HM Government

UK 5 Year Antimicrobial Resistance (AMR) Strategy 2013–2018

Annual progress report and implementation plan, 2014

Northern Ireland Executive

Llywodraeth Cymru
Welsh Government

The Scottish Government

This publication is available at www.gov.uk/government/publications

HM Government

UK 5 Year Antimicrobial Resistance (AMR) Strategy 2013–2018

Annual progress report and implementation plan, 2014

Contents

Foreword

Just over a year ago, in September 2013, we wrote the foreword for the new UK Five Year Antimicrobial Resistance Strategy.

We said then that there are few public health issues of greater importance than AMR, both in the UK and across the world, in terms of their impact on society. Action was needed to reduce the number of infections and control their spread, to diagnose infections quickly, use the antibiotics we have appropriately and to develop a sustainable supply of new antibiotics.

That position has not changed. But a year further on, we have put AMR securely on the international agenda. We hope the alliances we have built, working closely with governments and partners across human and animal health, will help to ensure there is a sustained global commitment to take action.

This report describes the good progress that has been made in the UK in the first year of the Strategy. Particular developments that mark a step change include: collection and analysis of baseline data from which prescribing and trends in resistance can be monitored; publication of outcome measures against which the UK will assess progress; development of a strong research infrastructure to address knowledge gaps and promote collaboration; and establishment of an independent Review on AMR.

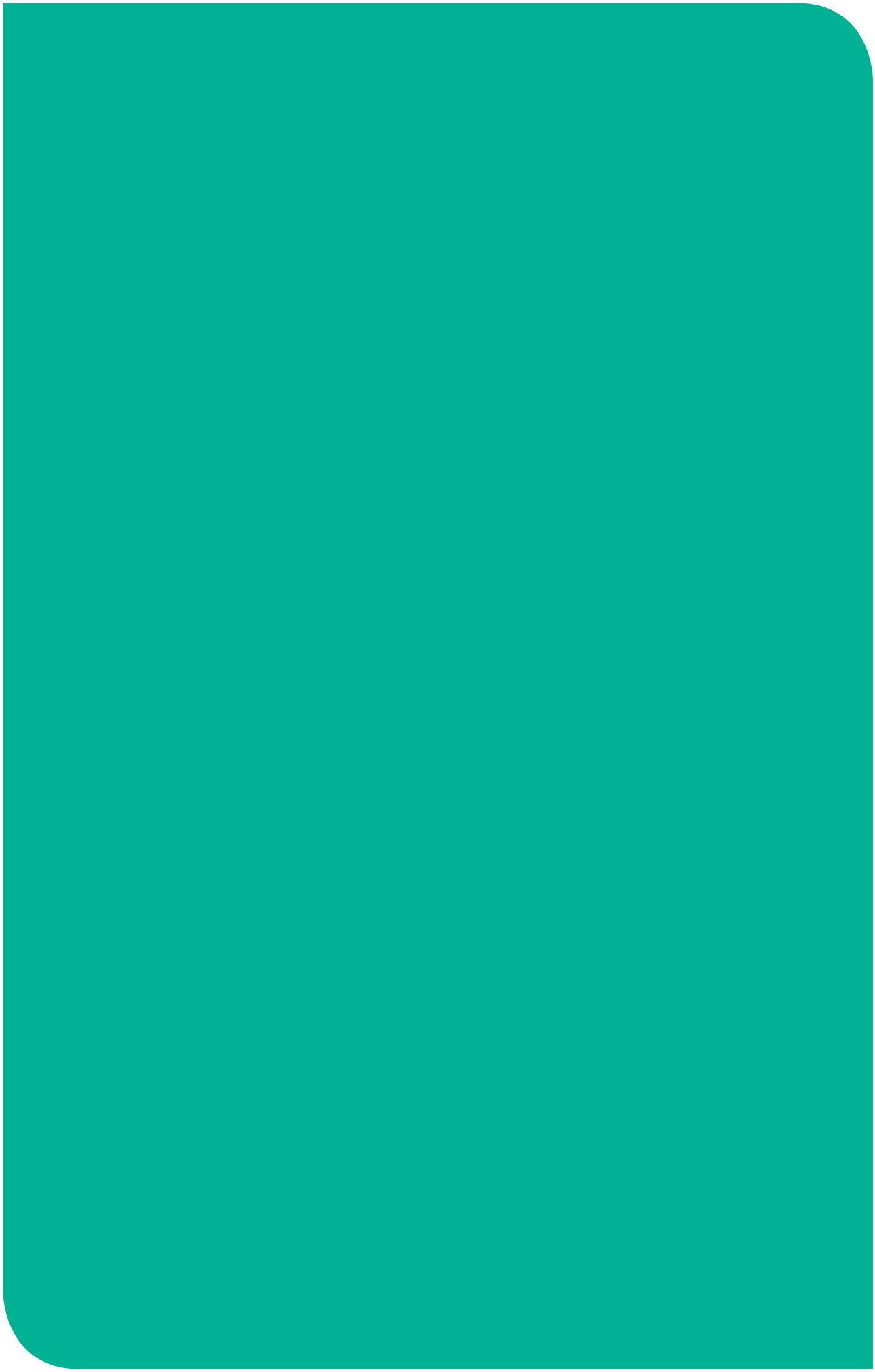
However, there is more to be done in both human and animal health. The implementation plan in section eight of this report demonstrates the breadth and depth of activity that needs to be completed to have an impact and slow the growth of resistance.

We are pleased so much activity has gone on, across all sectors and by such a wide range of organisations, to address AMR and that all our UK partners have come together to develop this integrated plan. We will look to the lead organisations to make sure that delivery is kept on track, so we can see clearly the difference everyone is making in the second annual report in 2015.

Finally, we are very pleased to note that this year's £10m UK Longitude Prize was awarded to further work on AMR, by popular vote. This very welcome development underlines the importance of the topic to public health.

Professor Dame Sally C Davies
Chief Medical Officer
Chief Scientific Adviser
Department of Health

Nigel Gibbens
Chief Veterinary Officer
Department for Environment Food and Rural Affairs



Executive Summary

The UK five year AMR Strategy was published in 2013 and identified seven key areas for action. Implementation is being driven by a cross-government High Level Steering Group (HLSG). This report summarises progress in the seven areas across human and animal health in the first year of the strategy.

It includes a detailed implementation plan which highlights those actions that we believe will have the biggest impact in slowing the spread of AMR. Robust infection prevention and control (IPC) practices and antimicrobial stewardship are key at all levels and across all sectors, alongside ensuring a sustainable supply of suitable new diagnostics and treatments. These need to be underpinned by comprehensive data collection systems, professional leadership and public awareness.

Importantly, the report identifies that significant progress has been made to strengthen knowledge of the local and national picture through surveillance and supporting good stewardship. AMR is a global concern and the UK cannot address it alone. We continue to work hard to promote the need for global action; our global message is consistent with the national one.

The following are the key achievements in the first year of the five year Strategy

Data collection and analysis

We have established the baseline metrics for key infections and antimicrobial use against which progress will be measured. Data at NHS England Area Team level across General Practices and hospitals for England were published in October.[1]

In animal health, we are undertaking the most extensive surveillance in Europe on AMR veterinary pathogens. In addition, for food borne pathogens the statutory surveillance programme has been expanded and now includes two additional micro-organisms.

See section 5 for more detail.

1 http://bit.ly/espaur-report

Prescribing

We have published national antimicrobial prescribing quality measures[2] that aim to reduce total antibiotic prescribing and encourage the use of narrow spectrum antibiotics in both primary and secondary care.

Using NHS England Area Team prescribing data from General Practices and hospitals, we have now embarked on a programme to support local clinicians improve their prescribing practice.

A detailed scoping study has been completed to enable establishment of a data hub for collection of species specific prescribing data, to help assess whether antibiotics are being used responsibly.

See sections 2 and 5 for more detail.

Behaviour Change

We have reviewed the evidence on the best ways to influence both public and professional behaviour with regard to the prescribing and use of antibiotics. In evaluating behavioural interventions we have identified new approaches to deliver change in GP and public behaviour which are now being piloted.

We have reviewed across Europe, and published in the scientific literature, factors that influence prescribing amongst vets in order to inform behaviour change interventions.

European Antibiotic Awareness Day (EAAD) in November 2013 took a 'One-Health' approach with both human and veterinary health professionals working closely to give a unified message across the UK. It saw unprecedented levels of on-line access to educational materials. We have built on this for 2014 and included the launch of an Antibiotic Guardian campaign calling for action in the form of on-line pledges from both professionals and members of the public.[3]

See section 4 for more detail.

Research

We have established a new AMR Research Funders Forum, led by the Medical Research Council (MRC), bringing together major research funders and government departments to promote joint action to better understand the relationship between AMR in animals and humans.

Two National Institute for Health Research (NIHR) Health Protection Research Units (HPRUs) have been established with a focus on Healthcare Associated Infections (HCAIs) and AMR, to lead on research to support the development of effective approaches to combat AMR.

These initiatives, together with a number of AMR themed research calls from NIHR and other research funders, lay a solid foundation from which progress can be made.

See section 6 for more detail.

2 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/322358/Outcome_measures.pdf

3 http://antibioticguardian.com

International collaboration

The UK and Sweden led the development and adoption of a new World Health Organisation (WHO) Resolution on AMR, providing a mandate for the development of a WHO-led Global Action Plan by May 2015. We are working with the WHO and Member States to develop the Plan, which will take a 'One-Health' approach.

The UK, in conjunction with the Netherlands and Sweden, led the development of the AMR Action Package within the Global Health Security Agenda. This was published in September 2014, and we will continue to work with a range of international partners on implementation.

On the animal health side, the UK leads the Heads of Medicines Agencies Task Force on AMR and, with the European Medicines Agency (EMA), effected the voluntary withdrawal of an enrofloxacin-colistin combination product in five of six Member States.

See section 7 for more detail.

New drug development and improved diagnostics

The Prime Minister has established an independent Review on AMR. The Review will look at the antimicrobial drugs pipeline and recommend actions that can be taken globally to stimulate the development of new drugs. It will play an important role in developing and raising awareness of the evidence base for the economic and social burden of AMR and the long term costs of failure to contain its global spread.

We have started work to review the current status of diagnostics across the system with a view to developing a framework for prompt and better diagnostic testing across the NHS.

See section 4 for more detail.

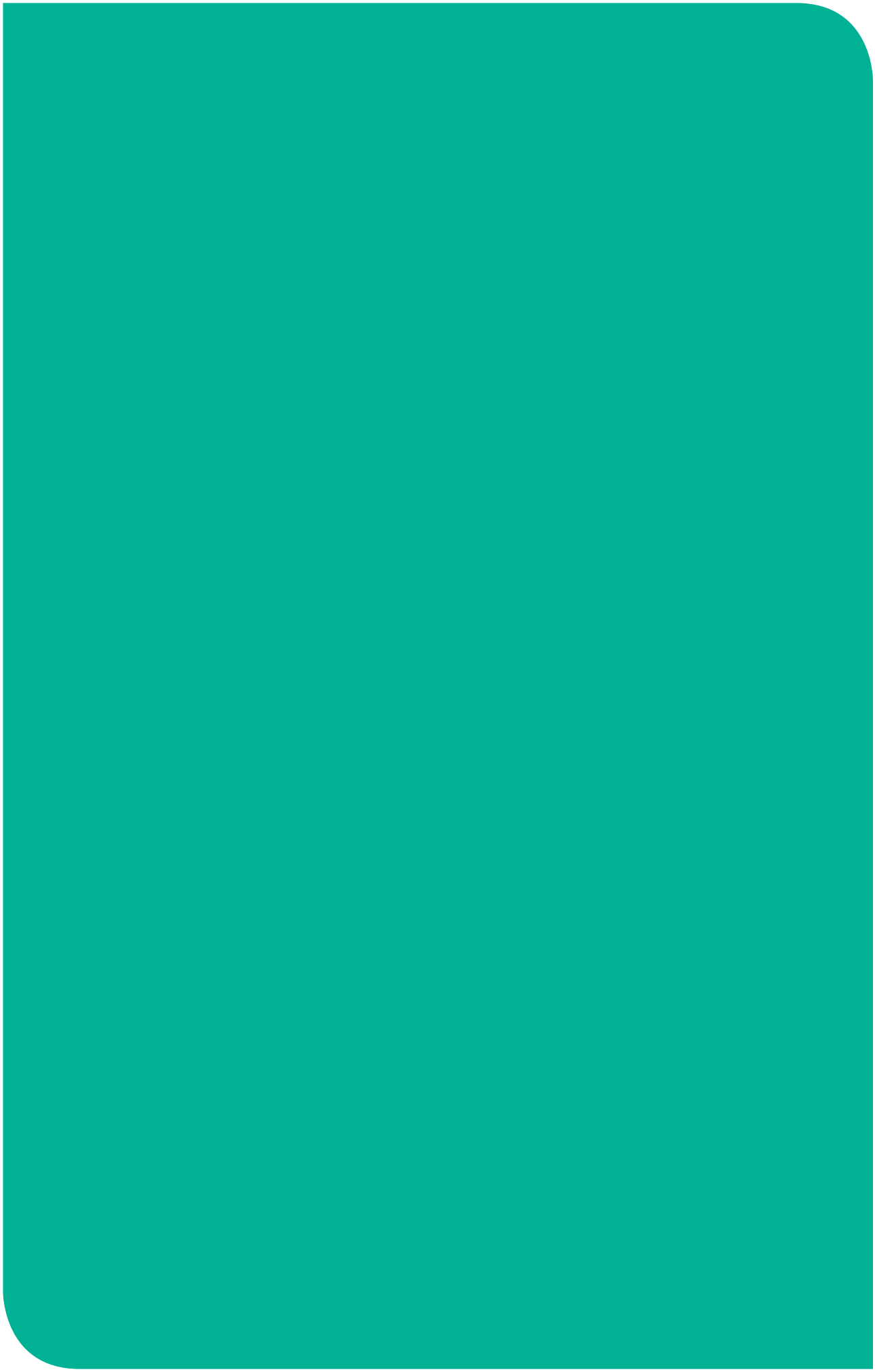
Together, these achievements form a valuable basis from which to progress the work set out in the implementation plan. The emerging use and resistance data provide a benchmark to measure progress in achieving the aims of the strategy. Sustained activity is required, and our focus now is on strengthened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

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

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

We also want to reduce antimicrobial use in livestock production in real terms over the next four years.

Improving our understanding of AMR by coordinating cross sector research, ensuring collaboration between research councils and disseminating the outcomes is essential to ensure that knowledge gaps are addressed.



Introduction

AMR is a serious and growing global public health concern with implications for every Government and the populations they serve. The emergence and spread of infections caused by bacteria that are resistant to treatment by current antibiotics strikes at the heart of modern medical and veterinary practice. The use of antibiotics is essential for saving lives in conditions such as sepsis and without effective antibiotics; even minor surgery and routine operations could become high risk procedures due to the increased likelihood of resistant infection.

Across Europe around 25,000 people die each year as a result of hospital infections caused by resistant bacteria, and others may face more prolonged and complicated illness.

Extensively drug-resistant tuberculosis (XDR-TB), for example, has been identified in 92 countries. In 2012, there were about 450,000 new cases of multidrug-resistant tuberculosis (MDR-TB) world-wide. MDR-TB requires treatment courses that are much longer and less effective than those for non-resistant TB.[4]

In the future, without effective antimicrobials, the rate of post-operative infection could be far greater and those with a serious infection will die. This is why we have completed a risk assessment for AMR in humans to support the consideration of its inclusion in the UK's National Security Risk Assessment that is designed to compare, assess and prioritise all major disruptive risks to our national security with relevant experts.

The UK Five Year AMR Strategy was developed by the government in 2013 with three strategic aims, to:

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

A UK interdepartmental High Level Steering Group (HLSG), with senior representatives from government departments, agencies, the NHS and devolved administrations, is responsible for driving forward the implementation of the strategy.

This progress report from the HLSG summarises actions taken in the last year and sets out its plans. The UK has made demonstrable progress and increased the profile of AMR on the world stage, but there is much more to do to address human and animal health, food and environmental aspects at both national and international levels.

Of the Strategy's seven areas for action below, the three **highlighted** are those that we consider are likely to have the most direct impact on resistance. These are underpinned by the other key action areas as shown in the pyramid diagram.

The 7 key areas for action:

Improving infection prevention and control practices in human and animal health (prevent),

4 http://www.who.int/mediacentre/factsheets/fs194/en/

Optimising prescribing practice, through good antibiotic stewardship, to promote better use of antibiotics and new diagnostics (protect),

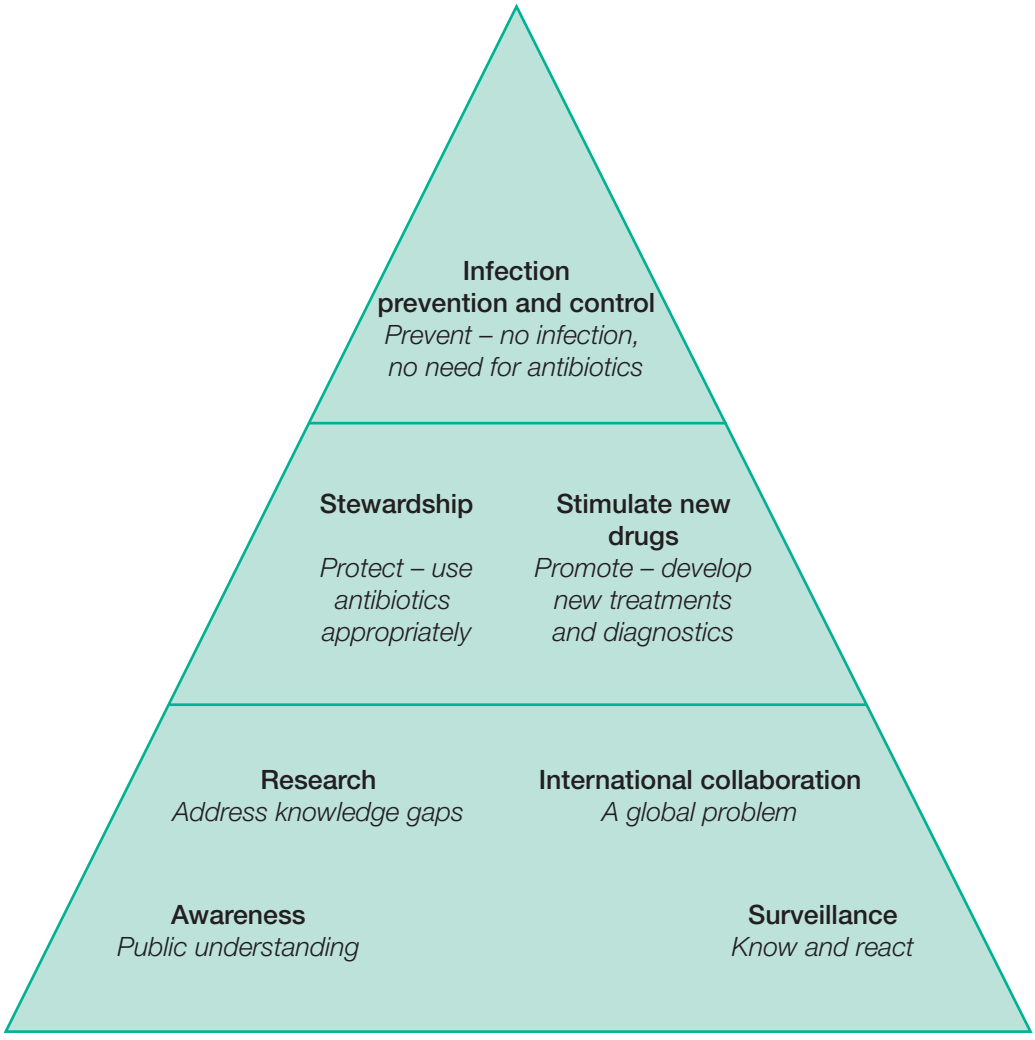
Improving professional education, training and public engagement to improve practice and increase understanding,

Developing new drugs, treatments and diagnostics through better collaboration between research councils, academia, industry and others (promote),

Better access to and use of surveillance data in human and animal sectors,

Better identification and prioritisation of AMR research needs to focus activity and inform our understanding of AMR,

Strengthened international collaboration working with a wide range of governmental and non-governmental organisations.



The UK cannot address the challenge of AMR acting alone. AMR is a global phenomenon and we need to make sure that action is being taken to address it both nationally and internationally. The UK is one of the first countries to take a cross government approach and continues to encourage others to do the same. The Chief Medical Officer (CMO), the Chief Veterinary Officer (CVO) and government ministers have been promoting the need for a one health approach to tackle AMR in a range of high level international fora, sending a strong message to the rest of the world that the UK is united in its determination to tackle AMR. By acting together, we can better address the challenge of resistance.

Infectious disease: the cost

The estimated cost of infections and infectious disease overall, in England, is around £30 billion each year.[5]

Current patterns of antibiotic use in the UK

Human

- *20% of antibiotic use is prescribed in hospitals; 80% is community prescribed.*[6, 7]
- *The majority of antibiotics prescribed are for just 15 out of over 60 antibiotics that are generally available.*

Animal

- *The total weight of antibiotic sold compared to the farm animal population has remained essentially stable in the UK over the past five years.*
- *Clinical resistance is rare in animal health in the UK and resistance in key veterinary zoonotic micro-organisms (that can cause disease in humans) are generally among the lowest in the European Union (EU).*

Who 'we' are

PHE, Defra Veterinary Medicines Directorate (VMD) and DH are leading work with the Department for Business Innovation and Skills (BIS), the Foreign and Commonwealth Office (FCO), the Department for International Development (DFID), the devolved administrations, the National Institute for Health and Care Excellence (NICE), expert advisory groups and key commissioning and delivery partners including NHS England, Health Education England (HEE), Medicines and Healthcare Products Regulatory Agency (MHRA), NHS Trusts, CCGs, general practice, as well as the local Government community, social care organisations, professional bodies for both human and animal health sectors, the Research Councils and academia. As this is a UK strategy, corresponding devolved administration government departments of health and agriculture are also involved. The role of the HLSG is to act primarily as a driver and coordinator of activity, and to monitor progress. However, 'we' in this report should not be read simply as the HLSG, but as everyone contributing to what has already been, and will be, achieved.

5 Analysis commissioned for the CMO annual report 2011 from the Health Protection Analytical Team at the Department of Health (unpublished).

6 http://antibiotic-action.com/wp-content/uploads/2011/07/Standing-Medical-Advisory-Committee-The-path-of-least-resistance-1998.pdf

7 http://bit.ly/espaur-report – states that 90% are community dispensed in England.

A cross-sector approach

The AMR Strategy recognised that success depends on sustainable change. It acknowledged that this would require human and veterinary care professionals, researchers and academia, industry and the public to all play their part. It set out a call to action across all sectors. In the first year the commitment of professional and other groups has been demonstrated through a range of publications, actions and events. Examples are many but include:

- the UK Faculty of Public Health (FPH), the Royal College of Physicians (RCP), Royal Pharmaceutical Society (RPS), Royal College of Nursing (RCN) and the Royal College of General Practitioners (RCGP) Joint Statement on AMR setting out the areas where they are committed to taking action,[8]
- the Responsible Use of Medicines in Agriculture Alliance (RUMA) action plan for the livestock sector, based on the actions set out in the strategy,[9]
- the RCN position statement on the nursing contribution to tackling AMR.[10]

Our approach to achievement of the strategic aims

It is essential that steps are taken to ensure a sustainable supply of antibiotics. With our current state of knowledge, immediate things we can do are to limit the need to use antibiotics in the first place and conserve the effectiveness of existing antibiotics. In other words, we need to **prevent infections** and practice **good antimicrobial stewardship**.

Robust IPC is essential and complements good stewardship. Good hygiene is an important measure in preventing infection and there is more to do to ensure that guidance is rigorously and consistently applied in all health and care settings. Strong leadership and accountability for IPC and good stewardship will be key to embedding good practice and making sustainable change.

Making better use of existing data sources to more accurately monitor prescribing practices and antibiotic use (medicines optimisation) and track AMR trends will help us to make the most effective use of antibiotics. As a result of work undertaken in the first year, we have been able to report on antimicrobial prescribing and resistance data across healthcare settings.

To improve our knowledge and understanding of AMR, the UK Strategy called for better identification and prioritisation of research needs, with greater collaboration between research funders. This has been addressed through the establishment of a national AMR Research Funders Forum, led by the MRC.

However, these activities will only achieve our strategic aims if they are replicated in other countries. We recognise the challenge in many developing countries in ensuring that everyone with life threatening infections has access to antibiotics and that this may complicate efforts to achieve improved stewardship of the use of antibiotics. Nevertheless, the need for coordinated global action remains a priority. Our global approach is consistent with the national one: better infection prevention and control, conservation of the antibiotics we have and the need to ensure a sustainable supply of suitable diagnostics and new treatments. Progress through international collaboration is reported in the individual sections of this report.

8 http://www.fph.org.uk/uploads/amr-joint-statement-v1-28-05-14.pdf

9 http://www.ruma.org.uk/antimicrobials.htm

10 http://www.rcn.org.uk/__data/assets/pdf_file/0003/590484/004681.pdf

Measuring Progress

It is important to ensure that antibiotics are only used where they are needed and we are putting in place extra guidance to ensure this happens. The HLSG will comment on the impact of actions taken on prescribing from 2015 onwards in future reports.

In June 2014 we published four initial measures or metrics,[11] to monitor:

- trends in resistance as determined by the number of reported bloodstream infections (BSIs) and the proportion resistant to specific antibiotics,
- trends in prescribing, aiming to reduce overall antibiotic prescribing and improve diversity in prescribing,
- changes in professional and public knowledge and behaviour around the use of antibiotics,
- actions taken at a global level to encourage increased international collaboration, and reduce the spread of AMR, including the implementation of a 'One-Health' approach in national, regional and global strategies and action plans.

The baseline UK data collected in the first year indicate that BSI rates are a serious concern. As data improve, we will implement further measures to assess the overall status of our IPC, antimicrobial prescribing and antimicrobial stewardship activity. Appropriately targeted local information will be provided against which future progress can be more firmly evaluated and monitored. We are also exploring the possibility of developing a new integrated indicator which can be used to communicate local and national standards for HCAI and antimicrobial resistance to drive up standards in care and improve patient outcomes.

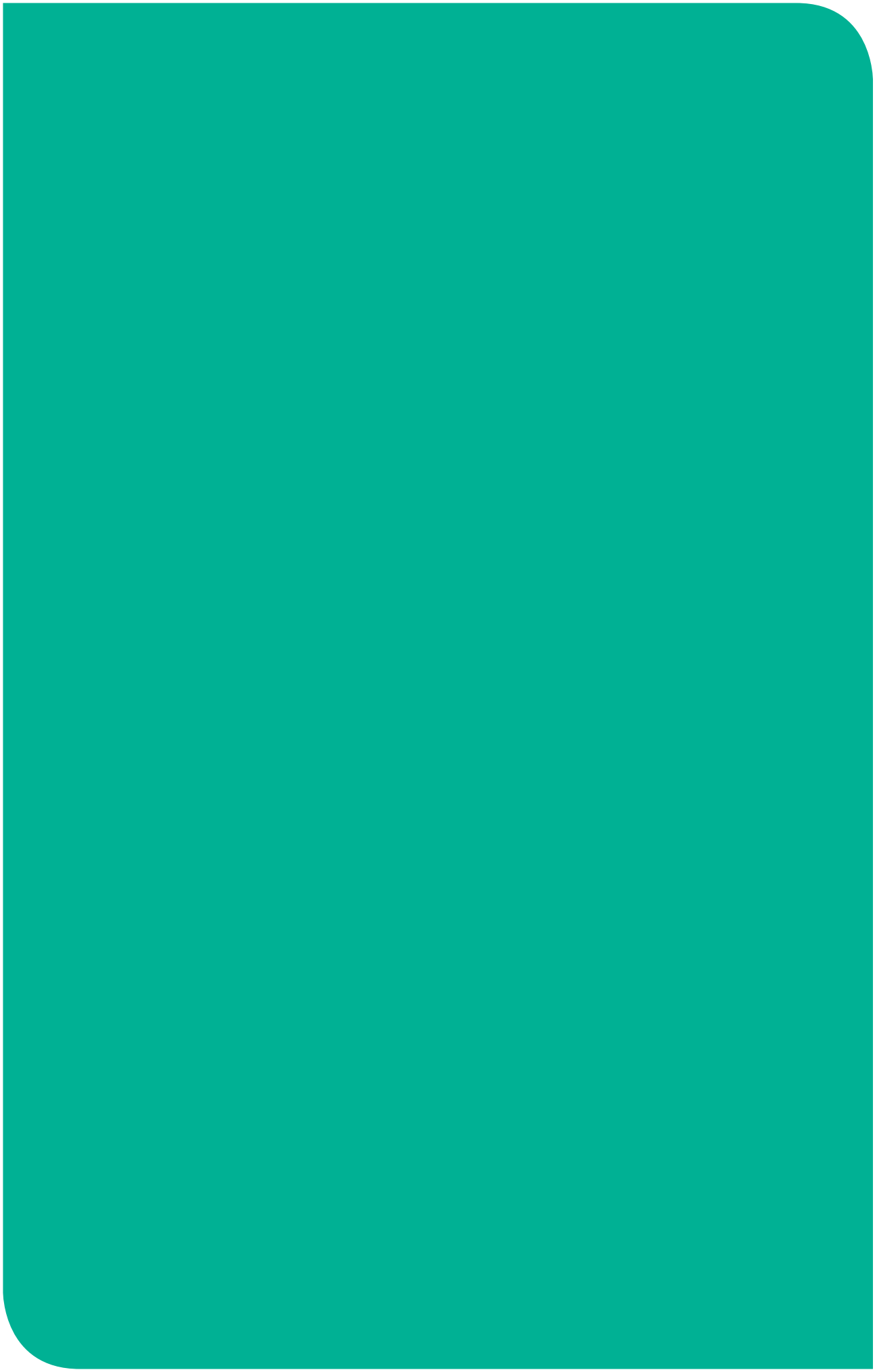
The UK Implementation Plan

In this first annual report, as well as describing the key achievements, the implementation plan (section 8) outlines those activities that we believe will make the biggest impact and contribution to the achievement of the strategy aims in each of the seven key areas for action. The plan identifies which lead organisation is accountable for the activity, while recognising that additional organisations will play a key role in delivery of many of the activities. We have included timescales as far as we are able.

Many of the actions set out in the plan address the whole of the UK but, in addition, the devolved administrations are producing their own implementation plans tailored to reflect local issues and priorities.

The plan will not remain static and many of the actions will inform future measures as we learn and understand more about AMR and adapt our strategies to tackle it accordingly. At the end of the five year period (2018) an evaluation report will be produced to assess the effectiveness of the implementation activities, identifying any further priorities for action or make additional recommendations as necessary.

[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/322358/Outcome_measures.pdf



Section 1: Key action area 1 – Improving infection prevention and control (IPC) practices

Introduction

The more we can do to prevent infections and control their spread, the more we will reduce the need for antibiotics and the opportunity for antimicrobial resistant strains to develop will be less. This is true both in the UK and globally.

The success in reducing *Clostridium difficile* (CDI) infections and *Meticillin Resistant Staphylococcus aureus* (MRSA) bloodstream infections across the UK has shown what is possible when concerted efforts are made to ensure that good hygiene measures are observed and best practice guidance adhered to.

With animals, good farm management, effective bio-security and animal husbandry systems reduce susceptibility to bacterial disease, minimising the need for antibiotic use in animals.

Leadership and accountability are required to ensure that all health and care workers receive appropriate training and that best practice is fully embedded across all sectors.

What have we delivered?

Human health

Leadership and accountability

We recognise the need to strengthen accountability for IPC so we are putting in place the infrastructure to help improve consistency in the way IPC services are delivered at local, regional and national levels. We are also sharing best practice with international partners.

PHE is leading the development of a national strategy for IPC. A new IPC steering group is being established that will involve the public and stakeholders from across health and social care.

As well as strong local leadership, the use of champions or link practitioners will be critical in ensuring that good IPC becomes daily practice. The aim is to create a culture of continuous improvement and shared learning. There are already examples of good practice taking place at a local level, including:

- primary care/community infection control nurses who have produced local infection and antibiotic prescribing policies and work closely with GPs/staff in General Practice,
- local PHE professionals and IPC specialists that have joined forces to form an IPC collaborative to support zero tolerance of certain HCAIs,
- local guidance on the management of urinary catheters, including a patient held catheter record,
- proactive IPC audit programmes with care homes and GPs (as agreed and funded by the CCGs) being undertaken to identify areas of good practice and non-compliance,
- local root cause analysis of CDI cases being carried out with feedback to GPs and locally produced patient information leaflets,

- groups of CCGs working together to undertake whole health community reviews of guidance,
- the implementation of link practitioner programmes to support ownership and embedding of IPC at the care level.

In Northern Ireland, 'Ten Elements', an aide-mémoire for board members of the Health and Social Care Trusts in Northern Ireland, especially Non-Executive Directors, is helping to strengthen board-to-ward accountability in Trusts with specific reference to HCAIs.

Regulatory

We are strengthening the 'Code of Practice on the prevention and control of infection and related guidance' (The Code), linked to the Health and Social Care Act 2008. The Code sets out the requirements against which healthcare providers are registered by the Care Quality Commission (CQC). The changes will strengthen the IPC and antimicrobial stewardship framework for healthcare providers, clarifying requirements and improving consistency in delivery of standards. Consultation on the strengthened Code is planned later in 2014-15.

In addition, fundamental new CQC safety standards coming into force for all providers from 1 October 2015 will address poor care leading to harm and will therefore include infection control and optimisation of medicines.

Together, these initiatives aim to provide a sound basis for enforcing IPC standards and better stewardship.

Commissioning

Providers are already required to have a plan to reduce certain HCAIs each year and to comply with their obligations under that plan. The plan must reflect local and national priorities relating to HCAI including AMR. Under the NHS Standard Contract, commissioners are able to impose financial sanctions where providers fail to achieve MRSA and CDI reduction targets.

Guidance

There is a range of guidance aimed at improving clinical practice and enhancing patient safety. The DH sponsored clinical evidence based guidance on prevention of HCAI in hospitals to support health professionals, EPIC 3,[12] with best practice that needs to be integrated into local practice guidelines and used in audits to reduce variation in practice and maintain patient safety.

Other examples of guidance include:

- NHS Scotland has nationally agreed Standard Infection Control Precautions (SICP) and Transmission Based Precautions (TBP) as part of a National Infection Prevention and Control Manual,[13] devised to reduce variation and optimise IPC practices in healthcare settings,
- PHE's 'Acute trust toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae'[14] to minimize inappropriate use of Carbapenem antibiotics,

12 http://www.his.org.uk/files/3113/8693/4808/epic3_National_Evidence-Based_Guidelines_for_Preventing_HCAI_in_NHSE.pdf

13 http://www.hps.scot.nhs.uk/haiic/ic/nationalinfectionpreventionandcontrolmanual.aspx

14 https://www.gov.uk/government/publications/carbapenemase-producing-enterobacteriaceae-early-detection-management-and-control-toolkit-for-acute-trusts

- National Institute for Health and Care Excellence (NICE) 'Infection prevention and control quality standard' (QS61 April 2014) which helps practitioners make decisions about care based on the latest evidence and best practice for trusts,
- Joint guidance to support commissioning of IPC in health and care settings by the RCN and the Infection Prevention Society (IPS).[15]

Training

Skills for Health[16] was established to help the whole UK health sector develop a more skilled and flexible workforce. Skills for health is updating its e-learning programmes on infection prevention. The Academy of Medical Royal Colleges is revising its training guideline on infectious disease and microbiology. The IPS is also planning a series of educational events to build local capacity to aid effective implementation of evidence based guidelines.

Animal health

IPC in animal health is equally important, underpinning all animal health disease policies. Healthy animals are productive animals, and the costs of production are lessened by preventing disease and prompt control. Government is responsible for control of Notifiable Diseases, i.e. those with greatest impact which may be on international trade and/or public health. The farming industry is responsible for the management and control of endemic diseases which impact individual businesses.

Through the 'Rural Development Programme for England' (RDPE), a number of schemes have been in place to provide advice, training and knowledge transfer on specific endemic diseases. The RDPE has supported farmers implementing farm health planning and control and prevention of specific disease impacting on their farm.

Farm Health Planning encourages proactive prevention and management of livestock disease on a routine basis planned into the farm husbandry cycle to reduce the occurrence and impact of disease in farm, thereby reducing farm costs and improving animal welfare. Many farm assurance schemes have a farm health plan as a requirement of compliance.

Defra provides guidance on on-farm biosecurity in relation to specific disease risks and, across livestock sectors, to encourage the prevention of disease introduction onto farms.[17]

We are also involved in co-funding a number of research projects to identify new approaches aimed at minimising endemic disease impact, and to understand the factors which influence farmers' behaviour in relation to disease control. Current projects include a research fellowship focusing on the costs and cumulative benefits of specific biosecurity measures for farmers.

Where do we want to get to?

We want to ensure a 'whole sector' approach to IPC whereby service users can expect the same standard of 'harm-free' care in any setting.

Development of the IPC strategy will include the establishment both of strong national leadership and strategic direction for IPC and a whole-system approach across all care settings. An early task will be the development of a systems map with review of existing IPC tools and guidance (to streamline, standardise and simplify approaches).

15 http://www.rcn.org.uk/__data/assets/pdf_file/0006/481290/Infection_prevention_Final.pdf

16 http://www.skillsforhealth.org.uk/

17 https://www.gov.uk/disease-prevention-for-livestock-farmers

To support this we will use commissioning and regulatory processes to incentivise good practice, and improve accountability. We aim to have the revised Code of Practice in place by April 2015 to coincide with the new regulatory requirements that come into effect next year. We are engaging with the CQC to explore how IPC and antimicrobial stewardship aspects can be built into the key lines of enquiry used in their inspections.

We are exploring how best to use readily available data sources to improve standards in clinical practice, track trends in infections, share best practice and refine and improve collaboration across the healthcare system. Based on these existing data sources, we plan to develop new integrated HCAI-AMR indicators which will include IPC and antimicrobial stewardship components.

We want to strengthen the role the expert Rapid Review Panel (RRP)[18] has in assessing innovative infection prevention and control products, equipment and materials for potential use in the NHS.

In animal health, we will encourage and support animal keepers to adopt biosecurity and husbandry practices that minimise disease occurrence, and improve disease control.

[18] https://www.gov.uk/government/publications/rapid-review-panel-terms-of-reference

Section 2: Key action area 2 – Optimising prescribing practice (medicines optimisation)

Introduction

Antibiotics will continue to be prescribed, but we need to do this appropriately and ensure that we conserve the antibiotics we have through good stewardship. Better prescribing is key, at all levels across all settings, in both humans and animals.

Antibiotic prescribing and antibiotic resistance are inextricably linked. Overuse and incorrect use of antibiotics are thought to be major drivers of resistance. Despite the availability of guidance on best prescribing practice, total antibiotic prescribing by GPs for coughs and colds was higher in 2011 than the 1990s.[19]

One contributory factor to the increase in prescriptions is that they are often written in the absence of adequate information about the nature of the infection, or before the results of diagnostic tests are known. Improved access to better diagnostic technology is required, but that will take time to develop and roll out. In the short term, the aim is to improve local leadership and accountability, supporting prescribers to embed good antibiotic stewardship.

We have focused on setting an ambition to reduce overall antibiotic prescribing, encourage narrow spectrum prescribing, improve the diversity of the antibiotics prescribed and establish new primary and secondary care antibiotic prescribing quality measures to minimise the development of resistance to commonly used antibiotics. Better data collection will help us to understand the reasons for over-prescribing and prescribing variation around the country. To improve stewardship, healthcare staff need to receive education and training to help them in their day to day practice.

In contrast to antibiotics for human use, sales of veterinary antibiotics have remained relatively stable over the past five years, when considered in conjunction with changes in animal demographics. However, sales of certain critically important antibiotics have gradually increased during that period. Currently, the data do not allow us to identify whether it is antibiotic use in one particular animal species which has led to this change. We are therefore initially focusing on developing better data collection. Once we are able to identify sub-optimal prescribing practices in particular animal sectors, we can focus on effective and meaningful targeted interventions.

What has been delivered?

Human health

Prescribing Quality Measures

Use of quality prescribing indicators in hospital and primary care settings since April 2009[20] in NHS Scotland has been shown to improve the quality of antibiotic use.[21, 22] In June 2014, we published details of the initial antimicrobial prescribing quality measures[23] that we will use in England from 2015.

19 Trends in antibiotic prescribing in primary care for clinical syndromes subject to national recommendations to reduce antibiotic resistance, UK 1995-2011: analysis of a large database of primary care consultations. Hawker JI, Smith S, Smith GE, Morbey R, Johnson AP, Fleming DM, Shallcross L, Hayward AC. J Antimicrob Chemother. 2014 Aug 4.

20 http://www.sehd.scot.nhs.uk/mels/CEL2009_11.pdf

21 The Scottish Medicines Consortium (SAPG) Empirical Prescribing National Report – April 2011. https://www.scottishmedicines.org.uk/files/SAPG_Antimicrobial_Supporting_Indicators_Report_-_April_2011.pdf

22 http://www.scotland.gov.uk/Publications/2014/07/9192

23 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/322358/Outcome_measures.pdf

Leadership and accountability

To deliver the ambition of a reduction in total antibiotic prescribing, local teams in England are starting to use data already available through the Quality Innovation Productivity Prevention (QIPP) comparator data in primary care. The report from the English Surveillance Programme for Antimicrobial Use and Resistance (ESPAUR) published, for the first time, national and regional surveillance data on antibiotic use and resistance from 2010 to 2013. Local leadership will ensure that those data are used effectively and appropriate action taken to improve prescribing.

ESPAUR reports that the majority of respondents to a survey of NHS Trusts (2014) undertook a review of the national Start Smart Then Focus (SSTF)[24] guidance on antimicrobial stewardship in secondary care, but less than half put an improvement plan in place. Almost 80% of Acute NHS Trusts collated data on at least one of the recommended audits in SSTF; however, specific audits that can be correlated to patient outcomes were rarely conducted. While more than 90% of responding Trusts had an antimicrobial stewardship committee, the survey showed that representation on those committees from general physicians, surgeons, nurses and pharmacists was low. Two-thirds of Trusts provided training in stewardship and antibiotics but only a minority performed prescribing competency assessments. This survey now provides baseline data on antimicrobial stewardship against which progress in strengthening stewardship will be monitored.

Training and competencies

Key to supporting prescribers achieve optimal prescribing is ensuring that everyone has the right training and skills. Work is underway to ensure the antimicrobial prescribing and stewardship (APS) competencies for professional prescribers,[25] are fully embedded.

Having the right guidance and tool kits available to support prescribers is important and we have been monitoring implementation of the 'SSTF' guidance for hospital prescribers. This guidance is being revised in the light of feedback to make it more suitable for use by clinicians.

ESPAUR reports that there is over reliance on a few antibiotics (15 out of more than 60 available) and we need to improve the diversity of prescribing. We will consider the need for new metrics to monitor compliance with the guidance and make it simpler for local prescribers to review their own practice.

With the RCGP we have provided additional support to GPs in engaging patients in informed dialogue about antibiotics and their effective use. This includes the development of on-line educational modules on antimicrobial prescribing in primary care. The Treat Antibiotics Responsibly Guidance and Education Tool TARGET toolkit[26] was developed to assist GPs. This toolkit will also be subject to further refinement and enhancement in the coming year. The RCGP's module on urinary tract infections was launched in 2014.

In Scotland, the Scottish Reduction in Antimicrobial Prescribing (ScRAP)[27] resource was launched in October 2013. It is an educational toolkit to help prescribers to reduce unnecessary prescribing of antibiotics, and support NHS Boards in delivering the target on antibiotic volume.

---

24 Antimicrobial stewardship: Start smart – then focus https://www.gov.uk/government/publications/antimicrobial-stewardship-start-smart-then-focus

25 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253094/ARHAlprescrcompetencies__2_.pdf

26 http://www.rcgp.org.uk/clinical-and-research/target-antibiotics-toolkit.aspx

27 http://www.nes.scot.nhs.uk/media/2725088/nesd0189_scrap_guide_vfinal.pdf

Behaviour change

To improve understanding about why misuse of antibiotics occurs, and to engage practitioners and the public in reducing consumption, we have undertaken a literature review[28] exploring the key behaviours that affect prescribing of antibiotics. We then identified and evaluated a range of behavioural interventions.

As part of that work, we are piloting some new approaches. A randomised control trial is being conducted to test the impact of a feedback letter from the CMO to GPs on their antimicrobial prescribing rates compared to similar populations and national norms. If successful, the intervention will be scaled-up and rolled out nationally. A similar approach is being taken in Scotland to drive down the unnecessary use of antibiotics using a GP-tailored education and audit tool.

We have held events with professional organisations who have published supporting documents and taken action within their own communities. For example, the PHE Director of Nursing included a day on AMR in Health Protection week in February 2014. PHE and the RCN co-delivered a master class on AMR at the 2nd Personalised Care and Public Health conference in July 2014.[29] AMR features in the national Framework for Personalised Care and Population Health[30] and the RCN published a position statement on the role of nurses in tackling AMR.

Good practice examples

Good practice in England includes:

- CCGs with access to pharmaceutical and microbiological expertise, leadership and advice reinforcing good prescribing,
- hospitals with specialist pharmacists, microbiologists, infectious disease physicians and infection control teams, have implemented more rigorous prescribing policies, and in some cases, five year strategies,
- local GPs with protected learning time for sessions delivered by a consultant microbiologist,
- community pharmacies delivering services to patients for minor ailments, local data mapping to provide a visual tool used to successfully promote changes in prescribing practice, led by a CCG prescribing adviser and demonstrating the potential for that role in helping deliver the reduction in prescribing ambition nationally,
- use of electronic prescribing with mandatory stop dates, smart phone ‘apps’ and local audit tools.

The Chief Pharmaceutical Officer continues to work with HEE, CCGs, RCGP and the RPS to ensure GP practices have access to clinical pharmacy expertise to help optimise use of medicines.

We are also looking at ways to support providers and commissioners to better utilise local and national data, to work with local clinicians so that best practice becomes the norm, and assess the impact of local practice on infection and resistance.

---

28 To be published by the end of the year.

29 https://www.phe-events.org.uk/hpa/frontend/reg/tOtherPage.csp?pageID=138054&eventID=346&eventID=346

30 https://www.gov.uk/government/publications/framework-for-personalised-care-and-population-health

In Scotland, there is a network of local Antimicrobial Management Teams (AMTs). These have been supported through national guidance and recommendations to improve stewardship at board level. National leadership in Scotland, together with the coordination of AMTs has contributed to changes in prescribing practice.

In Northern Ireland, AMTs are also in place in trusts, with some including participation from primary care. A regional antimicrobial pharmacists' network is well established and operational, delivering an antimicrobial stewardship and education programme in secondary care. Regional empirical antibiotic prescribing guidelines are in place in secondary care and primary care, with the latter incorporated into a full Northern Ireland formulary and associated website. Antimicrobial stewardship in primary care has also been strengthened through, for example, the provision of antimicrobial prescribing data to GPs and non-medical prescribers, practice audits and educational sessions.

Animal health

Guidance

Guidance has been strengthened to reflect the government position that routine preventative use of antibiotics is unacceptable. A position statement has been published advising vets on use of the 'cascade' legislation to ensure responsible prescribing.[31] In parallel to the revisions made to the Royal College of Veterinary Surgeons (RCVS) Practice Standards Scheme, we have included 'responsible use' within the VMD veterinary practice premises inspections to assess how practices implement responsible use principles.

The UK participates closely in the development of EU guidance on responsible assessment, authorisation and prescription of antibiotics, and contributes to the collation of the EU Commission Guidelines for prudent use of antimicrobials in veterinary practice.

Regulation

We continue to target illegal sales of antibiotics through intelligence-led enforcement activity, with 356 unauthorised antibiotic products removed from online retailers in 2013. We will continue to support international efforts to use regulatory levers to enforce change. We also introduced an internet retail scheme to enable internet purchases of veterinary medicines to be undertaken in an assured way, which is informing the development of an EU wide scheme.

As of 1st October 2014 VMD will not issue import certificates for products containing virginiamycin (a streptogramin, which is defined as a critically important antibiotic class for human use) and it will be an offence to use or possess them.

Behaviour change

Jointly with the Federation of Veterinarians of Europe (FVE) we undertook a study involving more than 3000 practitioners working in 25 countries to determine the factors that influence antibiotic prescribing habits.[32]

This will inform interventions to help improve prescribing habits. The RUMA alliance has published an action plan setting out education and engagement activities to promote responsible use of antibiotics in livestock production. The Pig Veterinary Society (PVS) has published antimicrobial prescribing principles to inform veterinary surgeons treating pigs, adding to guidance already published by the British Veterinary Association (BVA), the British Small Animal Veterinary Association (BSAVA), British Equine Veterinary Association (BEVA) and RUMA.

31 http://www.vmd.defra.gov.uk/pdf/vmgn/vmgnote13.pdf

32 http://veterinaryrecord.bmj.com/content/early/2013/09/25/vr.101454.full

The Department of Agriculture and Rural Development Northern Ireland (DARDNI) has developed guidance on the responsible use of antimicrobials in livestock which has been circulated to farmers and is available on the DARDNI public webpage.

Where do we want to get to?

Human Health

In the first instance, we want to return total antibiotic prescribing to 2010 levels in primary care (CCG Level); to 2012 levels in secondary care antibiotic consumption (Area Team Level); and increase diversity in prescribing (reduce inappropriate use of broad spectrum antibiotics) in both primary and secondary care.

This will be supported by work to improve local access to appropriate information, expertise and advice. In doing this we will seek to influence the shape of professional education and training on antimicrobial stewardship for staff in all settings, strengthen commissioning and regulatory processes to incentivise good practice in primary and secondary care and ensure accountability for antimicrobial prescribing.

We will work with the Royal Colleges and professional bodies to identify how best to utilise the health professional appraisal and revalidation system to reinforce stewardship and embed best prescribing practice.

We will establish implementation options for scale-up and national roll-out of successful interventions to reduce antibiotic prescribing in 2015. We will help embed the antimicrobial stewardship principles set out in SSTF by developing a national framework to improve adherence to the Focus stage of SSTF in hospitals by 2016.

Animal Health

We will reduce antimicrobial use in livestock production in real terms over the next four years, measured in sales of antibiotic products against national livestock population, (milligrams per population correction unit). We will ensure that sales of fluoroquinolone and modern cephalosporin classes of antibiotics remain low and reduce further as a proportion of total antibiotic sales.

To support these aspirations we will collect data on antibiotic prescription/consumption by animal species; these data will provide the intelligence on which to identify sub-optimal prescribing practices and to base productive interventions, including, if necessary, setting reduction targets, to achieve similar antibiotic usage as comparator EU Member States.

We also aim to improve access to sensitivity data to inform optimal veterinary prescribing. In addition, we will undertake work to understand the factors that influence prescribing behaviour, and the uptake of good biosecurity and husbandry practices. We will also strengthen education and training for veterinary surgeons and animal keepers in responsible prescribing and administration of antibiotics.

Section 3: Key action area 3 – Increasing public awareness

Introduction

This section focuses on the work to raise public awareness of the problem of resistance and that antibiotic use should be targeted for identified infections. Professional education and training is described in earlier sections as it underpins work to drive improvements in IPC and antimicrobial stewardship.

Awareness of appropriate antibiotic use is higher in the UK than the EU as a whole. 52% of the UK public compared to 40% in the EU are aware that antibiotics are ineffective against viruses. 70% are aware that antibiotics are ineffective against colds and flu, compared to the EU average of 52%.[34]

The recent Longitude prize[35] demonstrated a welcome level of awareness among the public in that development of a diagnostics tool to help address AMR was the most popular choice out of six major issues as a focus for the prize.

What has been delivered?

Human health

Given that prescribers report pressure from patients as a factor in the use of antibiotics, we need to address that by finding new ways of engaging the public on appropriate antibiotic use. This includes supporting public awareness raising efforts nationally and internationally. So far, this has primarily been achieved through EAAD activities. EAAD is a Europe-wide initiative which takes place on 18th November every year to encourage responsible use of antibiotics. PHE's evaluation of the 2013 EAAD showed the benefit of social media to achieve wider reach. We have built on the 'One-Health' approach promoted last year by encouraging both human and veterinary health professionals to communicate a unified message.

In 2014, we launched an Antibiotic Guardian campaign as part of EAAD 2014 to start to drive behaviour change by encouraging the public and professionals to sign-up to on-line pledges. This year there was a 10,000 pledge target for the public and health professional (human and veterinary) which has been exceeded. An example pledge for a member of the public is '*The next time I have a cold or flu I will talk to the pharmacist first about how I can treat my symptoms rather than making a GP appointment*'.

A survey undertaken in January 2014,[35] measured trends in public knowledge, understanding and attitudes to AMR and the use of antibiotics. The findings were used to inform the development of materials for use in primary care settings as part of the TARGET programme.

The E-bug programme[36] is aimed at school children and young adults and promotes awareness of prevention of infections, including the importance of hand hygiene, and

33 http://ec.europa.eu/public_opinion/archives/ebs/ebs_407_en.pdf

34 http://www.longitudeprize.org/

35 Not published at the time of this report

36 http://www.e-bug.eu/

appropriate use of antibiotics. The intended outcome is to lower infections and improve use of antibiotics and acceptance of vaccines in young people. Visits to the PHE-led e-Bug Programme website have more than doubled in 2014; recent translation into Arabic has increased accessibility and work has commenced to expand the target age-group to include 16-18 year olds.

A 'public engagement' workshop was held at the Royal Pharmaceutical Society AMR Summit in November 2014. The workshop facilitated a debate between members of the public, voluntary sector representatives and health professionals about the best ways to engage the general public and patients in implementation of the AMR Strategy and will used to inform the next steps.

Animal health

EAAD 2013 heralded the first coordinated cross-government approach to antibiotic resistance in animals. Activities generated awareness through both traditional and social media coverage. A workshop on Responsible Veterinary Prescribing was hosted by Liverpool University.

We have also undertaken a range of activities to engage with vets, farmers and pet owners on AMR issues. These include:

- updating the VMD public-access webpages on AMR to deliver clear information, outline surveillance activities that are underway, and signpost additional available resources,
- updating of DARDNI website to include information on AMR and the DARDNI AMR Action Plan.
- establishing sector-specific engagement fora, which first convened representatives from academia, animal keepers, vets, and retailers in November 2013. Intelligence from these groups has informed our work on strengthening antibiotic use and resistance surveillance, and is helping target our engagement work on promoting responsible use. These fora continue to be active, with additional face-to-face meetings planned,
- supporting the 'One-Health' Conference on AMR organised by Bella Moss Foundation in October 2014,
- hosting a summit for senior leaders in major animal health and livestock production organisations from across the UK in November 2014. Participants outlined current activity within their sector and asserted their commitment to tackling AMR,
- surveying awareness of AMR and antibiotic use in animals amongst the public, in collaboration with PHE.

We are reviewing the impact of this engagement activity to feed into an analysis of prescribing and infection prevention behaviours and the factors that influence these and will help shape future engagement work.

The Pig Health and Welfare Council (PHWC) has also convened a subgroup on antibiotic use, in which members from across the pig sector, including the British Pig Executive (BPEX), the Pig Veterinary Society (PVS), the National Farmers Union (NFU) and the National Pig Association (NPA), have joined together to focus on actions to promote responsible use.

Where do we want to get to?

We want to get to the point where there is public and professional understanding of the important messages relating to infection prevention, control and hygiene, and better vaccination uptake, to feed through into changes in antibiotic demand and use.

To achieve this we will need a sustained approach to public engagement across human and animal health to ensure a 'One-Health' approach which achieves a shift in attitude towards antibiotic use and create a focus on conservation and stewardship both nationally and internationally.

We will continue to promote AMR messages through a variety of campaigns and events and will seek to engage the public in debates that tackle some of the more difficult issues. To begin this process, a 'Hard Choices' workshop in September 2014, focused on the impact and potential adverse consequences of a change in antimicrobial prescribing policy aimed at reducing AMR. The outputs of the workshop will be published and identify a list of priority research questions to be addressed to help support ongoing public dialogue with the public on AMR policy development.

Section 4: Key action area 4 – developing new drugs, treatments and diagnostics

Introduction

If the first two areas on which we need to focus are minimising the incidence of infections and then optimising our use of existing antibiotics, the third key area of focus needs to be ensuring a sustainable supply of new treatments and better diagnostics.

The limited number of new antibiotics under development targeted particularly at gram-negative bacteria is a cause of international concern. No new classes of antibiotics against bacteria have appeared for more than 25 years. However, there are some promising developments with a total of 13 new antibiotics with potential activity against Gram-negative bacteria in development, one of which has a license pending with another anticipated in 2015, and four at phase III clinical trials stage. The UK government is determined to encourage a sustainable supply of new antibiotics for the future to protect the gains made by modern medicine.

Equally, development and availability of improved diagnostics and new treatments for people and animals is essential. Better diagnostics will enable us to identify the right treatment more quickly, and reduce unnecessary or incorrect use of antibiotics.

What has been delivered?

The drug pipeline

In July 2014, the Prime Minister asked Jim O'Neill, an economist of international standing, to explore what actions may be taken by governments around the world to stimulate investment in new antimicrobial drugs. This independent Review on AMR will investigate the economics of antimicrobial drug development at an international level, look at how the international community can respond to the urgent need to stimulate the development pipeline for new antibiotics by setting out a plan for encouraging the discovery and development of new antibiotics with recommendations that are acceptable and can be internationally implemented.

The Review will play an important role in raising awareness of the economic and social burden of AMR, and the costs over the longer term of a failure to act effectively to contain its global spread. It is due to report in 2016.

Diagnostics

The increased focus on diagnostics and the provision of funding to support work in this area, for example, the recent research funders' call (see section 6) and the Longitude prize will help develop point of care, (on the veterinary side, pen-side) diagnostics for more effective diagnosis and treatment of patients.

We are encouraging closer collaboration between Research Councils, academia, industry and others; and greater public-private investment in the discovery and development of effective new antimicrobials, rapid point of care diagnostics for use in health, social care, and veterinary systems. We are also looking at mechanisms, including clinical trials and regulatory requirements, to bring promising treatments to market as quickly as possible.

To improve access to rapid and better diagnostic testing across the NHS, the HLSG is developing a framework for rapid diagnostics for infection to support the appropriate prescribing of antibiotics, beginning with work to identify what diagnostics are currently in use across the system and what new technologies are on the horizon both nationally and internationally. This work will be informed by a survey of Public Health and NHS laboratories, including identification of the incentives and barriers to the use of rapid diagnostics.

Supporting businesses

Innovate UK, part of BIS, has been working with multiple stakeholders, including industry, the NHS, DH, Defra and the Research Councils and devolved administrations, to develop the Precision Medicine Catapult Centre[37] which supports a range of novel diagnostic approaches. The Small Business Research Initiative continues to support small and medium sized enterprises (SMEs) to overcome barriers and get new technologies to market. The joint Innovate UK/ MRC Biomedical Catalyst scheme provides responsive and effective support for the best translational life science opportunities arising in the UK, both academic and SMEs, to move their research more quickly from discovery to commercialisation.

Industry participates in the EU Innovative Medicines Initiative (IMI) and we continue to support their engagement with the Research Councils in relation to development of new antibiotics and diagnostic technologies.

More generally, the government's 'Strategy for UK Life Sciences' (2011)[38] sets out an ambitious long-term programme of action to improve the wider environment for health life sciences companies.

Regulatory Issues

Last year the EMA, with a high level of assistance from MHRA, reviewed the licensing requirements for new antibiotics and made amendments which have built in extra flexibility into the arrangements. MHRA has been actively engaging with industry to explain the new arrangements and advise those seeking regulatory approval of products.

Where do we want to get to?

We want to ensure that the right economic models and infrastructure are in place to support the development and rapid uptake of new diagnostics, drugs and other technologies that support good antibiotic stewardship and help slow the spread of resistance.

We also want to explore the use of alternative treatments and ensure that we can exploit any emerging potential. We have commissioned a review of treatments that provide an alternative to antibiotics, including vaccines, the role of alternative antimicrobials and opportunities to use genomics in diagnosis and in understanding infective processes.

Government will continue to explore what more can be done to stimulate diagnostics and drug development both nationally and with international partners throughout the life of the Prime Minister's Independent Review. Some of the Review's recommendations will be critical in achieving lasting change, in terms of encouraging medicines developers to do more R&D in the area of antimicrobials, and it would be wrong for the Government to pre-empt them. But in the interim we will consider issues which might not need to wait for the Review's

37 https://www.innovateuk.org/healthcare

38 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32457/11-1429-strategy-for-uk-life-sciences.pdf

conclusion, such as how products already in the pipeline can be dealt with by the system in a way which is compatible with the broader goals of the Strategy.

Economic analysis of the global impact of AMR is needed and the independent Review will also be looking at the economic issues associated with the supply, and use, of antimicrobials more broadly. DFID has agreed to contribute funds for a World Bank study into the economic costs of AMR, and it is expected to report in 2016.

Building a life sciences ecosystem, through the 'Strategy for UK Life Sciences', will capitalise on our existing partnerships between universities, the wider research base, businesses and the NHS. We want to attract, develop and reward the best talent so that our highly skilled researchers, clinicians and technicians of the future are able to work collaboratively across traditional boundaries. We will also progress work to overcome the barriers and create incentives that allow discoveries to be translated into commercial opportunities and into real benefits for patients and for business.

Section 5: Key action area 5 – better access to and use of surveillance data

Introduction

To minimise the incidence of infections, control their spread and optimise prescribing of antibiotics, better access to and use of local and national infection surveillance data underpins key action in areas 1 (IPC) and 2 (prescribing).

The initial focus has been on improving access to data by local teams across different sectors. These data will enable individual organisations and health economies to benchmark against national and regional antibiotic resistance and prescribing levels and help inform appropriate local action. It enables us to monitor the spread of AMR so that we can adapt our strategies accordingly.

What has been delivered?

Human health

Published data

The ESPAUR Report[39] combined data for the first time on antibiotic use (in primary and secondary care) with data on resistance to antibiotics used to treat particular infections for England. The key findings are summarised below:

- *E. coli* bloodstream infections have continued to increase year-on-year, with a corresponding increase in the numbers of resistant infections, with approximately one in five *E coli* blood-stream infections recorded as resistant to at least one key agent (quinolones, cephalosporins, aminoglycosides or carbapenems),
- between 2010 and 2013 total antibiotic consumption (primary care, other community and hospitals) rose by 6% in England, from 25.9 to 27.4 defined daily doses (DDD) per 1,000 inhabitants per day. Prescribing in England is comparable to that seen in the highest prescribing countries in Europe in this period prior to publication of the Strategy,
- over the same four year period, GP prescribing rose by 4%; prescribing to hospital inpatients rose by 12%; and other community prescriptions (including dentists) rose by 32%,
- there is considerable variability in both antibiotic resistance and antibiotic prescribing across England, with higher prescribing in the north of the country than the south,
- frequently, areas with high prescribing also have high resistance; this association, as well as the regional variation, needs more investigation to determine whether, for example, this reflects differences in deprivation, differences in co-morbidities, or other factors and will be subject to further detailed analysis.

Trends in resistance

We have collected data on key bloodstream infections and gonorrhoea against a list of drugs used to treat them ('drug/bug' combinations). Bloodstream infections (BSIs) have been used

[39] http://bit.ly/espaur-report

as they tend to be more serious in nature and can be life threatening. The data shown in the Table at Annex B will form the baseline from which to measure changes.

Trends in resistance to key antibiotics for *E. coli* and *K. pneumoniae* have stabilised in the last few years and are broadly similar between countries within the UK. However, the incidences of BSIs due to *E. coli* and *K. pneumoniae* have increased over time. The total burden of BSIs caused by resistant Gram-negative infections has also increased (see figure in Annex A). Interventions to reduce BSIs will be especially important in reducing the numbers of resistant infections, as well as continuing to reduce the proportion of isolates that are resistant.

Improved surveillance

The key aims of the ESPAUR programme (managed by PHE) are to develop surveillance systems to measure both antimicrobial utilisation and resistance and to measure the impact of antimicrobial utilisation on resistance and patient/public safety. The data in the 2014 report provide a baseline measure from which we can track changes in both prescribing and resistance in England.

We now need to investigate the potential associations between antibiotic resistance and antibiotic use. A number of improvements have been made to national systems, which allow us to integrate routine data on infections and their antibiotic resistance profiles to provide more information on trends at NHS Area Team, general practice and hospital level. This is in contrast to previous surveillance reports, which have focussed on trends at the national level. Antibiotic consumption data are also being incorporated to inform further action to reduce the development and spread of resistance.

To increase our understanding of the size of the problem relating to carbapenem resistant bacteria in England, an enhanced surveillance programme commenced in May 2014, with national roll-out in 2015. Data on infections in intensive care units across England are also to be collected as part of the Infections in Critical Care Quality Improvement Programme (ICCQIP), which is expected to launch by the end of 2014.

International collaboration

The WHO global surveillance report on antimicrobial resistance published in April 2014[40] highlighted the need for international surveillance to be strengthened and identified key organisms to be monitored for antibiotic resistance at a global level. These are largely consistent with those being monitored in the UK. Through ESPAUR we have increased capability in the surveillance of antibiotic consumption and resistance and are well placed to assist the WHO in developing and strengthening systems. We also submit data to two European surveillance systems, the European Centre for Disease control (ECDC) European Surveillance of Antimicrobial Consumption Network (EASAC) and the European Antimicrobial Resistance Surveillance Network (EARS).

PHE has been working with Commonwealth countries on a laboratory ‘Twinning Initiative’ with the aim of improving capability to monitor, manage and contain AMR. The concept was first developed in 2011 and proposals presented to Commonwealth Health Ministers meeting in 2013/14 focused on developing networks to combat AMR, including appropriate support to establish effective surveillance and infection prevention and control measures.

We can learn from our European partners where local surveillance programmes have contributed to reductions in antibiotic prescribing. For example, the Swedish Strategic Programme for the Rational Use of Antimicrobial Agents has reduced antibiotic consumption

40 http://www.who.int/drugresistance/documents/surveillancereport/en/

without adverse consequences (pressure to reduce antibiotic prescribing should not result in the inappropriate treatment of infections)[41] and France has also demonstrated success in using awareness raising activity to reduce antibiotic prescribing.[42]

Animal health

Our key focus so far has been on examining the ways in which we can improve the data collected on antibiotic use and resistance in animals. With extensive stakeholder engagement across the animal health and livestock production sectors, we have completed a detailed scoping exercise exploring options for cost effective collection of antibiotic use data. A central data hub is to be created and hosted at the VMD by May 2015 which will collect data from priority livestock sectors in the first instance. In addition we are participating in the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) pilot project to collect antibiotic consumption data from pig producers.

We have expanded our surveillance programme of resistance in veterinary bacteria, setting up new sampling and testing schemes for *Campylobacter* and commensal *E.coli* in poultry at slaughter, and rolling out a scheme which examines resistance in commensal *E.coli* in pigs in 2015. The UK initiated and leads a project to design a harmonized surveillance scheme within Europe for antibiotic resistance in veterinary pathogens of priority livestock species.

For the first time in 2013 we published a combined report on antimicrobial sales and on antibiotic susceptibility of veterinary pathogens, the UK Veterinary Antibiotic Resistance and Sales Surveillance report (UK-VARSS). The second report was published in November 2014.[43] For all testing human clinical breakpoints are used as a definition of resistance to facilitate comparison to human pathogen AMR surveillance. Antibiotic sales data are submitted to ESVAC and antibiotic sensitivity data to the European Food Safety Authority (EFSA) annually for inclusion in their EU wide reports.

VMD supports the newly-formed PHWC subgroup on antibiotic use where members of the pig production industry gather and analyse data, and determine specific industry actions to promote responsible use. Others across the animal health and livestock production sectors are also taking action to collect data. The Red Tractor farm assurance scheme has imposed new requirements on members to collect data on antibiotic use; and the Scottish Salmon Producer's Organisation and the British Poultry Council are working with members to collect detailed data in their respective sectors.

Where do we want to get to?

To achieve the initial ambition of reducing prescribing to 2010 levels in primary care, to 2012 levels in secondary care for human health and increased diversity in prescribing (reducing inappropriate use of broad spectrum antibiotics), we need robust surveillance and monitoring systems to accurately track consumption and resistance trends at local level. By 2018, we want to achieve this at patient and farm level.

We are committed to developing a single data repository where human health and care organisations can interrogate key resistance and consumption data at the same time.

---

41 Sustained reduction of antibiotic use and low bacterial resistance: 10-year follow-up of the Swedish Strama programme. Mölstad S1, Erntell M, Hanberger H, Melander E, Norman C, Skoog G, Lundborg CS, Söderström A, Torell E, Cars O.Lancet Infect Dis. 2008 Feb;8(2):125-32. doi: 10.1016/S1473-3099(08)70017-3

42 Significant Reduction of Antibiotic Use in the Community after a Nationwide Campaign in France, 2002–2007 Plos Medicine 2009

43 https://www.gov.uk/government/publications/veterinary-antimicrobial-resistance-and-sales-surveillance-2013

Validation of individual hospital prescribing data is an essential step in this process and will be completed for all acute care organisations in the coming year. Once the validation of hospital data is complete, data relating to the new antimicrobial prescribing quality measures will be published.

We will reach the point where all healthcare providers are actively reporting into national surveillance systems and will have access to surveillance outputs that are useable and relevant to support good IPC and antibiotic prescribing practice.

We want to increase the availability of resistance data for key veterinary pathogens to aid veterinary surgeons to make better primary prescribing decisions, and of consumption data to enable vets and farmers to benchmark their level of use, so that action can be taken when consumption is higher than in equivalent production systems.

We also want to get to the point where we can integrate data from the human and animal sectors and use comparisons across the UK and Europe.

Section 6: key action area 6 – better identification and prioritisation of AMR research needs

Introduction

Research and data analysis provides the evidence to underpin work in all six other key areas of the strategy.

We still have gaps in our knowledge of the development and transmission of AMR in and between humans, animals, food and the wider environment. We also need a better understanding of the human behaviours and their relative contribution to the spread of AMR.

What has been delivered?

AMR Research Funders Forum

In the first year, our focus has been on establishing new mechanisms to improve collaboration between research bodies and fund new research spanning both human and animal health. To this end, the MRC has established an Antimicrobial Resistance Funders Forum which comprises all seven Research Councils, the Wellcome Trust, DH, NIHR, Innovate UK, Defra/VMD, the Food Standards Agency (FSA) and other UK Health Departments. The Forum is promoting and coordinating joint action to improve our understanding of AMR and address gaps in the evidence base.

Cross Research Council funding initiatives

The Research Councils led by the MRC have launched calls in the following areas:

- understanding resistant bacteria in context of the host, which will be commissioned in March 2015,
- accelerating therapeutic and diagnostics development, proposals evaluated by March 2016,
- understanding the real world interactions, in two phases, wider environment initially and the built environment in 2015,
- behaviour within and beyond the health care setting (to be launched).

The Research Councils have commissioned new work to study AMR spread in both humans and animals and the interaction between the two. The Natural Environment Research Council (NERC) is leading on behalf of the Research Councils to scope the research questions around the role of the environment and AMR.

The Biotechnology and Biological Sciences Research Council (BBSRC) has launched a strategic priority ‘Combatting antimicrobial resistance’, and the Engineering and Physical Sciences Research Council (EPSRC) is highlighting a future call opening entitled ‘Bridging the gaps between the engineering and physical sciences and AMR.’

Initially, up to £20million has been ring-fenced by the MRC and BBSRC to fund these calls, plus a further £5million for the EPSRC to engage engineering and physical sciences researchers with the AMR challenge. The research will build on the expertise of the academic sector and link strongly with the private sector.

In addition to the Research Council's work, the Centre for Environment, Fisheries and Aquaculture Science (Defra/ CEFAS) has held an interagency workshop to consider environmental reservoirs for AMR. In Scotland, a Scottish Infection Research Network R&D Consortia 2015-18 has been set up.[44] In Northern Ireland, Queens University Belfast has undertaken research on antimicrobial prescribing and resistance in primary, secondary and long-term care facilities. Pharmacy and Medicines Management Centre in the Northern Health and Social Care Trust has published both antimicrobial use and broader HCAI research.

Health Protection Research Units

The DH has commissioned two NIHR HPRUs focusing on HCAI and AMR. These units, which are partnerships between universities and PHE, became operational in April 2014. They will lead on research to support the development of effective approaches to combat AMR. The Oxford unit will look at research to help bring genome sequencing into everyday practice, while the unit at Imperial College has a focus on best practice in infection prevention and antibiotic prescribing behaviours.

NIHR themed calls

In addition, the NIHR is running an AMR-themed call across eight different funding programmes with some successful research bids already being announced and more to follow in 2015.[45]

The Health Innovation Challenge Fund

The Health Innovation Challenge Fund (HICF), a joint DH/ Welcome Trust initiative, has funded four studies looking at detection and diagnosis of infection outbreaks and the role of genome sequencing in diagnostics and infection response. These studies will be completed in 2016/17.

International Collaboration

DH and BIS, through the Research Councils and Innovate UK, are also working to strengthen EU and international AMR research collaboration, promoting inter-disciplinary working to encourage new diagnostics and treatments. The MRC is leading on behalf of the UK, the EU Joint Programming Initiative (JPI) on AMR which aims to coordinate research activity across 17 member states, Norway, Switzerland, Canada, Israel and Turkey. We are working with the EU sponsored IMI that involves working with small and medium sized businesses.

AMR is a priority for the BIS-FCO Science and Innovation Network (SIN), with significant engagement globally. Projects supporting international collaboration between UK and overseas researchers and policy makers are being led by SIN teams in Japan, USA, Brazil and India. New partnerships have been developed with the Indian Department of Biotechnology in AMR. The British Embassy in Beijing is supporting work to inform the Chinese government's approach to containing AMR with UK experience.

DFID has also begun work to commission a review of evidence on antimicrobial resistance and agricultural production in the developing world.

---

44 http://www.gla.ac.uk/researchinstitutes/iii/research/researchcentres/sirn/aboutsirn/

45 http://www.themedcalls.nihr.ac.uk/amr/meet-the-programmes/phr-programme http://www.mrc.ac.uk/research/initiatives/antimicrobial-resistance/

A strategy for use of antibiotics

A workshop, facilitated by the Infectious Disease Research Network (IDRN), considered measuring and mitigating potential consequences of introducing an antimicrobial prescribing policy. The output of this work will also be used to inform the development of a safe antibiotic prescribing and stewardship framework.

Review of evidence

We will publish an initial overall systems map showing the interrelationship between different factors influencing AMR and a review of the available empirical evidence base on resistance to antibiotics by the end of the year. These will inform further action on AMR and be of use to researchers and academics.

VMD funded research

The VMD has supported the Royal Veterinary College to undertake an economic review for the World Bank on the impact of AMR on livestock production, and is funding research into optimal prescribing of certain antimicrobials and the impact of prebiotics in turkey production. It is also funding research into novel methodologies for control of *Clostridium difficile* enteritis in pigs.

In addition it is funding research by Liverpool University into the 'motivators' of antimicrobial prescribing in the pig sector. Results from the first part of this project have been published. The results from this study are being analysed, together with the results from similar studies in the equine and dairy sectors and the results of the VMD/FVE European wide survey of veterinary prescribing habits (see section 2), to inform future interventions to encourage behavior change.

Where do we want to get to?

We want to fill the gaps in our knowledge and understanding of AMR and use that knowledge to inform future actions.

We want to continue to see greater cross-sector working and collaboration that results in a coordinated research approach. To this end, we will continue to promote the work of the AMR Funders Forum, the EU JPI and the EU IMI.

Research is required to:

- fully understand the potential of alternative treatments, in particular, the role of vaccines in the prevention of infection and to understand how we might be able to use antibiotics differently to help address AMR,
- identify new targets for drug discovery, improved drug delivery, new diagnostic techniques and treatments other than antibiotics,
- provide greater understanding of the role of the environment in AMR,
- support development of novel surveillance techniques and modelling,
- improve understanding of the impact of behaviours on bacterial resistance.

We will continue to share the outcomes of our analytical work and encourage the wide dissemination of the research underway. We will keep research needs and questions under

review to ensure that gaps in our knowledge and understanding of AMR are filled and new drugs and alternative approaches to tackling infection are developed.

We will also review the activity we have undertaken to date and use it to revise our plans and set our future direction.

Section 7: Key action area 7 – strengthened international collaboration

Introduction

The UK strategy reiterates that slowing the spread of AMR is of global concern and cannot be achieved simply through national action. The UK is identifying approaches to secure concerted efforts at an international level to reduce AMR, working with international bodies including: the WHO, the World Organisation for Animal Health (OIE), the Food and Agriculture Organisation of the United Nations (FAO), the United Nations (UN) and the World Economic Forum (WEF). These efforts are coordinated through an interdepartmental steering group chaired by the Foreign and Commonwealth Office (FCO) and includes DH and all Departments with an interest in taking forward the international AMR agenda. The aim of this group is to strengthen international collaboration by developing a coordinated approach that will support and secure action in the WHO, OIE and FAO.

The UK international work programme aims to deliver the following:

- galvanise international collaboration to prevent the global spread of AMR,
- garner international support for a 'One-Health' approach to tackling AMR,
- be instrumental in and take a leading role in work with the UN and other key international bodies to develop innovative financing and regulatory (licensing) approaches which will help stimulate development of new antimicrobials.

The CMO, along with Ministers and other senior officials, champion this agenda globally, utilising international fora to raise awareness of and political support for action at a regional, national, and global level.

What has been delivered?

Galvanising international collaboration

The UK and Sweden, working closely with other WHO Member States, developed the WHO Resolution on AMR adopted at the World Health Assembly in May 2014.[46] The Resolution, which received co-sponsorship from over 60 countries, is a major step forward in the fight against AMR. It provides a mandate for the development of a Global Action Plan on AMR by May 2015. The UK responded to the WHO consultation[47] to inform development of the plan in August 2014 and will remain actively engaged, working closely with the WHO and other Member States as work to develop the plan continues. The Plan is being structured around five strategic objectives and is intended to provide a framework for national action. It is aligned with the action areas in the UK Strategy, where national action is already underway.

To accelerate implementation of the Global Action Plan, the UK is leading the Action Package on AMR within the Global Health Security Agenda (GHSA), along with Sweden, the Netherlands, Germany and Canada, also working with a number of contributing countries. This Action Package was launched at the White House in September 2014[48] and proposes an

46 http://apps.who.int/gb/ebwha/pdf_files/WHA67/A67_R25-en.pdf?ua=1&ua=1

47 http://www.who.int/drugresistance/amr-consultation/en/

48 http://www.whitehouse.gov/the-press-office/2014/09/26/fact-sheet-global-health-security-agenda-getting-ahead-curve-epidemic-th

integrated package of activities to combat AMR, consistent with the WHO Global Action Plan, taking a 'One-Health' approach.

There is now a higher level of awareness and political support for a 'One-Health' approach. Recognition of the economic impact of AMR has seen collaboration between human health, animal health and the agricultural sector (including WHO, FAO and OIE) to an extent not seen before.

The UK is already working with a number of countries, including India, China and Caribbean countries to share expertise and build capacity and we will continue to coordinate these activities through the GHSA.

International efforts to tackle AMR as a threat to global health security have been noted at a number of international fora including: the World Economic Forum Statement in January 2014,[49] the Commonwealth Health Ministers Statement in May 2014, the Brussels G7 Summit Declaration[50] in June 2014, and the G20 Leaders' Statement on Ebola in November 2014.

Optimising prescribing will be difficult to tackle with a single approach and will need different strategies where health systems are at different stages of development around the world. It will be important to ensure that in improving rational use, new approaches that involve prescription regulations do not restrict access for those with life threatening infections.

We have also been working to strengthen international research collaboration (see section 6).

'One-Health' approach

The UK Government, including Ministers across Government departments, the CMO, the CVO, Chief Scientist and the Permanent Representatives to the UN Agencies in Geneva and Rome, have all been working to raise the profile of a 'One-Health' approach to combating AMR at a global level.

The 2014 WHO Resolution on AMR supports further action by the WHO to work with the FAO and the OIE to get similar action in agricultural and food related areas. The UK is closely engaged with both organisations to take this work forward. Ministers from DH and Defra, along with the CMO and CVO, participated in a conference hosted by the Netherlands in June 2014, attended by the WHO, FAO and OIE, which agreed core principles for developing the WHO Action Plan on AMR, based on a 'One-Health' approach.[51]

DFID is leading work to develop a position among FAO Member States and the governing body process is on track for the FAO Conference to consider a resolution on AMR in June 2015. Defra is also supporting work to be initiated by the OIE to establish a list of priority animal species and diseases for which the development of vaccines could potentially reduce the use of antibiotics.

Developing approaches to stimulate the development of new antimicrobials

As noted above (section 4), the UK announced an independent Review to look at the antimicrobial drugs pipeline and recommend what collective action could be taken globally to stimulate the development of new antibiotics. The government provided initial support on international engagement to ensure that the global community was aware of the Review from an early stage and were clear that it will take a collaborative approach.

---

49 http://www3.weforum.org/docs/WEF_GlobalRisks_Report_2014.pdf

50 http://europa.eu/rapid/press-release_MEMO-14-402_en.htm

51 http://www.rijksoverheid.nl/documenten-en-publicaties/vergaderstukken/2014/09/30/verklaring-ministeriele-bijeenkomst-joining-forces-for-future-health-engels.html

DFID continues to work with a range of international partners to support the development of new antimicrobials (including antiparasitics and TB) and develop new and better diagnostic tests to help identify infections and target antimicrobials better.

DFID is also working to strengthen health systems by undertaking research that can help identify hotspots, with a focus on reducing uptake of sub-standard or counterfeit drugs and reaching at-risk groups, specifically in relation to malaria control with a global consensus on next steps being developed via the WHO.

Where do we want to get to?

We want to get to a position where all countries around the globe are working to improve their IPC, better steward antibiotics ensuring that there is access to appropriate antibiotics when they are needed and agree on the best ways to stimulate the development of new drugs.

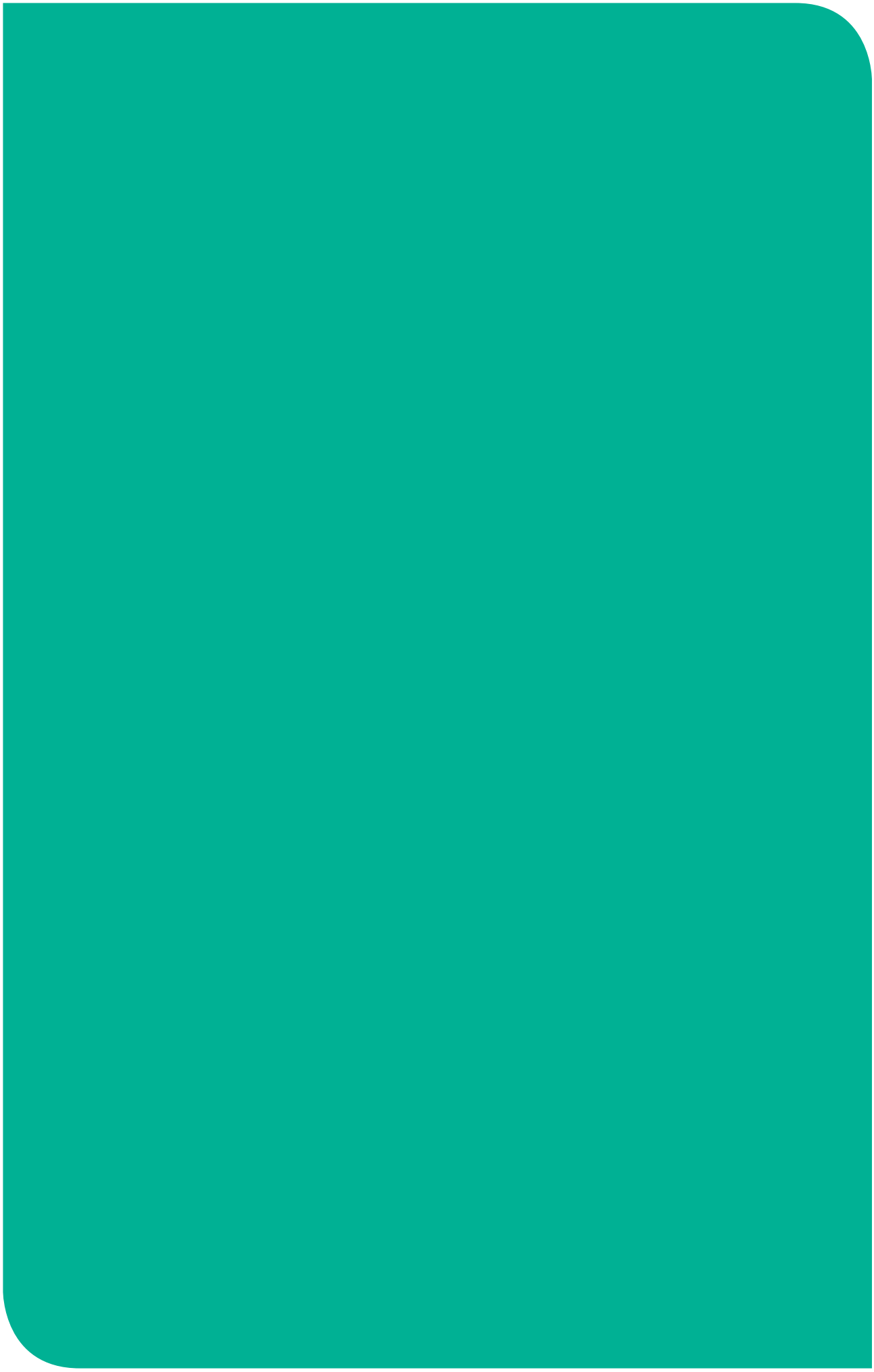
The WHO Resolution was a major step forward. The aim now is for the Global Action Plan to be ratified at the World Health Assembly in May 2015, which will require work to achieve a global consensus.

The UK would like to see action being taken through the FAO and OIE to complement the WHO Resolution and will be continuing to work with partners to achieve this aim.

We will engage with the independent Review team on an international level to offer support as necessary and ensure that our international approaches are aligned.

We will work to ensure that AMR is included as part of the post-2015 sustainable development goals, to reflect the growing recognition that this is an issue that requires urgent global action.

We are already thinking about potential options for action through the UN from 2016 onwards. DH and FCO will be meeting with experts on the UN system, WHO and counterparts from other countries, to consider what options are available and what the UK can be doing to drive forward the agenda.



Section 8: UK AMR strategy implementation plan

This implementation plan sets out how the collective organisations of the High Level Steering Group intend to address the actions set out in the UK AMR Strategy. New data or information has informed planning of what needs to be done in some individual areas. In some cases, actions included in one key area will be addressed by activity set out in another, where this is the case, it is reflected in the text. Those actions that we believe will have the biggest impact are in **bold** font. This plan will not remain static and many of the actions will inform future measures as we learn and understand more about AMR.

The **Lead Organisation** identified in the plan is one of the key partners, PHE, Defra, VMD or DH. However, in many cases the lead organisation will be dependent on partners for delivery of the activity; in particular, PHE has a system lead role and works closely with NHS England, Health Education England, NICE, the Care Quality Commission and others.

While many of the actions take a 'One-Health' approach, addressing both human and animal health, activity that relates solely to animal health is shaded.

Key action area 1: Improving Infection Prevention and Control (IPC) practices in human and animal health.
Improving IPC and reducing the number of infections is essential in controlling AMR. If we reduce the number of infections, we will reduce the demand for antibiotics, thereby helping conserve the antibiotics we have.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Embedding strong infection prevention practices and control of cross-infection in all educational programmes for healthcare workers and veterinary teams.	**Ensure strong leadership and accountability for IPC, from Board to patient, throughout the health and care system**	• **Lead the development of a national strategy for IPC across the health and care system by end 2016/17 providing strategic direction on:** – **leadership and governance** – **roles and responsibilities** – **quality and standards** – **education and training** – **streamlining and standardising guidance.**	**PHE**
	Ensure that healthcare professionals have easy access to streamlined, standardised and simplified IPC guidance.	• Establish a new IPC steering group that will assess the current status and agree a strategy for streamlining, simplifying and making available guidance and audit tools, potentially improving access through an authoritative single portal from **2015**.	PHE
		• Commission NICE to develop guidance as follows: – 'Reducing Morbidity and Mortality from HCAI' – update NICE guideline 'Prevention and control of healthcare-associated infections: Quality improvement guide' (PH36), first published Nov 2011. **Review decision to be published Dec 2014.**	DH
		• Publish NICE accredited guidance on the prevention and management of exotoxigenic Staphylococcus aureus infections in **2015**.	PHE
	Ensure access to appropriate advice and expertise in all health and care settings.	• Work with NHS England to obtain specialist clinical advice on AMR and HCAI to support commissioners strengthen existing clinical networks and collaboration with partner organisations.	PHE
	Ensure education and training for medical infection trainees and continuing professional development supports the IPC and AMR agendas.	• Work with the Hospital Infection Society to implement a structured three-year training programme covering all aspects of infection and control for medical infection trainee doctors (three training sessions per year) in **Feb 2015**	PHE

Key action area 1: Improving Infection Prevention and Control (IPC) practices in human and animal health.
Improving IPC and reducing the number of infections is essential in controlling AMR. If we reduce the number of infections, we will reduce the demand for antibiotics, thereby helping conserve the antibiotics we have.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Ensuring adherence to evidence based guidelines for preventing healthcare associated infections and clinical best practice guidance for infections caused by multi-drug resistant organisms.	Provide advice and support for hospital and community settings to manage patients colonised with bacteria resistant to one of our key 'antibiotics of last resort' (carbapenemase-producing Enterobacteriaceae).	• Publish and embed the 'carbapenemase-producing Enterobacteriaceae Non-acute Toolkit' and implementation resources. Evaluate its use in **2015**.	PHE
		• Lead the development of a programme to facilitate support and training for Local Authorities and other agencies in local oversight and risk assessment of healthcare providers' infection control arrangements in **2015**.	PHE
	Support the uptake of new technologies designed to support infection prevention.	• Promote the work of and strengthen the role and impact of the Rapid Review Panel established to assess products for use in healthcare settings to reduce HCAIs.	PHE
	Strengthen the legislative framework and the commissioning, regulation and delivery of healthcare in relation to IPC.	• **Work with PHE and NHSE to revise the Health and Social Care Act Code of Practice on the prevention and control of infections. This will include guiding providers on the expected minimum IPC and antimicrobial stewardship standards against which CQC and other regulators will assess compliance. Aim to publish the revised Code in March 2015.**	**DH**
		• Work with NHS England to consider what provisions can be included in the NHS Standard Contract to highlight the need for healthcare providers to follow the Code of Practice.	PHE
	Develop new quality measures and indicators which make best use of existing data sources encompassing infection prevention and control, healthcare associated infection surveillance, antimicrobial prescribing and stewardship issues.	• **Work with PHE and NHS England to develop a comprehensive, integrated set of national indicators based on existing data, which can be rolled out across the healthcare system from 2016 to drive up standards in care and improve patient outcomes. This will be presented in a form that can be used to easily communicate local and national HCAI and AMR standards to the public.**	DH

Key action area 1: Improving Infection Prevention and Control (IPC) practices in human and animal health.
Improving IPC and reducing the number of infections is essential in controlling AMR. If we reduce the number of infections, we will reduce the demand for antibiotics, thereby helping conserve the antibiotics we have.

Strategy Actions	Objective	Activity and milestones	Lead organisation
	Reduce the number and proportion of cases of drug-resistant tuberculosis.	• Work with NHS England to deliver priority actions to 'Reduce drug-resistant TB' as part of the forthcoming Collaborative Tuberculosis Strategy for England 2015 to 2020 (pending outcome of consultation).	PHE
Encouraging and supporting animal keepers to improve bio-security and husbandry practices to minimise disease occurrence; for example, through appropriate housing design and good disinfection procedures.	Engage in negotiation of the new EU Animal Health Law to put forward the UK goals to achieve a regulation that is simpler, focused on outcomes, provides flexibility to manage disease and threats appropriately and is firmly risk, evidence and science based.	• Political agreement between Member States and European Parliament expected early 2015 with formal adoption late **2015** with a transition period for adoption of delegated legislation and adaptation of national law of at least 3 years (this is still subject to negotiation). Regulation implemented in the UK from late **2018**. • Establish a cross-cutting informal Defra network group on biosecurity, including implications for antibiotic use and resistance. **Ongoing**.	Defra
Encouraging appropriate use of best practice in disease control, for example through isolation of sick animals, testing of new stock prior to mixing, use of vaccines and disease eradication programmes.	Ensure disease prevention as a routine is integrated into a coordinated approach to improving on-farm biosecurity, across animal health policies.	• This work is **ongoing** across several policy areas, Defra frequently issues guidance and are investing in research to test the effectiveness of different biosecurity measures (e.g. for Campylobacter), and to look at the cost-effectiveness of different biosecurity measures.	
	Promotion of good husbandry and biosecurity practices to control zoonoses, endemic and exotic diseases.	• Carry out a systematic review of the existing literature on husbandry practices and antibiotic use to inform more targeted future work by **end 2015**.	
	Continue to build on the disease specific activities to test the effectiveness of different biosecurity measures and provide appropriate guidance to farmers on maximising biosecurity for a range of diseases.	• Implement the Farming Regulation Task Force recommendations to simplify the livestock movements' regimes over two transitional years during **2016-2017**. This will improve our disease control capability for both endemic and exotic diseases by providing better and more robust information on animal locations.	

Key action area 1: Improving Infection Prevention and Control (IPC) practices in human and animal health. *Improving IPC and reducing the number of infections is essential in controlling AMR. If we reduce the number of infections, we will reduce the demand for antibiotics, thereby helping conserve the antibiotics we have.*			
Strategy Actions	**Objective**	**Activity and milestones**	**Lead organisation**
	Build on a programme of social science research to inform how we most effectively encourage positive husbandry and biosecurity. Continue to ensure that advice on animal movement and isolation is an integral component of the biosecurity advice issues to farmers. Support the provision of advice to farmers on good practice to prevent endemic disease introduction, and assist eradication.		
Sharing intelligence on emerging issues in human and animal health and making better use of early warning systems to trigger appropriate containment measures at a national and global level to limit spread of AMR.	Strengthen joint working between ARHAI and DARC to ensure horizon scanning and early exchange of information on emerging issues relating to transmission of AMR.	• Joint ARHAI/DARC meetings to continue to be held annually to develop and review the one health surveillance data. *See also action area 5 re-integrated surveillance data.*	DH/Defra VMD
Cost-effective use of licensed vaccines to reduce the incidence of infections as well as promotion of the development of new vaccines, including those against multi-drug resistant organisms.		• The Joint Committee on Vaccines and Immunisation will consider the cost-benefit of reducing antimicrobial use when analysing the cost-effectiveness of vaccine programmes and explore the potential for modelling opportunities related to this, from 2015. *See also, key action area 4 and the exploration of new and alternative treatments, including vaccines.*	DH

Key action area 2: Optimising prescribing practice

When, despite improved IPC practices, infections do occur, to control AMR it is imperative that antibiotics are only prescribed where they are needed – at the right time, for the right patient and at the right dose. This will enable us to stop infections from becoming resistant to the antibiotics that we have for as long as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Developing enhanced education and training in prescribing and administration of antibiotics.	**Strengthen stewardship guidance to ensure safety for patients**.	• **Lead the development of an overarching national framework to optimise prescribing by end 2016/17.**	PHE
		• Monitor effect of antibiotic diversity (as set out in the optimising prescribing framework) on patient outcomes and update as necessary from **2016**.	PHE
	Provide evidence based guidelines to improve antimicrobial stewardship.	• Commission NICE to develop guidelines and quality standards on: – 'Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use', new NICE guidelines to be published by **May 2015** – Medicines optimisation, new NICE guideline to be published by **March 2015** – Quality Standard on Antibiotics for neonatal infection to be published **December 2014**. – A new suite of comprehensive short evidence based clinical infection syndrome specific antibiotic prescribing guidelines linked to surveillance data from ESPAUR reports from **2015**	PHE
		• Work with NHS TDA to ensure that NHS non-Foundation Trusts annual planning technical guidance includes measures to address AMR as set out in the UK national AMR strategy, **from 2014**.	PHE
	Embed antimicrobial prescribing and stewardship competencies into national curricula, continuing professional development (CPD), appraisal and (for doctors) revalidation programmes for healthcare professionals.	• Work with HEE to lead the identification of options for implementation of embedding competencies into undergraduate, post graduate and CPD curricula, **2015**.	DH
	Embed use of tools and resources for optimising prescribing in primary and secondary care.	• Lead the development of updates and enhancements to existing AMS tool kits for primary and secondary care and promote the use of:	PHE

Key action area 2: Optimising prescribing practice

When, despite improved IPC practices, infections do occur, to control AMR it is imperative that antibiotics are only prescribed where they are needed – at the right time, for the right patient and at the right dose. This will enable us to stop infections from becoming resistant to the antibiotics that we have for as long as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
		– Start Smart Then Focus (SSTF), secondary care tool kit, – Treat Antibiotics Responsibly, Guidance and Education Tool (TARGET resource for use by GPs and primary care teams in England from **Nov 2014**.	
		• Include reference to SSTF and TARGET in the Health and Social Care Act 2008 Code of practice on the prevention and control of infections and NICE guidelines on AMS to ensure these resources are used to drive best practice across the healthcare system.	DH
		• Undertake a national survey to assess variance between antimicrobial prescribing and stewardship activities across primary care in **2015**.	PHE
Identifying the optimum arrangements for recording and reporting of data (including the use of electronic prescribing) as well as analysis of data on antibiotic use, resistance and clinical outcomes.	Improve access to data allowing NHS organisations to benchmark their antimicrobial consumption data.	*See actions in area 5 – surveillance.*	PHE
Improving the quality and standardisation of routine antibiotic testing and interpretation of results to improve diagnosis and treatment of infections.	Improve standardisation of susceptibility testing and reporting arrangements in NHS and private laboratories.	• Lead the development of guidance to standardise antimicrobial susceptibility testing and reporting arrangements in **2015**.	PHE
		• Provide expert advice to NHS England to enable the best use of commissioning levers and incentives to improve the timely reporting of antimicrobial susceptibility data to national databases by **2015**.	PHE
	Ensure quality and standardisation of AMR testing of *Neisseria gonorrhoea*	• Work with professional societies to provide the evidence base for appropriate methods for AMR testing of *Neisseria gonorrhoea*, by **September 2015**.	PHE

Key action area 2: Optimising prescribing practice

When, despite improved IPC practices, infections do occur, to control AMR it is imperative that antibiotics are only prescribed where they are needed – at the right time, for the right patient and at the right dose. This will enable us to stop infections from becoming resistant to the antibiotics that we have for as long as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
		• Liaise with UK- National External Quality Assessment Service (NEQAS) to develop a UK-wide External Quality Assessment (EQA) programme for *N. gonorrhoea* susceptibility testing, **April 2016**.	PHE
		• Establish a mechanism for improved communication between PHE and NHS laboratories to ensure rapid dissemination of alerts and guidance in relation to resistant *Neisseria gonorrhoea*. **June 2015.**	PHE
		See also, key area 4: new treatments and diagnostics.	
Evaluating the effect of reasonable innovative strategies to increase heterogeneity of local antibiotic prescribing policies over set periods of time on usage, resistance rates and outcomes.	**Develop evidence-based interventions aimed at changing professional and public behaviours around prescribing and demand for antimicrobials**.	• **Provide expert advice to NHS England to enable the development of commissioning incentives to encourage health care providers to achieve the new prescribing quality measures in primary and secondary care.**	PHE
		• **Pilot interventions with GPs to improve prescribing practices in 2014-15 and establish implementation options for scale-up and national roll-out of successful interventions, 2015.**	PHE
		• Work with the Chief Pharmaceutical Officer (CPO) to explore options for establishing local networks of antimicrobial pharmacists, to link secondary and primary care and to align antimicrobial stewardship practices **from 2015**.	PHE
		• Work with Regulators, Commissioners and other supervisory bodies to review governance structures and leadership roles and responsibilities across primary, secondary and social care with respect to antimicrobial stewardship and infection prevention and control **by 2016/17**.	PHE
		• Continue to work with NHSE to enable Medicines Optimisation across the NHS and promote use of the 'medicines optimisation dashboard which includes two key indicators on antibiotic use by 2015.	PHE

Key action area 2: Optimising prescribing practice

When, despite improved IPC practices, infections do occur, to control AMR it is imperative that antibiotics are only prescribed where they are needed – at the right time, for the right patient and at the right dose. This will enable us to stop infections from becoming resistant to the antibiotics that we have for as long as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Auditing local prescribing practices and outcomes across the system to assess the effects of antimicrobial stewardship programmes in human and animal settings.		• Work with NHS England and NHS Improving Quality during 2015 to encourage the 15 newly established Patient Safety Collaboratives led by each Academic Health Science Networks (AHSNs) to consider selecting AMR and HCAI/IPC as a key priority area to focus on. Also promote good antimicrobial stewardship through the new Medication Safety Networks.	PHE
	Audit local prescribing practice and outcomes to assess effects of stewardship programmes.	• Continue to audit uptake and impact of prescribing guidance across the healthcare system, between **2014-18**.	PHE
	Ensure compliance with antimicrobial stewardship guidance and best practice.	• By collecting more accurate data on antibiotic prescription and sales data by animal species, we will be able to measure the impact of antimicrobial stewardship programmes in the animal health sector. Until the methodology for antibiotic prescription and consumption data collection has been developed, we will audit via qualitative methods, i.e. by examining the outcome of surveys conducted amongst veterinary surgeons and animal keepers by external stakeholders.	VMD

Key action area 2: Optimising prescribing practice

When, despite improved IPC practices, infections do occur, to control AMR it is imperative that antibiotics are only prescribed where they are needed – at the right time, for the right patient and at the right dose. This will enable us to stop infections from becoming resistant to the antibiotics that we have for as long as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Facilitating development of sector specific prescribing guidelines, which, for example advocate minimising the routine use of preventative antibiotics in animal health and to promote responsible use practices including engaging with representatives across the animal health spectrum to ensure effective dissemination of guidance.	Facilitate the availability and uptake of prescribing guidance for all animal species sectors.	• Continue to encourage the veterinary professional bodies to provide prescribing guidance for each animal species sector **2014-15.**	VMD
	Ensure proportionate and evidence based controls on use of veterinary antibiotics that aim to minimise development of resistance in veterinary bacteria while still permitting effective treatment of disease.	• Conduct an analysis of research on drivers and motivators behind veterinary prescribing habits by the end of **2015**. • Work alongside Defra social scientists to review past research and identify research gaps on driving behaviour change in the veterinary and farming sectors, by the end of **2015.**	VMD
	Ensure that regulatory framework for veterinary antibiotics is evidence based and facilitates effective risk assessment.	• **Engage in negotiation of the revision of the EU Veterinary Medicinal Products legislation 2014-16, the EU legislation which sets out controls that apply to veterinary antibiotics.** • Continue to be proactive in EU fora **2014-18** that influence the development of guidance and guidelines on authorisation, availability and use of veterinary antibiotics throughout the EU, including the European Medicines Agency Antimicrobials Expert Group and Antimicrobials Working Party, and the Heads of Medicine Agency AMR taskforce.	VMD VMD

Key action area 3: improved education, training and public engagement

The two critical things that we can do now and that are most likely to have an immediate impact in reducing AMR – preventing people from becoming ill in the first place and minimising the risk that they might die or suffer extended illness through a difficult to treat infection – are to reduce infections and improve our prescribing of antibiotics. Improvements in the education and training of all those who work in human and animal health and care as well as a better understanding by the public about hygiene and the appropriate use of antibiotics will support and underpin other activities to prevent infection and conserve the antibiotics we have.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Identifying mechanisms to improve the uptake of guidance for professionals, including through commissioning and audit of prescribing, infection prevention and control.	**Support optimisation of prescribing practice.**	• **Work with the Royal Colleges and professional bodies to identify how best to utilise the appraisal and revalidation system to reinforce stewardship and embed best prescribing practice, from 2014.**	**PHE** **VMD**
Development of NICE quality standards.	Further develop the evidence base to understand the behavioural drivers of Antimicrobial Resistance.	• Commission NICE to produce Public Health Guideline – 'Antimicrobial resistance: changing risk-related behaviours', for publication by **March 2016.**	DH
Ensuring that generic prescribing competences, which are being developed, are adopted and embedded in curricula, and those antimicrobial stewardship competences are included in professional curricula and continuing professional development.	Embed AMR themes/generic prescribing competencies through undergraduate courses.	• Develop AMR educational toolkit responsible use training resource for veterinary undergraduates and agriculture students, **by 2016**. • Work alongside RUMA to develop a lecture programme for agricultural colleges, **by 2016.** *See also activity in section 2: optimising prescribing.*	VMD VMD
Increasing public engagement to promote key messages about antimicrobial use, including promotion of training of non-health professionals, like farmers, with responsibility for administering antibiotics.	Investigate whether EAAD activity is having an impact on improving public awareness/understanding and changing behaviour.	• Lead the development of a measure for use in monitoring public awareness, and changes in public attitudes and behaviour over the course of the strategy from **2016/17**.	PHE
	Ensure a sustained approach to public engagement throughout the year.	• Distribute printed educational materials on Antimicrobial Resistance for GP practices, and promote responsible use messages with the public and professionals as part of EAAD activities by **November 2014.**	PHE

Key action area 3: improved education, training and public engagement

The two critical things that we can do now and that are most likely to have an immediate impact in reducing AMR – preventing people from becoming ill in the first place and minimising the risk that they might die or suffer extended illness through a difficult to treat infection – are to reduce infections and improve our prescribing of antibiotics. Improvements in the education and training of all those who work in human and animal health and care as well as a better understanding by the public about hygiene and the appropriate use of antibiotics will support and underpin other activities to prevent infection and conserve the antibiotics we have.

Strategy Actions	Objective	Activity and milestones	Lead organisation
		• Deliver the Antibiotic Guardian campaign in 2014, engaging the public and professionals in pledging to take action to preserve antibiotics. Review and evaluate the impact of the campaign in 2015 to inform the development of a sustained approach across the life of the strategy.	PHE
	Continue to raise awareness of AMR and support CMO work in advocating change to conserve our existing antibiotics.	• Produce a targeted prescriber facing campaign in **2014/2015.**	DH
	Maintain strong links with representatives from across animal health and livestock production sectors.	• Continue to strengthen engagement forum network, holding face to face meetings for each sector (pig, poultry, ruminant, fish and companion animal) **annually**, and developing the remote network to enable on going communication. In addition we will participate in sector specific initiatives e.g. Pig Health and Welfare Council subgroup on antibiotic use.	VMD
Facilitating public debate to shift the societal view to raise awareness of antibiotics and ways to limit their use. This could include considering the potential for restricting the use of antibiotics for low risk self-limiting infections and/or restricting antibiotic use more widely to affect behaviour change.	To help change societal attitudes about the use of antibiotics.	• Facilitate a public debate on solutions to the AMR problem addressing societal questions such as rationing of antibiotics (informed by the ARHAI Hard Choices Workshop and 'Ethics of AMR' Symposium) in **2015**.	PHE

Key action area 4: developing new drugs, treatments and diagnostics

Improvements in diagnostic testing and better access to rapid diagnostic tests will help to ensure that antibiotics are prescribed appropriately. For both new diagnostics technologies and new drugs and treatments, it will be important to ensure that once these are developed and available, they can be taken up across the system as quickly as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Encouraging innovation and providing an impetus for improved collaborative action to develop rapid diagnostics and new treatments and vaccines.	**Ensure that diagnostic testing across the system is carried out within a nationally agreed framework to provide the right test at the right time in the right place and ensure that patients get the right and timely treatment, by 2018.**	• **Identify the tests and technologies currently in use across the system and identify any new technology on the horizon both in the UK and internationally by end 2014.**	**DH**
		• **Develop a draft framework for diagnostic and susceptibility testing and consult with stakeholders by mid-2015.**	**DH**
	Explore all potential alternative treatments available including the use of vaccines, to inform further actions and research and ensured that the appropriate infrastructure is in place to enable rapid and consistent uptake of new treatments as they become available by 2018.	• **Commission a report to consider emerging technologies for alternatives to antibiotics and assess their feasibility and barriers to further development for delivery by June 2015.**	**DH**
	Improved timeliness of diagnosis and appropriate treatment of *N. gonorrhoea* through novel methods and diagnostic approaches.	• Establish groundwork for implementing routine next generation sequencing (NGS) of *N. gonorrhoeae* samples in the Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP) and create a database of to provide a resource for development/ validation of point of care tests (POCTs) for AMR detection in *N. gonorrhoeae*. Present case and costings for routine implementation of NGS in GRASP, **January 2015**.	PHE

Key action area 4: developing new drugs, treatments and diagnostics

Improvements in diagnostic testing and better access to rapid diagnostic tests will help to ensure that antibiotics are prescribed appropriately. For both new diagnostics technologies and new drugs and treatments, it will be important to ensure that once these are developed and available, they can be taken up across the system as quickly as possible.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Addressing the commercial viability issues that are hampering investment in antibiotic development, assessing the relative merits of possible incentives to stimulate research and development in new antibiotics and other products, and fast-track priority review arrangements for new antimicrobials.	**Establish a set of cost-effective policy options that could deliver a sustainable supply of effective antimicrobial drugs and prompt wider change and consensus at international level, by end 2016.**	• **Establish an independent international review to develop innovative financing and regulatory approaches to help stimulate development of new antibiotics and rapid diagnostics by October 2014.**	**DH**
		• Commissioning research in collaboration with the Economic and Social Research Council (ESRC) in support of the Review from **October 2014**.	DH
		• Collate and publish the Government response to interim findings of the Review in **2015.**	DH
	Ensure that the UK is ready to take forward the policy options set out by the international Review **from 2017**.	• Work with stakeholders nationally and internationally to consider recommendations arising from the independent Review and agree a way forward.	DH
		• Work with industry to monitor use of the guidance on new EMA licencing requirements for new antibiotics.	DH
Supporting innovation through development of the scientific infrastructure, for example, through the Government's 'Strategy for UK Life Sciences'.	Make the UK a world-leading place for life sciences investment. Enable and support technology development in parallel with and subject to the Independent Review.	• Work with the Office for Life Sciences to convene a group involving key stakeholders including the biotechnology, pharmaceutical and diagnostic industries to explore how to address interim issues pending the Review's conclusion.	DH
Building international partnerships and coalitions to influence change at the national, European and international levels by influencing initiatives like IMI, to facilitate more efficient discovery and development of medicines, vaccines and diagnostics.	To strengthen national and international capability and capacity to facilitate the development of new drugs and other treatments.	*See key action areas 6 and 7 – research and international collaboration.*	

Key action area 4: developing new drugs, treatments and diagnostics *Improvements in diagnostic testing and better access to rapid diagnostic tests will help to ensure that antibiotics are prescribed appropriately. For both new diagnostics technologies and new drugs and treatments, it will be important to ensure that once these are developed and available, they can be taken up across the system as quickly as possible.*			
Strategy Actions	**Objective**	**Activity and milestones**	**Lead organisation**
Opening up the research agenda, encouraging life sciences companies and academics to work with and share information about targets (pre-competitive phase) and being innovative about the clinical research process to optimise effectiveness and efficiency (shorter time, less costly and fewer late-stage failures) whilst providing safety safeguards.			

Key area 5: better access to and use of surveillance

To improve IPC and ensure that we prescribe antibiotics appropriately, we need to collect and analyse good quality data and ensure that it is used to both inform prescribing decisions made in all settings and enables us to take appropriate action to control the spread of infections and adjust national prescribing strategies as resistance occurs and spreads.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Linking clinical and laboratory data in human health to improve control of the most resistant bacteria and to identify key 'drug-bug' combinations.	Link existing datasets to better understand how and where infections from resistant organisms are acquired and what the outcomes are for patients.	• Link patient-level data on antimicrobial resistance and Hospital Episode Statistics (HES) enabling enhanced epidemiological analyses, **ongoing**.	PHE
		• Link surveillance data with death registrations enabling monitoring of trends in mortality and improved understanding of the impact and burden of antimicrobial resistance, **ongoing**.	PHE
	Assess whether the strategy is having an impact on the growth of resistance improving prescribing in humans and animals, and reducing the level of inappropriate antibiotic use.	• Explore the feasibility of developing a single summary AMR index to communicate changes in the burden of AMR resistance at a local, regional and national level by **2016**.	DH
	Refine sourcing of veterinary pathogenic bacteria for sensitivity testing.	• Review the sourcing of veterinary isolates and explore additional and alternative methods of obtaining isolates by 2018, with the aim of obtaining more clinically relevant sensitivity data for veterinary prescribers **by 2018**. To support this aim we will lead on the design and trialling of a Target Pathogen Monitoring Programme.	VMD
	Increase availability of veterinary bacterial sensitivity data to inform veterinary prescribing.	• Increase frequency of publication of sensitivity data from veterinary isolates, and reduce time from data collection to publication, by end of **2018**.	VMD
		• Publish surveillance data annually in the UK –VARSS report, covering UK for sales/use data, and England and Wales for resistance data **from 2015**.	VMD
Developing antimicrobial usage and resistance surveillance programmes that can link to electronic prescribing systems as they are introduced.	**Expand the surveillance of antimicrobial resistance and antimicrobial usage in England to provide data to a level that enables the development of a clearer picture at local level and across the human and animal sectors.**	• **Publish English Surveillance Programme for AMR Usage and Resistance (ESPAUR) reports annually from 2014, with increased depth of data and expanded focus each year.**	**PHE**
		• **Expand surveillance systems to incorporate antimicrobial consumption data, giving provider access to live and historical data (2010-2013), pilot by March 2015.**	**PHE**

Key area 5: better access to and use of surveillance

To improve IPC and ensure that we prescribe antibiotics appropriately, we need to collect and analyse good quality data and ensure that it is used to both inform prescribing decisions made in all settings and enables us to take appropriate action to control the spread of infections and adjust national prescribing strategies as resistance occurs and spreads.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Developing antimicrobial usage and resistance surveillance programmes that can link to electronic prescribing systems as they are introduced.	Deliver new and improved data capture and surveillance systems to improve the reporting of, and provider access to, HCAI and AMR data.	• Secure prescribing data sharing permissions with every Trust to enable trust-level reporting, by **Dec 2014**.	PHE
		• Launch a new data capture system for mandatory surveillance of healthcare associated infections in **2016/17**.	PHE
	Establish voluntary surveillance of infections within intensive care units.	• Roll-out the routine, voluntary surveillance of bloodstream infections in intensive care units in paediatric, neonatal and adult settings to support quality improvement in the management of infections from **2015**.	PHE
	Establish the point prevalence of HCAI and antimicrobial use in hospitals in England.	• Undertake a national point prevalence survey of levels of healthcare-associated infections (HCAI) and levels of antimicrobial use in hospitals in England **during 2016**.	PHE
		• Assess reliability of AmSurv data for routine surveillance reports by triangulating with data available through sentinel surveillance i.e. the Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP), by **April 2015**.	PHE
		• Work with NHS laboratories to encourage routine referral of all *N. gonorrhoeae* samples with decreased susceptibility or resistance detected to the Sexually Transmitted Bacteria Reference Unit (STBRU) at PHE Colindale for further testing and confirmation, by **January 2015**.	PHE
	Improve coverage, timeliness and representativeness of surveillance data on antimicrobial resistance in *N. gonorrhoeae.*	• Work with the Sanger Institute to pilot the use of next generation sequencing (NGS) using clinical samples for detecting antimicrobial resistance in *N. gonorrhoeae* where culture is not available, by **September 2015**.	PHE

Key area 5: better access to and use of surveillance

To improve IPC and ensure that we prescribe antibiotics appropriately, we need to collect and analyse good quality data and ensure that it is used to both inform prescribing decisions made in all settings and enables us to take appropriate action to control the spread of infections and adjust national prescribing strategies as resistance occurs and spreads.

Strategy Actions	Objective	Activity and milestones	Lead organisation
	Improve coverage, timeliness and representativeness of surveillance drug resistance data for HIV, ensuring surveillance outputs are representative of all those living with diagnosed HIV infection.	• Work with the Medical Research Council HIV drug resistance database to improve the collection of data identifiers to better link drug resistance tests to HIV surveillance data, by **October 2015.**	PHE
	Improve access to data on antibiotic prescribing and/or consumption in food producing animals' data to facilitate benchmarking by veterinary practice and/or farm.	• Improve data collection on antibiotic use in the veterinary sector, 2014-18. Scoping study was completed July 2014. Second phase of the project, due for completion **May 2015**, includes the following activities: – develop a central data hub, hosted by VMD, to capture data on antibiotic use, – explore the development of a system to collect and capture data on antibiotic use in the pig sector, working in partnership with the pig industry, – collect data on antibiotic use from a sub section of pig farms using the cross-sectional method developed by ESVAC, – explore ways to achieve more accurate baseline national data on pig herds, including production type.	VMD
	Encourage and support academic and industry data collection initiatives which capture data on antibiotic use in companion animals.	• Assess the functionality of existing data bases by: – funding analysis of data already held on antibiotic use in companion animals in the VetCompass database of the Royal Veterinary College, by **March 2015**. – funding a PhD project to analyse antibiotic prescription and resistance data in companion animals held by the SAVs NET database of Liverpool University, to complete **by 2018**.	VMD

Key area 5: better access to and use of surveillance

To improve IPC and ensure that we prescribe antibiotics appropriately, we need to collect and analyse good quality data and ensure that it is used to both inform prescribing decisions made in all settings and enables us to take appropriate action to control the spread of infections and adjust national prescribing strategies as resistance occurs and spreads.

Strategy Actions	Objective	Activity and milestones	Lead organisation
		• Continued development of the central data hub and data collection methodology over the remaining three years of the strategy will be dependent on the outcome of the activity planned over 2015, and on the revision of the EU legislation that sets out the legal requirements for submission of antibiotic related sales and/or use data.	VMD
Improving the quality and standardisation of routine antibiotic testing and interpretation of results as well as making better use of surveillance data to improve diagnosis and treatment of infections.	Enhance data on susceptibility testing and resistance Integrate, update and roll-out enhanced laboratory reporting systems in 2014 across the health care system.	*Development of a diagnostic and susceptibility framework – see action area 4.*	DH
		• Recommend the inclusion of a requirement within the Standards for Microbiology Investigation (SMI) to test all samples of gram negative bloodstream infections for meropenem from **2015**.	DH
		• Provide expert advice to NHS England to enable the best use of commissioning levers and incentives to improve standardised testing **during 2015**.	PHE
	Establish surveillance system to monitor impact of Pre exposure Prophylaxis (PrEP) for HIV by monitoring the extent of PrEP usage directly and indirectly transmitted drug resistance among those newly diagnosed with HIV.	• Undertake an assessment of how data relating to PrEP access can be linked to the HIV and AIDS Reporting System, **February 2015**.	PHE
	Support the monitoring of drug resistance mutations that are of relevance for new antiviral drugs that are in development as well those being rolled out. e.g. Hepatitis C drugs.	• Work with key organisations to map emerging drug resistance mutations, **December 2015.**	PHE
		• Through the new HIV and AIDS reporting system (HARS) dataset, link emerging resistance mutations to information relating to drug regimens and co-morbidities, **December 2015.**	PHE

Key area 5: better access to and use of surveillance

To improve IPC and ensure that we prescribe antibiotics appropriately, we need to collect and analyse good quality data and ensure that it is used to both inform prescribing decisions made in all settings and enables us to take appropriate action to control the spread of infections and adjust national prescribing strategies as resistance occurs and spreads.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Exploring linkage of human and veterinary data and consideration of sharing laboratory/ testing methods between the sectors.	**Integrate human and animal health data and inform clinical practice.**	• **Start to publish 'One Health' surveillance reports from 2015. The first report covered 2013 UK antibiotic consumption and resistance data. The 2014 data will be reported more fully in the autumn of 2015 and then annual updates each autumn.**	**PHE and VMD**
		• **Review and update the key drug-bug combinations which are the focus for national surveillance and reporting annually from 2014.**	**DH/VMD**
Extending alerts about new and emerging antibiotic resistance issues, to a wide range of professionals.	Establish improved surveillance of bacteria that are resistant to one of the 'antibiotics of last resort' (carbapenemase-producing Enterobacteriaceae).	• Develop a national programme of enhanced surveillance of carbapenemase-producing Enterobacteriaceae in **2015**.	PHE
		• Pilot rapid confirmation and reporting of carbapenemase-producing Enterobacteriaceae outbreaks with a view to rolling it out in **2016.**	PHE
	Ensure interventions to reduce antibiotic prescribing do not result in the inappropriate treatment of infections, in either veterinary or human health sectors.	• Develop and publish a procedure for responding to isolation of resistant bacteria that may pose a risk to animal or public health, **by 2015.**	VMD

Key action area 6: better identification and prioritisation of AMR research and analytical needs

The UK AMR Strategy identified that we need to understand more about AMR and how it spreads, research is also needed to help us discover new drugs, treatments and other technologies and then to evaluate whether the actions we are taking are having the desired effect. Research is therefore another underpinning key area and one that may not have a significant impact immediately but will help us evaluate and revise our plans as we learn and understand more about resistance.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Ensuring funding of high-quality and relevant AMR projects in response to the NIHR themed call announced as part of a co-ordinated response to the publication of the 'CMO's Annual Report'. This call covers all aspects of translational, clinical and public health research that could contribute to a reduction in the spread or occurrence of AMR, through new developments or changes in practice.		• Proposals submitted to themed calls to be considered and work commissioned **by 2016**.	DH
	Extend the research agenda to cover antivirals, antifungals and antiparasitic treatments.	• Encourage funders to include in the scope of research **from 2017**.	DH
	Promote behaviour change within and beyond the healthcare setting.	• Encourage funders to support proposals which broaden the AMR research out from bacteria to other microorgansims **from 2017**.	DH
		• Take account of the areas for further research identified at the expert workshop on hard choices in antibiotic prescribing held in 2014.	DH
The NIHR plans to fund a 'Health Protection Research Unit (HPRUs) on AMR/HCAI' from April 2014. An open competition inviting universities in partnership with PHE is already underway.	Ensure that the new AMR focused HPRUs contribute to the knowledge and understanding of AMR and inform interventions.	• The HPRU Oversight Group to review annual reports and work plans for the HPRUs, including for the two HPRUs in HCAI and AMR starting **June/July 2015 and each year thereafter**.	DH
Ensuring that research funders continue to collaborate so that both research needs continue to be identified as the evidence base evolves and key priorities continue to be funded.	**Work with the AMR Research Funders Forum, ensuring they have the necessary support and information to develop coordinated research work programmes on AMR.**	• **Promote the work of the Funders Forum and research arising from it to key stakeholders, especially the broader research community.**	**DH**

Key action area 6: better identification and prioritisation of AMR research and analytical needs

The UK AMR Strategy identified that we need to understand more about AMR and how it spreads, research is also needed to help us discover new drugs, treatments and other technologies and then to evaluate whether the actions we are taking are having the desired effect. Research is therefore another underpinning key area and one that may not have a significant impact immediately but will help us evaluate and revise our plans as we learn and understand more about resistance.

Strategy Actions	Objective	Activity and milestones	Lead organisation
	Development our knowledge and understanding of AMR.	• Further develop an empirical evidence base (initially for antibiotics only) – with incidence and trends in the UK, analysis of significant AMR in other countries and inferences relevant to the UK. Expansion of this evidence base to include antivirals and antifungals in **2015/16**.	DH
		• Work with PHE to use available surveillance data to apply an algorithm to key drug-bug combination data collated by AmSurv to improve our understanding of the extent of outbreak incidence **by 2016/17**.	DH
		• Assess the impact of our interventions from a whole systems perspective by gathering and reviewing evidence associated with key pathways and interventions and incorporating these in an enhanced systems map **in 2015/16.**	DH
		• Evaluate cost effectiveness of specific interventions in the implementation plan from **2015/16.**	DH
Identifying, through expert advice from the Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) and the Defra Antimicrobial Resistance Co-ordination Group (DARC), emerging AMR research needs in humans and animals.	Develop a joint ARHAI/DARC annual report which will include research needs.	• ARHAI annual report will identify areas of research to address the AMR agenda **from 2014**. • Joint ARHAI/ DARC report annually on research needs **from 2015**.	DH
Forging stronger partnership around investigating the mechanisms leading to AMR with a view to identify potential new targets for drugs and vaccines.	To improve coordination of AMR research.	The Research Funders Forum, managed by the Medical Research Council has had a specific role to address this issue since 2013.	

Key action area 7: strengthened international collaboration *The UK cannot solve AMR acting alone and it is essential that the rest of the world also prioritises IPC, conserving antibiotics and developing new drugs and treatments.*			
Strategy Actions	**Objective**	**Activity and milestones**	**Lead organisation**
Continuing to demonstrate leadership in the task of building political support for action at a global and national level.	Strengthen global capability and capacity to control AMR.	• Develop the Commonwealth laboratory twinning initiative as part of the UK contribution to the Global Health Security Agenda AMR action package, support Commonwealth countries' responses to AMR for their own populations and contribute to wider regional and international efforts. Piloted commenced in **2014.**	PHE
Supporting efforts to strengthen international partnerships and coalitions to facilitate the development of new antibiotics and other treatments.	To further collective action to be taken globally to stimulate the development around antibiotics.	*See area 5: new drugs – the independent review.* *See also, activity in relation to the Global Health Security Agenda (GHSA) AMR action packages, below.*	DH
Seeking 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'.	To secure international agreement for global action plan to combat AMR.	• Development of a new WHO AMR Resolution adopted June 2014 includes mandate for WHO to produce a Global Action Plan **by 2015**.	DH
Pressing the European Commission to accelerate progress to implement the '2011 EU AMR Strategic Action Plan'.	Press the EU to develop its AMR road map and progress report, during 2014.	• Engage with the EU and encourage them to show leadership with respect to progression of the global agenda through continued work with WHO, GHSA, FAO, OIE, and OECD **from 2014 onwards**.	DH

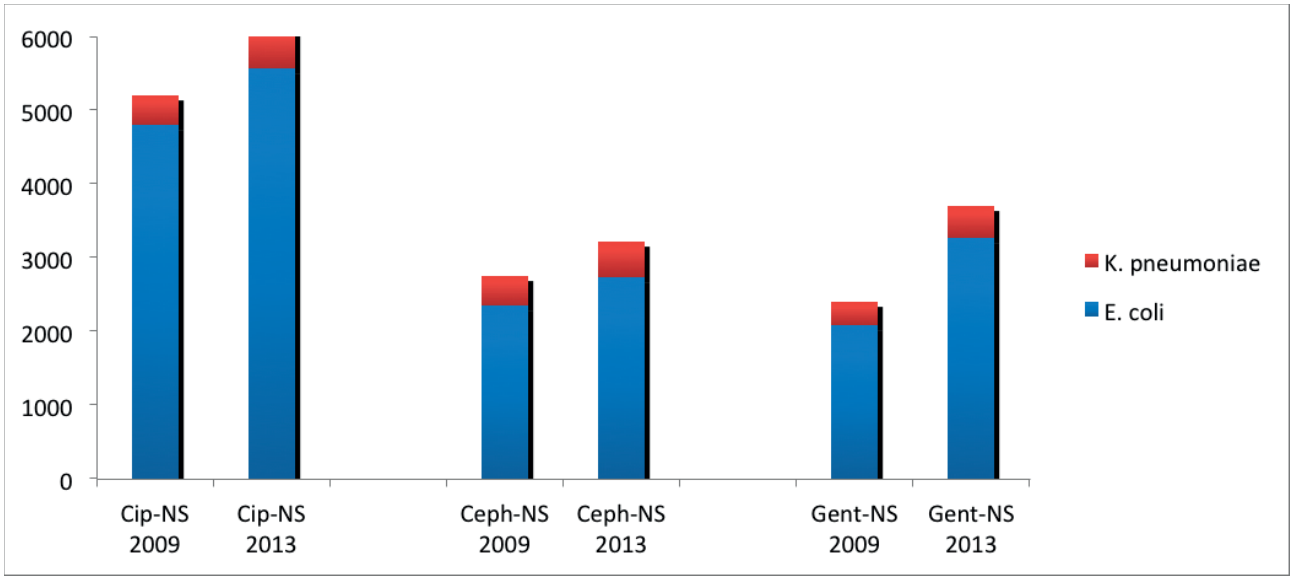
Key action area 7: strengthened international collaboration
The UK cannot solve AMR acting alone and it is essential that the rest of the world also prioritises IPC, conserving antibiotics and developing new drugs and treatments.

Strategy Actions	Objective	Activity and milestones	Lead organisation
Facilitating international action by helping WHO develop a framework for action to underpin an integrated programme of work to harness greater collaborative working.	**Influence the development of the WHO AMR Global Action Plan and indicators through WHO consultation activities with the WHO Strategic Technical Advisory Group and, Member States.**	• **Champion the 'One-health' approach and actively contribute work to assist WHO in development of the AMR Global Action Plan, including:** – **leading work with colleagues in Sweden and the Netherlands to produce the AMR Action package which forms part of the Global Health Security Agenda package published at Ministerial launch event held in Washington on 26 September 2014.** – **producing the Government response to the WHO consultation to develop the AMR Global Action Plan. Response provided by end August 2014 and participation in member States consultation meeting October 2014.**	DH
	Provide a UK contribution to the Global Health Security Agenda by leading work to develop an AMR Action Package and champion its implementation over a five year time frame.	• **Work to encourage other countries to make commitments to deliver the GHSA AMR package at a national level over a 5 year period.**	DH
Taking a leading role in the development of a new AMR resolution for consideration by the World Health Assembly and pursing supporting action in FAO and OIE (the UN bodies for food and animal health).	**Provide UK support for the development of instruments through the FAO and OIE to complement the WHO AMR resolution by 2016.**	• **Secure support for action on AMR at the FAO conference in November 2015.**	DFID
		• **Work with other Member States to gain support to prioritise actions on AMR in order to secure FAO and OIE instruments by 2016.**	DH
		• **Consider potential options for driving action through the UN from 2016 onwards.**	DH
Consider action on the need for a future international treaty to protect special medicines like antibiotics which are in short supply.	Garner support for UN action.	• Work towards internationally agreed One Health guidelines consulting experts on the UN system, WHO and counterparts from other countries. Subsequently consider options for developing guidelines and what the UK can do to drive forward agenda, **from 2016**.	DH

Annex A

This graph shows the increase in resistance between 2009 and 2013 of some important infections to the antibiotics commonly used to treat them.

Numbers of blood culture isolates of *E. coli* and *K. pneumoniae* in UK reported as non-susceptible (NS) to ciprofloxacin (Cip), third-generation cephalosporins (cephs) and gentamicin (Gent) in 2009 and 2013



The graphs show that resistance to ciprofloxacin has increased between the years 2009 and 2013 with rates just under 5,000 in 2009 rising to over 5,500 in 2013.

The increase in resistance rates for cephalosporins are less marked in the same period.

The increase in resistance to gentamicin in the same period is from around 2000 in 2009 to over 3000 in 2013.

Annex B

This table shows data collected on key blood stream and gonorrhoea infections against a list of drugs used to treat them ('drug/bug' combinations). Blood stream infections tend to be more serious in nature and can be life threatening. Blood stream infections can result from infections elsewhere in the body, for example, bacteria from a Urinary Tract Infection can pass into the blood stream, and hence these will account for some of the data collected. The drug/bug combinations reported against next year are likely to change as the combinations are kept under review.

Table 1. Baseline data for Key drug/bug combinations which are the initial focus of national surveillance (NS is non-susceptible)

Bacteria	Antibiotic class	Metric	UK Resistance Baseline (2013)	Examples of some infections caused by the bacteria
Klebsiella pneumoniae (K. pneumoniae)	Cephalosporin	% NS to cefotaxime and/or ceftazidime	11%	Rarely a problem for healthy individuals. In susceptible patients: severe pneumonia and bloodstream infection
K. pneumoniae	Carbapenem	% NS to imipenem and/or meropenem	0.8%	
Escherichia coli (E. coli)	Cephalosporin	% NS to cefotaxime and/or ceftazidime	10%	Urinary tract infection. In susceptible patients: bloodstream infection
E. coli	Carbapenem	% NS to imipenem and/or meropenem	0.1%	
E. coli	Fluoroquinolones	% NS to ciprofloxacin	18%	
E. coli	Aminoglycosides	% NS to gentamicin	10%	
Pseudomonas spp.	Cephalosporin	% NS to ceftazidime	7%	Ear infection. In susceptible patients, bloodstream and other serious infections. Chronic lung infection in individuals with cystic fibrosis
Pseudomonas spp.	Carbapenem	% NS to imipenem and/or meropenem	9%	
Neisseria gonorrhoeae	Cephalosporin	% NS to ceftriaxone	0.1%*	Gonorrhoea: sexually acquired infection, may cause pelvic inflammatory disease in women
Streptococcus pneumonia	ß-lactam	% NS to penicillin	4%	Ear infection, sinusitis, bloodstream infection, pneumococcal pneumonia.

* these figures are for England and Wales only, decreased susceptibility (≥0.125mg/L)

Annex C

Glossary

Antimicrobial	An antimicrobial is a drug that selectively destroys or inhibits the growth of microorganisms. Sometimes referred to as an 'antimicrobial agent'. Examples include antibiotics (also known as antibacterials) antiviral and antifungal agents.
Antimicrobial resistance (AMR)	The ability of a microorganism to grow or survive in the presence of an antimicrobial at a concentration that is usually sufficient to inhibit or kill microorganisms of the same species and that exceeds concentrations achievable in the human/animal/patient.
Antimicrobial stewardship	The use of co-ordinated interventions to improve and measure the use of antimicrobials by promoting optimal drug regimen, dose, duration and route. The aim is for optimal clinical outcome and to limit selection of resistant strains. This is a key component of a multi-faceted approach to preventing antimicrobial resistance.
Broad-spectrum antibiotics	These are effective against a wide range of bacteria. For example, meropenem is a broad-spectrum antibacterial.
Carbapenems	Carbapenems are broad-spectrum antibiotics, often used as the last line of treatment for hard to treat human infections caused by Gram-negative bacteria.
Carbapenemases	These are enzymes produced by bacteria which destroy carbapenems and other beta-lactam antibiotics.
Cephalosporins	Types of broad-spectrum antibiotics.
Cephalosporins – third-generation	Cephalosporins like cefotaxime and cefixime are particularly active against Gram-negative bacteria.
Critically Important Antimicrobials (CIAs)	Antibiotics identified by the World Health Organisation as critically important for human health and their use needs to be restricted, especially in the veterinary sector.
Gram-negative bacteria	Those bacteria that do not retain crystal violet dye in the Gram-staining procedure. They can cause many types of infection and include *E. coli* and *Pseudomonas aeruginosa*.
Gram-positive bacteria	These are bacteria that are stained dark blue or violet in the Gram-staining procedure. They include *Staphylococcus aureus* and *Clostridium difficile*.
Healthcare Associated Infections (HCAI)	Infections acquired via the provision of healthcare in either a hospital or community setting.
Multi-drug resistant	Resistant to multiple classes of antimicrobial.

Meticillin-resistant *Staphylococcus aureus*	MRSA – A strain of *Staphylococcus aureus* that is resistant to beta lactam antibiotics which include penicillins (eg meticillin and oxacillin) and almost all cephalosporin antibiotics.
'One-Health' approach	Collaborative multi-disciplinary work at local, national, and global levels to attain optimal health for people, animals and the environment.
Pathogen	An infectious agent (bug or germ), a microorganism such as a virus, bacterium, or fungus that causes disease in its host.
Prevalence	A snapshot at a particular point in time of the total number of cases, or proportion of resistant cases, in a given population.
Primary care	Services provided by GP practices, dental practices, community pharmacies and high street optometrists.
Quinolones	A family of antibiotics, includes broad-spectrum agents like ciprofloxacin.
Responsible prescribing	The use of antimicrobials in the most appropriate way for the treatment or prevention of infectious disease.
Secondary care	Covers acute healthcare, either elective care (planned specialist medical care or surgery, usually following referral) or emergency care.
Susceptibility testing	Testing to detect possible drug resistance in common pathogens and to assure susceptibility to drugs of choice for particular infections.

HM Government

2902669 Produced by Williams Lea for the Department of Health