the way it communicates what the UK wants, to each of the countries. I think the UK is very well-organised in giving the advice or priorities to embassies, to agencies, to all kinds of bodies that are linked to the UK, and I think that's a very strong part, and it's very impressive.[...] Since we started development of the global action plan, where there's the chair of the global action plan, somebody from UK, [...] and that just goes on, I mean, UN interagency group, influenced through all kinds of possible bodies, from

what I call embassies, agencies, individual people, and also, which is probably the one that I'm really most familiar with, which is the funding agency, and especially Fleming Fund.

The involvement and contributions of the UK through participation in international fora, working groups and standard setting processes were mapped and are shown in Figure 1. This graph illustrates the high degree of connectedness of UK departments and agencies on the topic of AMR in the international arena.

Figure 1. The UK's Participation in the global response to AMR



Legend: Red arrows= participation of UK departments and agencies in various fora and initiatives; **Agencies and organisations:** EMA - European Medicines Agency; EFSA - European Food Safety Authority; ECDC - European Centre for Disease Prevention and Control; FAO - Food and Agriculture Organisation; FCO – Foreign & Commonwealth Office; OIE - World Organisation for Animal Health; WHO - World Health Organization; **Working parties/working groups:** AMEG - Antimicrobial Advice Ad Hoc Expert Group; AWP - Antimicrobials Working Party; IACG - Interagency Coordination Group on AMR; CVMP - Committee for Medicinal Products for Veterinary Use; RONAFA – Working group on the Reduction of the need to use antimicrobials in food-producing animals; **Committees and Initiatives:** ERWS- Early Warning Response System; EARS-Net - European Antimicrobial Resistance Surveillance Network; ESAC-Net - European Antimicrobial Consumption Surveillance Network; EAAD - European Antibiotics Awareness Day; HAI-net - Healthcare-associated Infections Surveillance Network; IMI - Innovative Medicines Initiatives; TATFAR - Transatlantic Taskforce on Antimicrobial Resistance; **UK departments and agencies:** CMO – Chief Medical Officer; Defra – Department for Environment, Food and Rural Affairs; DFID – Department for International Development; DHSC – Department of Health and Social Care; FSA – Food Standards Agency; MHRA - Medicines and Healthcare products Regulatory Agency (executive agency sponsored by DHSC); PHE- Public Health England; VMD – Veterinary Medicines Directorate (executive agency sponsored by Defra); **Research and funding:** GAMRIF - Global AMR Research Innovation Fund; JPIAMR - Joint Programming Initiative on Antimicrobial Resistance; ERA-NET - European Research Areas.

Working according to the One Health approach

The Strategy adopts the One Health approach to improving AMR collaboration at the global level. The One Health approach is understood as a collaborative, multi-disciplinary effort including local, national, and global levels to attain optimal health for people, animals and the environment.¹ As explained by respondents, it has been an important overarching principle in the UK's international and intersectoral collaboration:

At a European level, the Commission have been really keen to try to get their various agencies to work more closely together, so we are now, rather than opinions coming out just from the European Medicines Agency, the RONAFA report was a combination of EFSA and the EMA and the AMEG group is a combination of EFSA, EMA and the ECDC. And because of the One Health approach, which they're taking, that has meant we are working far more collaboratively with our human counterparts. The thrust of the work that we're doing is really around the public health angle, and because of that, clearly the collaboration with human colleagues is absolutely vital.

If I had my way, I would actually even strengthen that further at the EMA level, I'd like to have more contact with the ... on the human side, they have the Infectious Diseases Working Party and certainly we've been writing reflection papers at the moment on Aminoglycosides and the extended spectrum Penicillins. And we have sections in that where we look at human use and we're looking at the risk of transfer from a resistance from animals to humans, and we need a lot of input from human colleagues on that side. So from that point of view, that's increased, that emphasis on the One Health approach has really increased the amount of work we're doing and the amount of collaboration that needs to be done, and that all takes time.

Based on the evidence provided in the interviews, we conclude that the One Health approach is accepted across sectors as the appropriate approach to address the international challenges of AMR.

UK's role in the UN resolution on AMR

Most notably, the UK was considered instrumental in drafting and gaining support for a high-level UN declaration on AMR, agreed at the UN General Assembly (UNGA) in September 2016.² The UK – via the Cabinet Office, DHSC and Defra – was also a leading participant on the G7 and G20 actions:

we're a major player, we're very influential with the World Health Assembly, [...] clearly seen as a global leader in this field. [...] we were very much seen as [...] global thought leaders, as raising awareness, prioritisation, of very much in terms of becoming soft power influentially.

UK's role in establishing the IACG

The UK contributed to the establishment of the Interagency Coordination Group on AMR (IACG)³, currently considered the overarching global framework for addressing AMR. It was established in the wake of the 2016 United Nations General Assembly, in consultation with the WHO/FAO/OIE tripartite. The IACG provides guidance on effective global action to address AMR, and has been designed in line with the WHO Global Action Plan⁴ and framed within the Sustainable Development Goals.⁵ The IACG is co-chaired by the UN Deputy Secretary-General and the Director-General of WHO, and it comprises high-level representatives of relevant UN agencies, as well as organizations and individual experts from a range of sectors. The UK co-hosted the first 'Call to Action on AMR' (and plans to help facilitate a second) to support the IACG's input into the Secretary-General's report. The CMO has had an important role in the IACG, as expressed by an interviewee

¹Global 'One-Health' approach. <http://www.onehealthinitiative.com/index.php>

² <http://www.who.int/antimicrobial-resistance/events/UNGA-meeting-amr-sept2016/en/>

³ http://www.who.int/antimicrobial-resistance/interagency-coordination-group/20170818_AMR_FfA_v01.pdf

⁴ <http://www.who.int/antimicrobial-resistance/publications/global-action-plan/en/>

⁵ <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

[...] she's now one of the convenors of the Interagency Coordination Group. And so I think that gives her special sort of influencing powers, I think being a convenor, you know, you sort of have a special status. So I think she will be able to use that, you know, to make sure that progress is made on AMR.

Other ways in which the UK contributes to the global AMR roadmap, governance and coordination

As outlined here and further below (and illustrated in Figure 1 above), the UK departments and agencies are fully engaged in EU and international bodies and initiatives on addressing AMR. For example, DHSC and Defra participate in the Global Health Security Agenda (GHSA) Action Package on AMR,⁶ a forum of 22 countries aiming to prevent the threat of AMR to Global Health Security. Several countries (including the UK) lead work on information and expertise sharing to strengthen in-country capacity.

We do have an active group on AMR through the Global Health security agenda which has got seven leading countries and quite a number of contributing countries. So over time, it would be wonderful to have one of the BRICs stepping up to the plate more and another sub-Saharan African country.

DHSC is also a founding member of the Alliance of Champions,⁷ a group of countries established to carry through the first WHO Resolution on AMR, which continues to provide a space for collaboration, partnership and alignment; and participates in the Group of Friends, made up of UN permanent representatives from the USA, Ghana, China, Mexico and South Africa to maintain political momentum and awareness on AMR at the UN, and to prepare the ground for the Secretary-General's 2019 report on AMR.

You know the UK's always been a major WHO contributor. Also the international work through DFID that's been historically has always been a very large part of the work plan of the UK internationally. Then [AMR] just puts on top of much of the infrastructure that's been done before.

Another way in which the UK contributes to a global roadmap, governance and coordination of AMR efforts is by working on international standards and regulations. The Medicines and Healthcare products Regulatory Agency (MHRA, an executive agency sponsored by DHSC) and the Veterinary Medicines Directorate (VMD, an executive agency sponsored by Defra), are both members of the Pharmaceutical Inspection Co-operation Scheme which leads the international development, implementation and maintenance of harmonised Good Manufacturing Practice (GMP) standards and quality systems of Inspectorates in the field of medicinal products. The MHRA chairs the International Coalition of Medicines Regulatory Authorities (a voluntary worldwide group of medicines regulatory authorities) and is an active member of the Working Group of Enforcement Officers (WGEO) which shares information and expertise globally relating to pharmaceutical crime; it also chairs the Heads of Medicines Agencies which deal with the regulation of medicinal products for human and veterinary use in the European Economic Area.

In addition, the UK Government is involved with other countries in incentivising pharmaceutical companies to produce effective new drugs, diagnostics and vaccines. This commitment was taken at the 2016 G20 summit in China, and followed through in the context of Germany's G20 Presidency. The UK was moreover influential in negotiating the 2017 G20 Agriculture Ministers' Declaration,⁸ which declared the use of antibiotics in food-producing animals, in the absence of risk-analysis, to not be prudent. The UK also worked in the G7 to ensure that AMR remains high on the global

⁶ <https://www.ghsagenda.org/packages/p1-antimicrobial-resistance>

⁷ <http://www.swemfa.se/2015/06/11/the-alliance-of-champions-the-fight-against-antimicrobial-resistance-amr/>

⁸

https://www.bmel.de/SharedDocs/Downloads/EN/Agriculture/GlobalFoodSituation/G20_Declaration2017_EN.pdf?__blob=publicationFile

agenda. The Foreign & Commonwealth Office (FCO) has played an essential, leading role in pushing AMR priorities at the G summits, lobbying for UN resolution on AMR, supporting the international work of the IACG, the WHO Action plan, the Call to Action summits and engaging with the GHSA.

The role of the Chief Medical Officer

The Chief Medical Officer (CMO) for England has been widely credited with galvanising efforts on AMR in the UK and globally, with the 2011 CMO Annual Report⁹ calling for action across all sectors, human and animal health, industry, academia and research funders. That call was reinforced in the cross-government UK AMR Strategy published in September 2013. The CMO has played a crucial role as a global champion and figurehead for AMR efforts.¹⁰

The CMO is very influential, she's very driven, and that ... and that is something that, you know, that trickles down and empowers [...] us.

Actually, I think the UK has cemented itself in a global leadership role in tackling AMR. And I think that that is hugely because of Dame Sally.

Then there has been the global strategic leadership, which has been pretty much led by Dame Sally, which has been extremely influential. There's a very wide recognition that's been extremely influential on driving this up the political agenda.

It's obviously all the work that Sally has done [...] which has being extraordinary, [...] at the World Health Assembly the week before last. [...] in terms of effectiveness of raising the international policy profile, in getting things done, it's quite impressive.

This perception was also confirmed by international partner interviewees. However, they also noted that progress needed to be paced considering less developed countries and their challenges in financial capacity.

The global importance of the 2014 O'Neill Review on Antimicrobial Resistance

The 2014 O'Neill Review on Antimicrobial Resistance, commissioned by David Cameron (the then Prime Minister), proposed concrete actions to curb AMR internationally, including public awareness campaigns, improving sanitation and hygiene, reducing pollution from agriculture and the environment, improving global surveillance, introducing rapid diagnostics and vaccines, increasing research and practice on AMR control, and building political consensus around the issue.¹¹

Interviewees recognised that one of the key AMR documents coming out of the UK was the O'Neill Review:

Now we've got all the permanent representatives in New York debating this and coming up with a draft outcomes document that could come out of the September UNGA meeting. These are people who are not health by background and the permanent representative, the Ambassador for Mexico, who is leading the negotiations, is passionate. [...] it does capture the imagination which I think is why Jim's first recommendation from the O'Neill report in terms of you need a global communications plan so that you alert the public and everybody to why this is important.

As we've just done with the Prime Minister's G7 announcements, we're now pushing ourselves beyond our original strategy. Because I think you were also there when we had our workshop and [...] asked the question last autumn, okay, so if we do everything that we've said we're going to do in the strategy, will we actually have made a significant difference to AMR? And the answer was possibly not; we made a difference but not a significant enough difference, which is why I'm delighted that we've now, with the G7 statement, we will have a response to the O'Neill review, the PM has already committed us to going much further and faster.

⁹ <https://www.gov.uk/government/publications/chief-medical-officer-annual-report-volume-2>

¹⁰ <https://quarterly.blog.gov.uk/2017/02/14/building-an-international-coalition-to-combat-antimicrobial-resistance/>

¹¹ <https://amr-review.org/home.html>

The importance of the O'Neill review was also acknowledged by international interviewees:

I think [the strategy is being implemented], because as an organisation, we're now engaged, whereas two years ago, we weren't really. I think it continues to focus on established plans of action and tracking activity, I'm not sure what concrete indicators of success the plan would set for itself. In that regard, I think it was very useful having the O'Neill review which, I think, gave some of those discreet measures of success, targets, timetables, which were maybe lacking in the plan. So I'd say, from my perspective, that's been the main way in which the plan has evolved and improved is by assimilating into it the O'Neill recommendations, which give more measurable success.

Of course, one of the important elements to mention, of course, the huge political pressure and will from UK Governance to fight AMR, and I think the Jim O' Neill report is, of course, a very, very important element in this, not only in UK, but also outside, and as commission, we often referred to this O' Neill report as being an important element in our discussions, in our thinking about the future of AMR.

Reported challenges of intersectoral and international approach on AMR

Interviewees outlined the various challenges of working effectively across sectors and across nations. As expressed by a respondent:

[...] we've been talking a lot [...] about how do we sustain the momentum after the UN General Assembly, and everyone I think is hoping that that might be achievable through the inter-agency coordination group the CMO is on, although I think that got off to a slightly hiccupy kind of start [due to] international politics. [...] I would really, really, really love to see the tripartite working seamlessly together, and I think that's really hard.

For others, it was difficult to move beyond the concept of One Health, to the practicalities of working across sectors:

I'd say there's awareness of the One Health concept, awareness of what it means, but I don't think, internationally, that people have fully thought through what it might mean in terms of, for example, the role of changes in animal husbandry practices in controlling the emergence and amplification of antimicrobial resistance. [...] there seems to be a willingness to debate and discuss [among private industries and national governments outside the EU] that falls short of significant change to general animal husbandry practices.

There is also a challenge for international organisations agreeing their respective roles within the One Health framework:

WHO's initiative to produce guidance on how vets should prescribe antibiotics which are critically important for human health. I mean I think that's just a gross overstepping of their remit. [...] recommending how vets should prescribe antibiotics is something that I would see as either an OIE thing, or an OIE and FA thing, or a tripartite thing. So, if the WHO is concerned about this, then for me a functioning tripartite would be that the WHO gets together with the OIE and the FA and says, okay, these are some of your concerns about how can we come together in a One Health way and tackle this, and that's not how it was handled and I think that's the problem.

Several interviewees commented on leadership issues between international organisations and the need to speak with one voice. We therefore conclude that although the One Health concept is accepted as the right approach, more needs to be done to illustrate how it should be implemented. It is currently not fully operational or effective, neither at UK nor international level.

Progress in terms of the IACG Framework for Action

The following sections report on the UK actions in terms of the IACG Framework for Action's three key areas for actions, i.e. 1) reducing need and unintentional exposure, 2) optimizing use of medicines, and 3) investing in innovation, supply and access.

Reduce need and unintentional exposure

The first action point of the IACG notes that prevention and control of the occurrence of infections that are likely to be treated with antimicrobials, including unintentional exposure, can reduce the need for antimicrobials and are therefore key to tackling AMR. Transmission pathways for unintentional exposure include via food and the environment.

The UK agencies and departments are highly involved in international efforts to address animal infection prevention and control, food safety, and environmental contamination control. For example, the VMD and FSA lead and contribute to work via Codex Alimentarius to revise the AMR Code of Practice and to develop new guidelines on surveillance. Moreover, the UK contributes to the electronic working group that will produce the outputs of a newly established Codex AMR Task Force. Defra also participated in the 2017 UN Environment Assembly (UNEA) resolution on the environment and health which includes a commitment to control environmental contamination, and to report on the risks to human and animal health and biodiversity arising from the rise in AMR in the environment arising from such contamination.

One of the key pieces of work that we've been doing with the [Antimicrobial Advice Ad Hoc Expert Group] AMEG group is a categorisation of antimicrobials according to the risk they pose to public health from use in animals. And it's like the WHO list, essentially, but the key criteria for that is, it's based on how important is this antimicrobial in human medicine and what's the extent of use. So we've worked very closely with ECDC colleagues on that and it's vital that we have that information to form a basis for the categorisation, so getting together to work with them is really important, but trying to find time in their schedules is really hard.

Interviewees noted that the WHO may not be best placed to make recommendations on non-human use of antimicrobials.

Optimize use of medicines and data sharing

The second action point of the IACG Framework for Action refers to the importance of optimizing the use of antimicrobials to ensure the right quality, drug, time, dose, duration, patient/animal, and route are taken. The UK agencies and departments are involved in international efforts to curb human, animal and agricultural use of antimicrobials, and to support laboratory capacity and surveillance. For example, in terms of human use, the PHE is involved in awareness raising programmes such as the "Antibiotic Guardian" programme, and initiatives aligned with ECDC and WHO (European Antibiotic Awareness Day and World Antibiotic Awareness Week). Another example where the UK is involved in international awareness raising and public education is via the British Society for Antimicrobial Chemotherapy (BSAC)¹²:

BSAC is the only charity and society focused on antibiotics and has been running for nearly 50 years. It has a very long track record. It started off as a members' society, which is why it's British. We've had a lot of discussions recently about changing it to be the Antibiotics Society, because 20% of the members are non-UK and the majority of our activities now are global. [...] And if you go on the website, you'll see just how global we are. So in terms of education, they have the massive open online course. [...] An incredible number of people go through that course now. It's now running in Russia. It's been translated in various languages. It's going into Africa in the autumn. So huge, for a little charity.

¹² <http://www.bsac.org.uk/>

However the challenges of increasing public awareness on AMR were also raised by interviewees:

So the evidence base [for improving public awareness] is not great. [...] reasonably good systematic review by Staffen Harbarth or a good systematic review and a number of other studies that have tried to delineate and identify the impact of public understanding on antimicrobial resistance.

But WHO, Global Action Plan and most other plans recognise this as being part of the strategy. Indeed coming out next week will be the O'Neill report that will also have as one of the key pillars of that, a component of public awareness. Public awareness methodology is really poorly defined.

Another way in which the UK is involved at the international level in optimizing the use of medicines is through setting reference standards for biological medicines and vaccines, and to do this the MHRA contributes to EU Medicine Regulation and Enforcement.

In terms of animal and agricultural use, Defra participates in the G7 Chief Veterinary Officers' forum's working group to develop common AMR definitions, in particular around preventive use and growth promotion; DFID is funding Consultative Group on International Agriculture Research (CGIAR) research programmes on animal health and productivity and is exploring research opportunities to include on livestock-driven AMR; and the VMD provides bilateral technical assistance e.g. to develop guidelines around animal feed.

PHE and VMD share data with the EU (ECDC) and with the tripartite through their involvement with a range of data networks such as EARS-net (European Antimicrobial Resistance Surveillance Network), ESAC-net (European Antimicrobial Consumption Surveillance Network) and HAI-net (Healthcare-associated Infections Surveillance Network).

Our contribution [to working with the EU] has been strategic and academic and financial. They're the three broad areas if you want to try and put that into place. [...] involved with ESAC and [...] with ECDC particularly. Working through the ECDC mechanisms. A number of people, [...] from PHE or from elsewhere are actually on ECDC boards and have contributed through those sort of routes.

VMD support regional and international improvement and harmonisation of surveillance on veterinary antibiotic use monitoring and AMR. They contribute expertise to the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) to develop and refine methodology for antibiotic use monitoring, analysis and reporting within the EU; they work with EFSA to contribute UK data on AMR bacteria using methodology harmonised across Europe; and they work with EMA, EFSA and ECDC to produce integrated reporting of Europe-wide (including the UK) surveillance from animals, humans and food.

At a European level, the Commission have been really keen to try to get their various agencies to work more closely together, so we are now, rather than opinions coming out just from the European Medicines Agency, the RONAFA report was a combination of EFSA and the EMA and the AMEG group is a combination of EFSA, EMA and the ECDC.

the categorisation work and the work that we've done on Colistin and also with the reflection of the other Aminoglycosides and things, we're sharing sales data from ESAC, so the ECDC are providing us with that. And certainly from resistance surveillance, when the MCR-1 gene issue arose, we were getting data through from EFSA on the surveillance information they had on Colistin. So yes, basically we're really utilising all of that data that's coming through and making really good use of it.

the JIACRA report, it's an inter-agency report between ECDC, EFSA and the EMA. And they're looking at consumption of antimicrobials in humans and in animals and then they're looking at taking the surveillance data from humans and animals and looking for the - So that is making really good use of all of that surveillance data.

Finally, the PHE AMRHAI Reference Unit¹³ (the national reference unit for investigating AMR in healthcare associated bacteria) is the WHO Collaborating Centre for Reference and Research on AMR and HCAI. It is also a member of the WHO AMR Surveillance and Quality Assessment Collaborating Centres Network¹⁴ established in December 2016 by WHO's Global AMR team. In addition, VMD contribute expertise to OIE in developing and refining methodology for global antibiotic use monitoring.

Capacity building is accepted to be an essential requirement to optimise use. Also, laboratory and surveillance capacity is lacking in many countries and regions. Through its strategy, the UK also contributed to these fields. Examples include PHE's inclusion on the steering group of the WHO-hosted Global AMR Surveillance System which was set up to establish a global standardized approach to the collection, analysis and sharing of data. PHE is also part of the WHO AMR Surveillance and Quality Assessment Collaborating Centres Network, whose mission is to assist WHO support countries, and, in particular, low income countries to build capacity to develop and implement AMR surveillance.

The Medical Research Council (MRC) participate in the funding and implementation of the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR).¹⁵ The JPIAMR was established in 2011, and it funds basic and exploratory research on new antibiotics, stewardship of existing antibiotics, and studies on the control of the spread of antibiotic resistance between humans, animals, and the environment, taking a One Health perspective.

The importance of the UK's role in the JPIAMR has been acknowledged by interviewees.

The UK has been a major player in this. So that's good. Unfortunately, EU JPIAMR doesn't have a huge pot for research funding, it comes out of the national budget. So the UK part of any JPI calls is MRC money. [...] Well, luckily, the EU JPIAMR is independent of the EU as it were. [...] Separate body. It's not part of the European Commission.

From 2018 onwards, JPIAMR will fund a number of international surveillance networks to address 6 themes, including: homogenising reporting of resistance rates in European countries; defining major outcome measures for reporting resistance rates; considering mentorship with low income countries; considering surveillance methodology to meet local, national and global needs; evaluating the impact and efficacy of control strategies; considering surveillance in the context of a One Health approach.

Invest in innovation, supply and access

The third action point of the IACG Framework for Action refers to the need to improve the development, supply, and access to old and new antimicrobials, vaccines and diagnostics to reduce AMR. The UK agencies and departments are involved in international efforts to develop and provide access to high quality new therapeutics, diagnostics and vaccines.

¹³ <https://www.gov.uk/guidance/amrhai-reference-unit-reference-and-diagnostic-services>

¹⁴ <http://www.who.int/glass/collaborating-centres-network/en/>

¹⁵ <https://www.jpiamr.eu/about/>

The AMR Funders Forum includes the research councils, DFID, DHSC, Defra, VMD, FSA, PHE, BEIS, and Innovate, to bring together the key UK funders and stakeholders in AMR research. Along with the abovementioned JPIAMR, another major funding initiative is the UK government's investment in a £50m Global AMR Innovation Fund (GAMRIF) which seeks to fund the most innovative science in neglected areas of AMR research and development specifically for the benefit of people in low-and-middle-income countries (LMICs). DHSC also supports the NIHR Global Health Research Programme to fund research on AMR. The UK also contributes to research in LMICs via MRC's involvement in the Cross Research Council Initiative, a £10m call under the AMR cross-research council initiative in partnership with DHSC.

The UK is involved in the development of new therapeutics via DHSC's participation in the Global AMR R&D Hub¹⁶ and various product development partnerships, such as DFID research Ross Fund Portfolio, Medicines for Malaria Venture (MMV) for new malaria treatments,¹⁷ the Global Alliance for TB Drug Development (TB Alliance) for new TB treatments,¹⁸ Innovative Vector Control Consortium (IVCC) for development of new insecticides for vector control,¹⁹ PATH drug solutions for development of new treatments for diarrhoeal diseases,²⁰ Drugs for Neglected Diseases initiative (DNDi) for treatments for a number of neglected tropical diseases,²¹ and the Global Antibiotic Research & Development Partnership (GARDP).²²

I don't know how much you are familiar with the Ross Fund, it's about a billion pounds. Over five years but that will contribute to research and operational activities. The Fleming Fund is I can't remember exactly three or four hundred million over that period for AMR combatting AMR and that money doesn't have to go through DFID. Now DFID is quite involved in how that money might be dispersed or spent and this and whatever but isn't the director of it. I think that's really helpful for UK what the UK government can do internationally. It will mean that we have more opportunities for PHE but also universities to bid for more relevant research monies.

Moreover DFID supported the establishment of the Access to Medicine Foundation's Index²³ in 2016, to analyse and rank the efforts in AMR of 30 of the world's largest pharmaceutical companies with the purpose of stimulating improved accountability and positive competition, leading to better performance.

Interviewees reported that the UK is very strong at the basic science:

[...] at the European level certainly a lot of research that's going on, in terms of the big trials and strategic trials, the UK does not play a major role. So we have a low level of trials infrastructure. Actually our academic component has been good from a basic science and very good from a molecular basis. Very good at basic microbiology. [...] very good in terms of primary care research on antimicrobial resistance. Fairly weak for big strategic infectious diseases trials. They have been mostly done in Holland, Spain, France, Italy, Germany.

The UK also supported diagnostics development, for example the DFID Partner Development partnership for development and delivery of diagnostics for poverty-related diseases.²⁴ The UK is the largest donor to Gavi, the Vaccine Alliance,²⁵ with a £1.44 billion investment from 2016 to 2020.

16 https://www.jpiaamr.eu/wp-content/uploads/2017/10/Junker-B_Akkoyun-A_G20_DLR.pdf

17 <https://www.mmv.org/>

18 <https://www.tballiance.org/>

19 <http://www.ivcc.com/>

20 <https://www.path.org/projects/edd.php>

21 <https://www.dndi.org/>

22 <https://www.dndi.org/diseases-projects/gardp/>

23 <https://accesstomedicinefoundation.org/>

24 <https://mrc.ukri.org/funding/science-areas/international-and-global-health-research/funding-partnerships/>

25 <https://www.gavi.org/>

Moreover the BactiVac network,²⁶ a global bacterial vaccinology network, was established in August 2017 following the award of £2.2m funding under the MRC's GCRF Networks in Vaccines Research and Development initiative. This will accelerate the development of vaccines against bacterial infections relevant to LMICs.

Interviewees suggested the AMR strategy had a positive impact on research conducted both in the UK as well as internationally:

A lot of researchers work internationally anyway, but the strategy has definitely strengthened international collaboration by the calls that have come out.

[...] There's been a financial component. So particularly through the Fleming Fund, through DFID and the work that's gone into WHO, you know the UK has been a clear net (financial) provider.

The consequences of "Brexit"

As a result of the UK European Union Membership referendum held in June 2016, the UK government invoked Article 50 of the Treaty on the Union March 2017, which has initiated a process of UK withdrawal from the EU (so-called "Brexit"). The change in UK membership of the EU may affect the potential effectiveness of the UK in international initiatives in the future. Relevant agencies and organisations have begun the transition process. For example, the European Medicines Agency will be relocating to the Netherlands and has begun the process of redistributing the UK's portfolio of centrally authorised medicines.²⁷ We asked interviewees to comment on the likely short to medium term (over the next 12-24 months) implications of the UK's decision to leave the EU for the international actions in the Strategy.

Well I think within Europe it's incredibly difficult to say because we just don't know where we'll ... what kind of relationship we'll have. It could be anything from still being able to sit in the committees and, [...] or we might be fully excluded. [...] AMR is a global problem regardless of regional politics, and we and the EU recognise that and we need to work together. [...] a lot of the international traction that's been brought to bear on AMR has actually come from [...] the UK through dynamic leadership of people like the CMO rather than through the UK's position in the EU. [...] the UK was a leader internationally on AMR before the referendum, and so hopefully ... I think in a sense the main risk is letting it drop, because ... AMR is ... an international success story as far as the UK is concerned to date.

Some interviewees felt that the strength of the global response would protect current UK AMR efforts, with the UK continuing to work in a similar capacity with EU and other international partners:

Of course it will change [...]. But the UK is a big player; I would expect us to continue to work international, including our EU partners. Why would we not? [...] we have those country relationships within the EU [...]. But it's something we would all have to engage with, so, you know, we shouldn't speculate but we will play our role. [...] We need to maintain those strong scientific links. Again, we can do more, we can do better if we're linked. In the world where the UK is outside the EU and we've created harmonised systems, in an ideal world, human, animal cross-country, why wouldn't we share our data? Of course, we would. So, I think those are things that we should not lose sight of, but again it's an international response to a global challenge and I don't think it should be crucial

Others expressed more concerns about a drop in standards in the UK due to weaker regulations, resulting in e.g. fragmented access to medicines and quality testing:

²⁶ <https://www.birmingham.ac.uk/research/activity/immunology-immunotherapy/research/bactovac/index.aspx>

²⁷

http://www.ema.europa.eu/ema/index.jsp?curl=pages/news_and_events/general/general_content_001707.jsp&mid=WC0b01ac0580a809a7

Well, I think the impact of Brexit is very serious. So number one, if we leave the EMA, the European Medicines Agency, that means that we might be the last people to get drugs, because companies will get them licensed with the EMA and the UK market may be an afterthought. It may be that we get less quality testing, so there might be a second-rate system, which is not the EMA, which is good enough for the UK. So, we're really concerned about that and I gave the example already about recording antimicrobial usage, if we're not doing that through the EU, it may be much harder for us to know what's going on, so I think there are some very serious problems there. If we lose some of the EU legislation, so there's a lesser quality legislation on antimicrobial limits and welfare, that could cause a drop in standards in the UK. I'm not saying that will happen, but it's a worry if it does.

[...] I've heard that it makes surveillance of antimicrobial consumption in animals potentially more difficult because people could quite easily bring antibiotics across the border to give to animals without it being noticed or recorded anywhere or it could be recorded in the wrong jurisdiction. [...]

The findings can be summarised as a high degree of uncertainty at the time that the interviews were conducted. Concerns were expressed regarding the sustainability of progress already achieved in various fields given the changed partnerships of the UK in the international arena.

Implications of the European Medicines Agency's move away from the UK

Interviewees highlighted the potential challenges of ending engagement in working groups or key organisations, especially the EMA:

The expectation is that, depending on what kind of Brexit we have, that if we have to cut all our ties with the EMA, then we won't be able to be involved with this work any longer, that's the expectation.

[...] the way that the European Medicines Agency is planning is for us to be no longer involved, not to be members of CVMP any longer, [...] which, to my mind, would be a huge loss [...].

the discussion that's been had at the EMA is ... and it's clearly stated on their website, so I'm not giving anything away, but in the lack of any other knowledge, they are having to plan for a worst case scenario, which is that they're planning for a hard Brexit in which the UK will no longer be involved with any of the EMA's activities. So they have already set up task forces to look at how to hand over the work from the UK to other agencies, they've already stopped me being able to bid for rapporteurships on new product applications coming through. [...] I've been given deadlines up until 30th March 2019, so the idea is, if I can't complete a rapporteurship before that deadline, I can't bid for that work, so our funding stream has already been cut off. So, from that point of view, the EMA are planning for us to be gone and that's already impacting [us]. [...] So, yeah, the impacts are potentially, to my view, quite concerning.

The future loss of connectedness and influence in EU fora was generally regretted, both in terms of the reduced international impact of individuals as well as in terms of the loss of a Member State committed to contribute the AMR cause in general.

Impact of Brexit on UK research on AMR

Another area of concern outlined by interviewees is the impact of Brexit on accessing European research funding:

So the question is what is going to happen to Commission funded research? And that's the million dollar question that everyone keeps asking. So I was planning to apply for European money and I'm not going to because we are already getting feedback that decisions are being made that if you've got a British person on a project, although nothing is in writing and everyone will say it's not happening, it is happening, people are thinking, "You know what, we've got two projects that are scoring the same and they're both really, really good and we've only got money for one. We'll go for the one without the Brit." [...] So it is affecting UK research [...].

I just find it a horrible thing. So, I don't know how it's going to pan out. The work I do is very much, you know, we've been involved with ECDC, we're involved with surveillance, we feed data into Europe, we have trainees here, [EPIET] Fellows, you know, we've got people on [EPIET] Fellowships. Research, I feel, is very much in ... You know, if we can keep all of that going, great. If Brexit puts a brake on all of that, I think we will lose out, and I'm worried that we will. And, you know, the bugs don't stop at borders, and they don't have passport checks, and they won't after Brexit, but our ability to prevent, and to share, might put us behind. I'm very worried

Again, the uncertainty among interviewees was consistently expressed as was the hope of finding solutions to be able to engage in international research and training partnerships with UK funding in the future. Doubts were expressed regarding the attractiveness of the UK for international researchers and possible long-term reduced competitiveness of the UK research sector. These concerns were understood to be of a general nature and not specific for AMR research.

Recommendations for the next phase of the Strategy

We collected evidence to describe the various directions on which progress was made to implement the UK Five Year Antimicrobial Resistance (AMR) Strategy 2013-2018, including reported challenges in doing so. This section outlines the implications for the next phase of the Strategy as proposed by respondents themselves.

The implications of these findings, expressed by interviewees, and particularly in the context of Brexit, centre on the need to: improve the implementation of the One Health approach, and linked to this, the need for understanding the drivers of veterinary prescribing; to maintain credibility as a global leader in this field, especially in light of Brexit; strengthen the global positioning of UK on AMR by continuing to actively engage with international AMR initiatives, and linked to this is the importance of supporting the building of international capacity for addressing AMR, and the Sustainable Development Goals; and ensure appropriate funding for research and development on AMR.

These recommendations were made directly by interviewees and so their words are reported verbatim by way of explanation.

Improve the implementation of the One Health approach

[...] the UK strategy is [...] also rather Public Health centric, and I would like to see it take a much stronger One Health approach. Now, I mean, it's not that it doesn't pay service to One Health, pay lip service to it; it's mentioned, it says right at the [front] that a One Health approach is needed, but as with so many of these things, it's mentioned and then it proceeds without it, sort of thing.

I would like to see, for example, the pie chart showing the relative investments into research and implementation of AMR mitigation across Public Health, agriculture and the environment. So, it would be interesting to see how skewed such a pie chart would be, in terms of the investment.

Linked to the above point are views that it would be important to **increase focus on understanding the drivers of veterinary prescribing:**

More than half of the antibiotics consumed globally are in animal production, so proportional to that consumption, there's very, very, very little work going on to understand that, to understand how transmission occurs with the environment, and to understand ways in which that can be dealt with and addressed.

[I would like to see more] understanding what the drivers are for continuing veterinary prescribing and how we may work with them to change veterinary practice. [...] There needs to be more consistent good practice and I know that [...] there are significant moves, here, in the UK, within the food supply chain to get vets together in those practices that work most with some of the food producers in pigs and poultry, and agree with them, standards for veterinary prescribing. [...] Better diagnostic testing, I think is at the heart of it, so understanding what's happening before prescribing, which in turn means the emergence of better tests that can be operated in the field at lower unit cost.

Strengthen global positioning of UK on AMR

The point of maintaining existing relationships and indeed strengthening the UK's global position on AMR was raised particularly in the context of Brexit, and with attendant problems such as medicines regulation once the EMA has relocated and the UK is out of Europe:

[...] we spoke about Brexit and the impact: I think it would be very important if this role that the UK is already playing could continue to be played by UK, and as I said, at a multilateral level, where we have, of course, different topics and different priorities, so I think it will only help, not only the Commission, but also the [...] EU member states, and then [...] wider [...].

Everyone agrees the way the EMA works is great, everyone agrees that the way the MHRA works and contributes to the European agenda is very good, and that should all continue. That's all fine, because they're all policy level considerations, they're all principle based regulations, or discussions.

[...] the UN process is independent of EU, likewise G20 so I think it would be even more important for the UK to be seen as a strong voice outside the European Union so I think they would probably want to double their efforts in, you know, being a leader in these areas where they are strong or where we are strong. So yeah, I would have thought, I mean with Brexit, it's obviously quite a complex issue and might have negative impacts in other ways.

there's also the ECDC, and that's one of the areas that we need to ... where we really need to preserve as far as we possibly can the cooperation with those countries that will be ... will still be members of the EU.

Linked to this are views that it will be essential to **support international capacity for addressing AMR**. It was recognised that many challenges reside in other countries, such as political will and infrastructure to implement internationally decided questions.

the global challenge is a challenge for the UK. If you understand that, then everything we do at UK level is dwarfed by the international challenge. It doesn't mean we shouldn't do it and it's important that we do it, and there are real benefits from so doing. I won't talk for the

human field, but, you know, they have taken real returns for action at the hospital level, for example, which are very tangible. I've described real change at the animal level, but also the potential actually for a step-change in good practice, husbandry and so on, which goes beyond the benefits we get from antimicrobial usage.

This is related to an acknowledgement that the ability to respond to AMR is unequal across nations. *the Transatlantic Taskforce, the TATFAR report [...] came out with just 26 process indicators; have you developed a stewardship committee, have you developed a therapeutic ... important things to do but they're the journey, you know, they're not the end game. And now in terms of the countries that are producing really hard end games, which are the very difficult choices around that, there are, I think, about five globally countries that are doing that at the moment.*

[...] the state of global national action plans is very limited at the moment, so within Afro region in WHO there's probably about three within sort of all the Afro countries. Emiro, there's about five. PAHO there's about six. And even in Euro, WHO Euro region, which, you know, with a mandate from ECDC that was in 2001 to say you have to develop formal national action plans [...] that, only about 14 or 15 European countries actually have done that.

This point leads to the need to take a supportive, enabling role, and to **actively link to the Sustainable Development Goals.**

[...] the link to the sustainable development goal is quite strong, because when you look globally, the places where the biggest problems lie are the places that have a lot to do in terms of their fundamental capabilities. [...] We need not to talk down to countries where the real problem is a different one; people are dying, animals are dying, you know; production's at below ground level. And we do need to do what is practical to make change in these areas where threat is orders of magnitude greater. So, I think, and it is the case when you see the international discussions, we need to be very sensitive to the need to make real progress, and we need to avoid presenting the rest of the world with the UK or the European template that we care to force them into, because it won't work.

There was agreement among interviewees that **sustained involvement of the UK in global AMR strategies and initiatives** will be essential, as it is after all a global challenge:

I think, in summary, the international strategies are absolutely crucial. I think again, not my department, credit to Health, great job in getting such a lot done on the international stage, Sally Davies herself, and that needs to be maintained. And we need international partners; this is not something the EU could do on its own, and certainly the UK. This is definitely a global resource challenge.

[...] it might not make that much difference what we do domestically if we don't tackle it globally and I know O'Neil work has been hugely important. There is lots of other things that need to go on around drivers for new medicines and so forth but nevertheless tackling simple prescribing and availability issues and I think about the Lancet AMR Report that came out in November, the same time when Sally had that independent supplement, newspaper supplement which is quite useful but the Richard Horton editorials were well crafted I thought in that he is a very strong reminder about the back on the global theme at tackling AMR

It's another one of those points of balance. We need WHO to be working with OIE and working with FAO such that we get a jointly shared approach which is sensitive to the kind of issues I was describing and doesn't lead you to the well-intentioned but not well-informed seeking to achieve something that actually is for real fundamental reasons not going to be

achievable. There's politics and negotiations and understanding in there, but there's actual hard reality. So WHO needs to work with FAO, needs to work with OIE, if we're going to take forward a solution that will actually be delivered on the ground. And they all need to be working with the aid organisations and it's starting to happen. But it works much better if you couch it in terms, which I know has been done, of the sustainable development goals and how this comes together. So, if then you put the UK into that framework, arguing internationally, why would we change?

Ensure appropriate funding for research and development on AMR

I mean, I really do think, though, that overall, the level of funding is quite feeble in relation to the potential magnitude of the problem, and it was, after all, the UK who commissioned this O'Neill report, with these estimated costs, I think, were 100 trillion by [2050]. So, the UK has done the advocacy work to a large extent, in a way, by ... I know these numbers are criticised in certain things, but it then doesn't take the lead in making investment that's indicated by those numbers.

Conclusions

The Strategy proposes seven overarching actions needed to strengthen international collaboration on AMR, notably: to demonstrate global and national leadership and build political support; to strengthen international research and development partnerships and coalitions for new antibiotics and other treatments; to encourage the WHO and the EU to implement their respective AMR commitments and action plans; to support WHO, FAO and OIE in their AMR actions and support the World Health Assembly in development a new AMR resolution; and to consider the need for a future international treaty to protect special medicines like antibiotics which are in short supply.

We drew upon data from 43 interviews with key stakeholders, including with interviewees based in international organisations, as well as key documents, and outputs from the Cross-Government International AMR Strategy Workshop, 19 January 2018. Interviews with key informants highlight the good progress made to address the above action points, notably the UK's strategic leadership role, particularly driven by Dame Sally Davies, but also high engagement of UK departments and agencies with UN organisations and at the EU level. The UK was instrumental in drafting and gaining support for a UN political declaration on AMR, agreed at the UN General Assembly (UNGA) in September 2016, and in establishing the Inter Agency Coordination Group on AMR whose framework is currently the overarching approach taking forward the global agenda. When considered in terms of the IACG Framework for Action key actions, the UK is extensively involved in contributing to 1) reducing need and unintentional exposure, 2) optimizing use of medicines, and 3) investing in innovation, supply and access.

Interviewees also highlighted several challenges in the UK's implementation of an international response to AMR response. These include the challenges of working effectively across sectors and across nations, of implementing the concept of One Health. Other reported challenges are the difficulty of increasing public awareness on AMR, and challenges related to data sharing. Discussions about the process of UK withdrawal from the EU (Brexit) revealed major concern and lack of clarity about the consequences for the UK's role, especially in European organisations, committees and working groups, but also on the potential impact within the UK.

The implications of these findings, expressed by interviewees, and particularly in the context of "Brexit", centre on a need to strengthen a sustainable implementation of the One Health approach, and linked to this to increase focus on understanding the drivers of veterinary prescribing. Moreover

there is a need to maintain credibility as a world leader in AMR, especially in light of “Brexit”. Also, there is a need to strengthen the global leadership of the UK on AMR by continuing to participate in global AMR initiatives, and linked to this, strengthen international capacity for addressing AMR. Finally an important implication is also the need to ensure appropriate funding for research and development on AMR as part of international consortia.

Specifically interviewees have made the following recommendations:

1. The UK should continue to promote the One Health approach in the context of AMR. This approach can be further strengthened and operationalised including a robust understanding of the drivers relevant to AMU and AMR in the respective sectors.
2. In a post “Brexit” phase, the UK should aim to sustain its collaboration with European partners using informal and voluntary participation in relevant fora as much as possible.
3. The UK should continue to strengthen its leadership position by sustained engagement in non-EU platforms and working groups in a post-Brexit phase.
4. The UK should continue to invest in building international capacity to reduce AMU and limit AMR in both the medical and veterinary sectors.
5. The UK should continue to collaborate with international partners to contribute to research and innovation necessary to control the risks of AMR.